

800355-0L  
August 2023

# User's Guide

nac

# MOVIAS Neo V3

# SP-623

(Ver. 3.25)

nac Image Technology, Inc.

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MOVIAS Neo User's Guide  
Reference Number: 800355-0L

August 2023

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## List of New Functions by Version of MOVIAS Neo

### Ver3.22

Windows 11 compatibility

### Ver3.15

6DOF Output Coordinate System Selection(p. エラー! ブックマークが定義されていません。)

### Ver3.14

Corrected a bug in the 6DOF value output where the results files was blank.

### Ver.3.13

- Added a dynamic 2D-6DOF function(p. 10－33)
- Added a 2D-6DOF starting point offset function
- 2D-6DOF analysis results graph creation function(p. 10－39)
- Switch between the Y axis and the Z axis on the 3 D tracking figure

### Ver.3.10

- Add the2D-6DOF function

### Ver.3.07

- Windows 10 compatibility

### Ver.3.00

- 64bit compatibility

#### Overview

Conversion from MOVIAS Neo Ver.3.00a to native 64bit.

#### Detailed Functions

Added 64bit software (p. 1－4)

- Optical Distortion Correction Image Conversion

#### Overview

When setting the optical distortion correction, enable export of measurement images as distortion corrected images.

#### Detailed Functions

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

Export as AVI (p. 8－3)

- Specify Graph Playback Range

#### Overview

If designating the playback range for the graph window, it is reflected in the graph display range.

#### Detailed Functions

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

- **Save the Playback Range**

**Overview**

The playback range can be separately set for the measurement image, graph, trajectory, stick and then saved. Also, you can select the “And range (range overlapping the playback range)”, “Or range (range including all the playback range)” for the playback range separately set for these during synchronized playback.

**Detailed Functions**

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

**Automatic Update of Group Tracking Rotation Angle**
**Overview**

The group tracking rotation angle can now be automatically updated after a group is created or when measurement data is constructed.

**Detailed Function**

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

**Ver.2.50**

- **Extended Optical Distortion Correction Function**

**Overview**

Improves the method of calculating distortion correction to perform [Polynomial Correction by Area] when the number of lines in the grid is 13x11 or higher.  
If there is no optical distortion correction chart, a function was added to perform distortion correction using GUI while viewing the measurement image.  
Compatible with the chessboard format distortion correction chart.

**Detailed Function**

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

- **Screen Axis Alignment Function(Image Alignment ・ Additional Charge)**

**Overview**

Function to horizontally and vertically align line segments connecting aligned reference points to the screen during 2 point image alignment.

**Detailed Functions**

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エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

- **Function to Enlarge the Image Area(Image Alignment ・ Additional Charge)**

**Overview**

Ability to enlarge the image size by adding a black frame outside the image when creating a project that is a solution to the problem of part of the image being cut off during image alignment.

**Detailed Function**

エラー! 参照元が見つかりません。 a (p. エラー! ブックマークが定義されていません。)



Ver.2.40

- **User Defined Points Function**

**Overview**

Measurement points calculating the coordinate values from existing measurement points. Just as with other measurement points, you can use [Superimpose], [View Graph], [Calibration] and [Reference Points for Image Alignment].

**Detailed Functions**

エラー! 参照元が見つかりません。 (p. 4-8)

Example of the Operation of User Defined Points (p. 4-16)

**Using User Defined Points**

Example of the Operation with User Defined Points 1 Marker is Hidden (p. 4-21)

Example of the Operation with User Defined Points 2 Measure Using Time Values Generated by an Event (p. 4-23)

- **Changing Perspective for Image Alignment (Additional Charge)**

**Overview**

Function to create [Image Seen from the Front] from the changing perspective settings and to perform alignment.

**Detailed Functions**

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

- **Analysis • CSV Export of Quadrants • Group Tracking Angle**

**Overview**

Enable the quadrants and group tracking angles to be displayed on graphs • lists and also be exported to a CSV file.

**Detailed Functions**

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

# 1. Introduction

The MOVIAS Neo software (hereafter, MOVIAS Neo) is a general purpose motion analysis software. The two versions include the 3D and the 2D analysis versions. The 3D analysis version can also be used for 2D analysis.

3D analysis photographs the target images from multiple directions and 2D data is derived from these images and then merged to produce 3D data that is then analyzed. 2D analysis uses images taken from a single direction.

Tracking of the target markers in the image that are the basis of analysis is automatically performed. Manual tracking and manual correction of the auto-tracking results is also available. Auto-tracking is performed on image files (MCFF, AVI formats, etc.) displayed on a PC monitor.

Tracking results are shown as videos, numerical lists, graphs and stick models. Some of the results (such as trajectory figures and stick models) can be superimposed on the images. Additionally, data can be exported to other software programs using a CSV format text file.

Also, waveform data can be imported as graphs to simultaneously display it with other graphs and images.

To properly and effectively perform analysis, read this guide carefully before using.

## 1.1 Basic Features

- **Image / Data Input**

AVI

- Corrects the aspect ratio of the image in the AVI file converted from DV-HDV/AVCHD for analysis using EDIUS Neo 2 manufactured by Grass Valley Co, Ltd.)

MCFF (Bayer)

WMV (Windows Media Video)

- To perform WMV analysis, Windows Media Player 11 or later must be installed. Only searchable WMV files can be input.

Sequential image files (TIFF, JPEG, BMP)

Waveform files (Wave-In binary files from Library, Inc.)

nac, Inc. nwf binary files

Import function for CSV format files (MOVIAS Pro format, simple CSV format)





- **Analysis Type**

2D analysis, 3D analysis (select either DLT or MDLT method)

- **Project Management**

Multiple project management (sessions), project templates

- **Tracking**

Automatic tracking of markers (quadrants  , white dot  , black dot  , and feature point )

Tracking Modes: Automatic, semi-automatic, manual (can be set for each tracking point)

Measurement point group tracking

Hidden point processing (interpolation of hidden points upon reappearance and continuous tracking)

Tracking data support for hidden areas  
(Interpolation with linear, 2D least squares, cubic, spline)  
Frame skip tracking  
Tracking area designation function, tracking direction designation function  
Common/custom virtual point calculations, user defined point calculation

- **Calibration**

Automatic recognition of the standard calibration chart produced by nac (3D)  
Real scale conversion  
Depth plane correction, scale plane correction  
Change perspective (incline correction)  
Optical distortion correction

- **Definition of Coordinates**

Dynamic coordinate system for each frame, definition of still coordinate system for fixed frames

- **Analysis Functions**

Distance, speed, acceleration, coordinate position, displacement, mass analysis (force, momentum, power, and energy) from the specified reference point  
2-point distance, speed, and acceleration between analysis points  
Angle, angular velocity, and angular acceleration between 2-4 points  
Quadrant, group tracking angle  
Projected area of part surrounded by multiple points  
Simple 6DOF analysis

- **Creating and Displaying Graphs**

Graph display (time-series graphs, correlation graphs, and graphs with multiple vertical axis)  
List display (tracking coordinates and angles of measurement points (quadrants), measurement data and analysis data)  
Graphing of external waveform data, synchronized playback of videos, analysis graphs, trajectory figures and stick diagrams  
Adjustment of auto-scaling of graphs, extended range function  
Comparison view of analysis results for multiple projects  
Low pass filtering for waveform data/analysis results, smoothing filter use  
Stick display (time-shift display, superimposed display of reference points)  
Trajectory figures  
Annotation functions (show diagrams and analysis results on images, show outlines linked to tracking points)

- **Export Results**

Export analysis results as a CSV file or Excel spreadsheet  
Export as an AVI file of the analysis results screen  
Export as AVI or still image merged with images, graphs, or sticks  
Function to paste the analysis screen into other programs  
Print function

- **Other**

Point zoom function (enlarged display of a tracking point area, enlarge a specific area)  
Synchronized playback of multiple images with different frame rates  
Image correction function (gamma, contrast, chroma, brightness, rotation, reversal, aspect ratio conversion and interlace deletion)

- **Options (Additional Charge)**

Image alignment, Overlay display, Afterimage display

Image alignment (function to display images based on a reference point)

Overlay display (function to display two images superimposed)

Afterimage display (function to display images from the previous and subsequent frames superimposed)

Refer to エラー! 参照元が見つかりません。 (p.エラー! ブックマークが定義されていません。 ) for image alignment, overlay display, afterimage display.

## 1.2 Operating Environment

MOVIAS Neo operates on a PC with the following specifications.

CPU:	Pentium 4, 2GHz or higher
Memory:	512MB or more (1GB or more is recommended)
Hard Drive:	150MB or more free space for software installation (200GB or more for data is recommended)
Monitor:	Resolution of 1024x768 or greater (1920x1080 or greater is recommended) If the vertical resolution is less than 864, please use after turning OFF the [Refer to the sequence with images] in the [Import Analog Waveform Data (detail settings)] window.
OS:	Windows 11, Windows 10 64bit / 32bit, Windows 8/8.1 64bit / 32bit, Windows 7 64bit / 32bit, Windows Vista (SP2 or later) 64bit / 32bit Windows XP (SP3 or later) 32bit
DirectX®:	Microsoft DirectX 9.0C or later
Other:	CD-ROM drive required for installation -USB port required for the MOVIAS license key

Refer to Operating Environment (p.エラー! ブックマークが定義されていません。 ) if using the Image Alignment and Overlay Function.

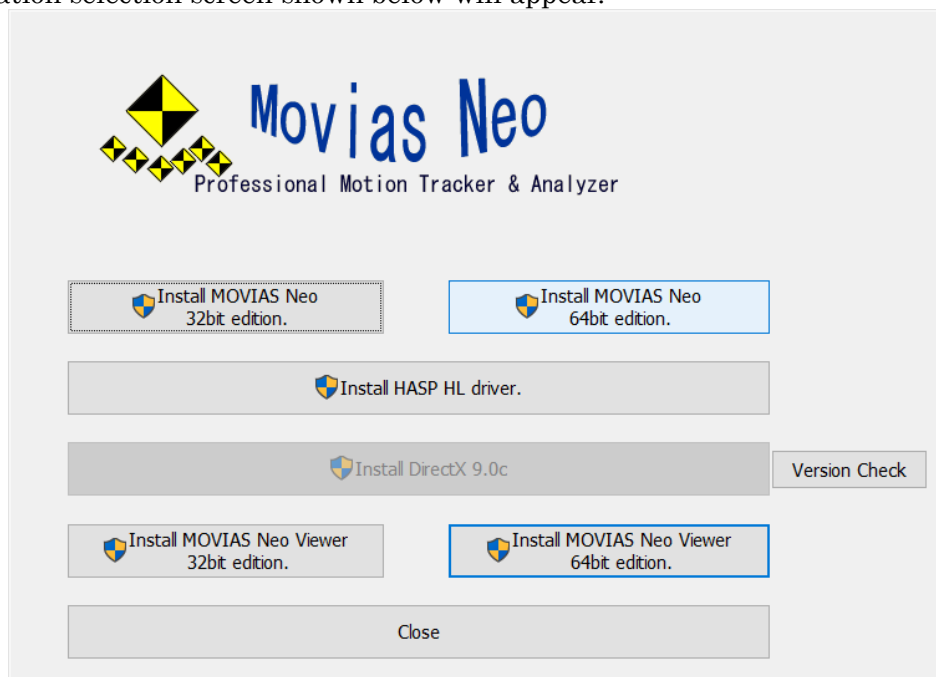
Excel export requires installation of Microsoft Office Excel 2003 or later. We do not warranty operation merging all the PC, OS with Excel.

## 1.3 Installation

### 1.3.1 Install MOVIAS Neo

Since the installation requires administrator authorization, please install after an authorized user has logged on.

Insert the MOVIAS Neo Installation CD into the CD-ROM drive of your PC. The installation selection screen shown below will appear.



**MOVIAS Neo Program Installation Selection Screen**

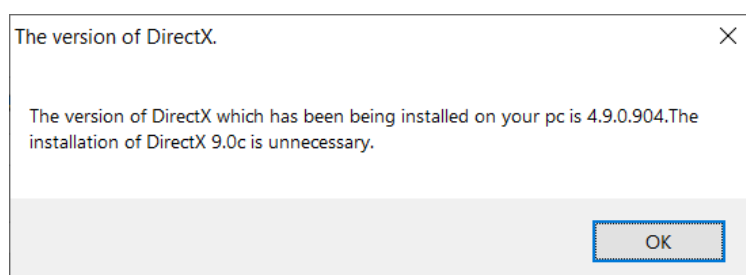
If the [Installation Selection Screen] does not automatically appear when the CD is inserted into the PC, go to the root folder on the CD and run "Launcher.exe" to access the [Installation Selection Screen].

Click each button on the [Installation Selection Screen] to start installation of each program. The install button on the 64bit version is only enabled on 64bit OS on Windows Vista or later.

- ✓ **Install the 32bit / 64bit MOVIAS Neo**  
Install the MOVIAS Neo software. Install 64bit only with a 64bit OS.
- ✓ **Install the HASP HL drive**  
Install the driver for the license key (HASP HL) that protects MOVIAS Neo. If this driver is not installed on the computer, MOVIAS Neo will not start. If this driver is not installed on the computer, install before starting MOVIAS Neo.



- ✓ **Install DirectX 9.0c**  
MOVIAS Neo uses DirectX to display sticks. Version 9.0c of DirectX or later is required to properly run MOVIAS Neo on your computer.  
If version 9.0c or later of DirectX is not on the computer, install before launching MOVIAS Neo.
- ✓ **Install the 32bit / 64bit MOVIAS Neo Viewer**  
Install the MOVIAS Neo Viewer software that displays the MOVIAS Neo analysis results. The 64bit version can only be installed on 64bit OS.
- ✓ **Confirm the Version**  
Confirm the version of DirectX installed on the computer. Click to display the [Version of DirectX] dialog.



**[Check the Version of DirectX] Dialog**

Click [Install the 32bit/64bit MOVIAS Neo] and the [Welcome to MOVIAS Neo Setup] dialog will appear.

The following is a description of the 64bit installation process. If you are installing the 32bit version, the text that appears on the screen may differ slightly, but the installation procedure is the same as that for the 64bit version.

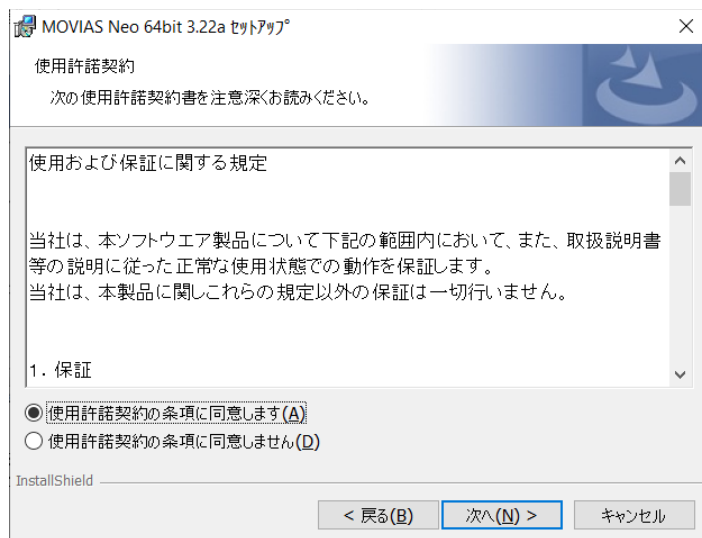


If an old version of MOVIAS Neo is installed, we recommend uninstalling that one and then run the setup for the new version.



**[Welcome to the MOVIAS Neo Setup] dialog**

Click [Next] to jump to the [Product License Agreement] dialog.



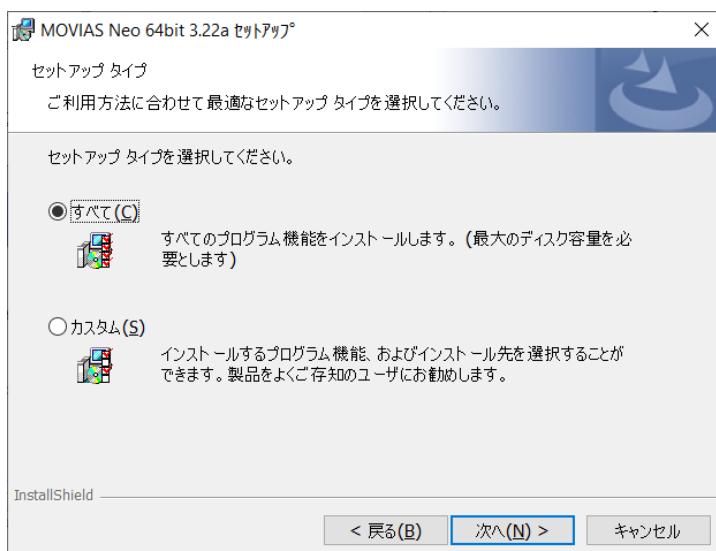
**[Product License Agreement] dialog**

Carefully read the contents of [Provisions Relating to Approved Use and Warranty] shown here and if you agree, select “I accept the terms of the product license agreement” and then click [Next] to display the [User Information] dialog. If you do not agree, click [Cancel] to stop the installation process.



[User Information] Dialog

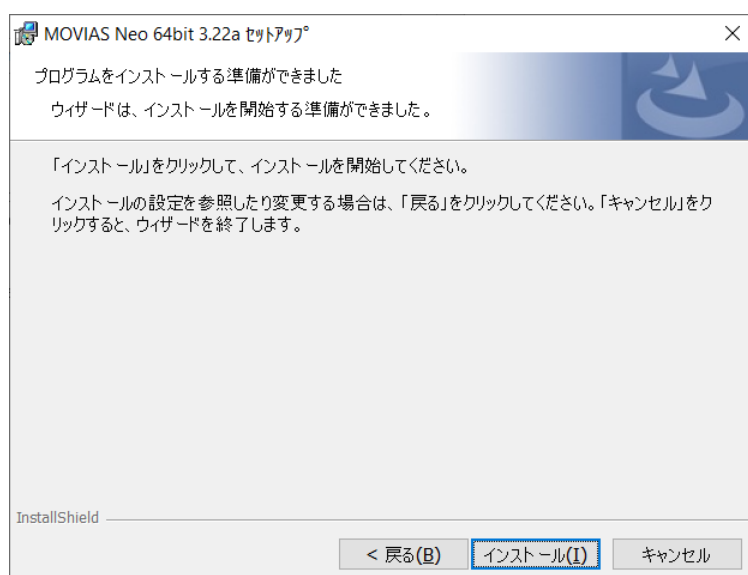
In the [User Information] dialog, enter the username and company name. Then click [Next] to go to [Setup Type] dialog.



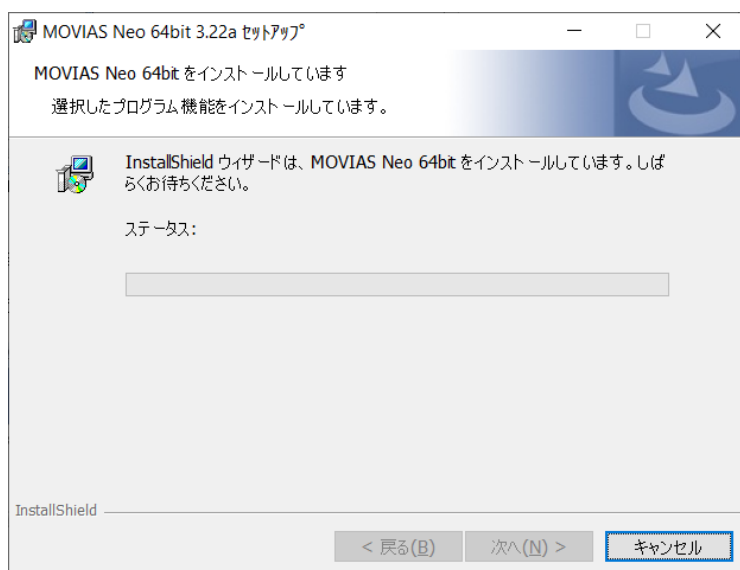
[Setup Type] Dialog

In the [Setup Type] dialog, click [All] and then click [Next] to jump to [Installation Ready] dialog. In this case, MOVIAS Neo is installed in [C: ¥Program Files¥nac¥MoviasNeo]. If the MOVIAS Neo 32bit version is installed to a 64bit OS, install to [C: ¥Program Files (x86)¥nac¥MoviasNeo].

When [Custom] is selected, go to the [Installation Ready] dialog via the [Installation Folder] and [Custom Setup] dialogs.

**[Installation Ready] Dialog**

In the [Installation Ready] dialog, click [Install] to start copying files. The [Installing] dialog will appear, and the program will be installed. Click [Back] to correct the settings.

**[Installing] Dialog**

Once the installation process is complete, the [Finish MOVIAS Neo Installation] message appears. Click [Finish] to exit.



### **[Finish MOVIAS Neo Installation] Dialog**

After installation, MOVIAS Neo is registered to [All Programs] → [MOVIAS Neo 64bit] on Windows, and the 32bit version is registered to [All Programs] → [MOVIAS Neo]. The MOVIAS Neo program shortcut will be added to the desktop.

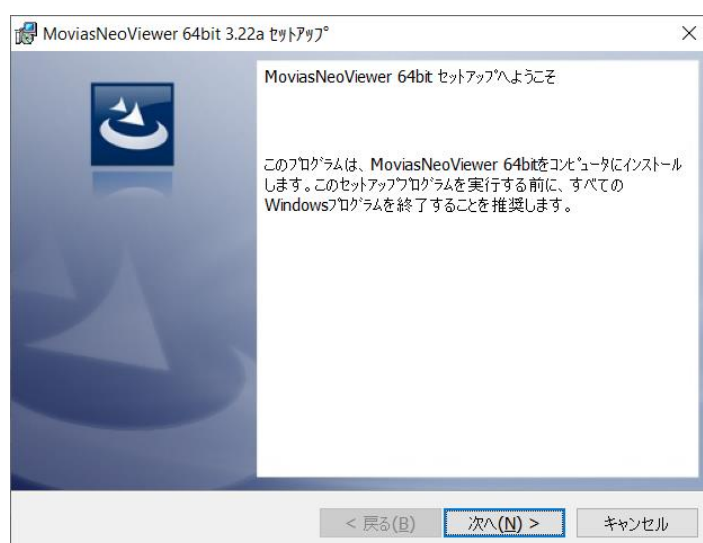
### 1.3.2 Install MOVIAS Neo Viewer

Click [Install 32bit/64bit MOVIAS Neo Viewer] to open the [Welcome to the MOVIAS Neo Viewer Setup] dialog.

The following is a description of the 64bit installation process. If you are installing the 32bit version, the text that appears on the screen may differ slightly, but the installation procedure is the same as that for the 64bit version.

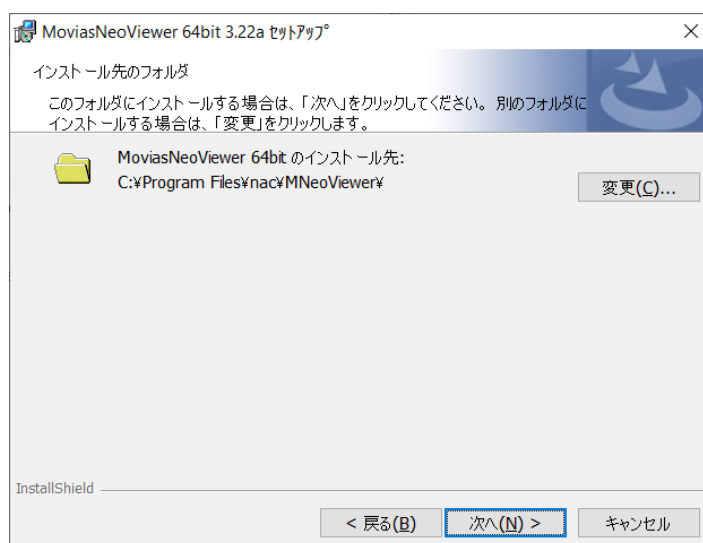


If an old version of MOVIAS Neo Viewer is installed, we recommend uninstalling that one and then run the setup for the new version.



[Welcome to the MOVIAS Neo Viewer Setup] dialog

Click [Next] to jump to the [Choose Destination] dialog.



[Choose Destination] dialog

After selecting the destination, click [Next] and the [Ready for Installation] dialog will appear.

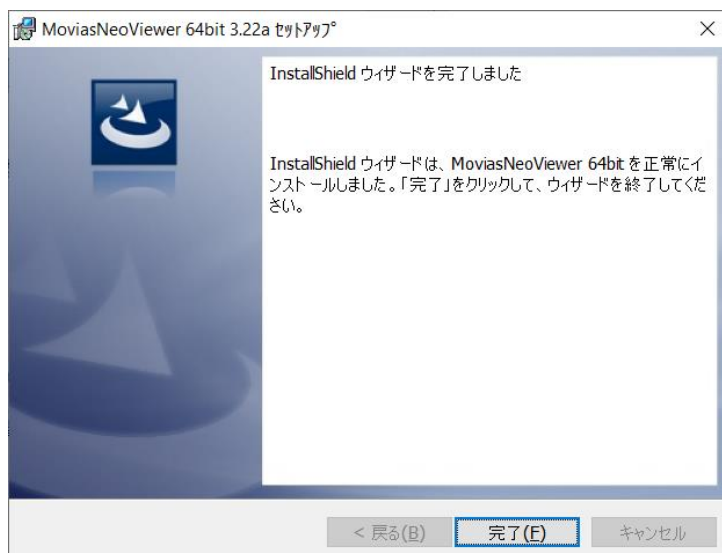


**[Ready for Installation] Dialog**

In the [Ready for Installation] dialog, click [Install] to start copying files. The [Installing] dialog will appear, and the program will be installed.

Click [Back] to correct the settings.

After installing, the [Finish Installation] dialog will appear.

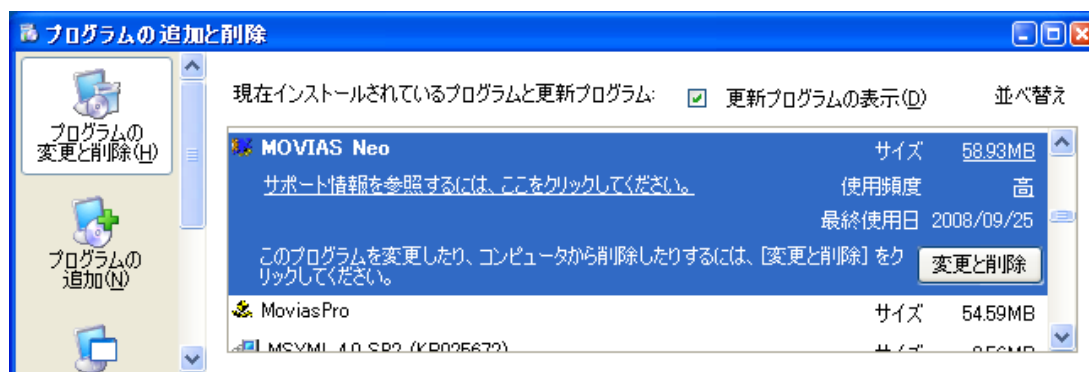


**[Finish MOVIAS Neo Viewer Installation] dialog**

## 1.4 Uninstall

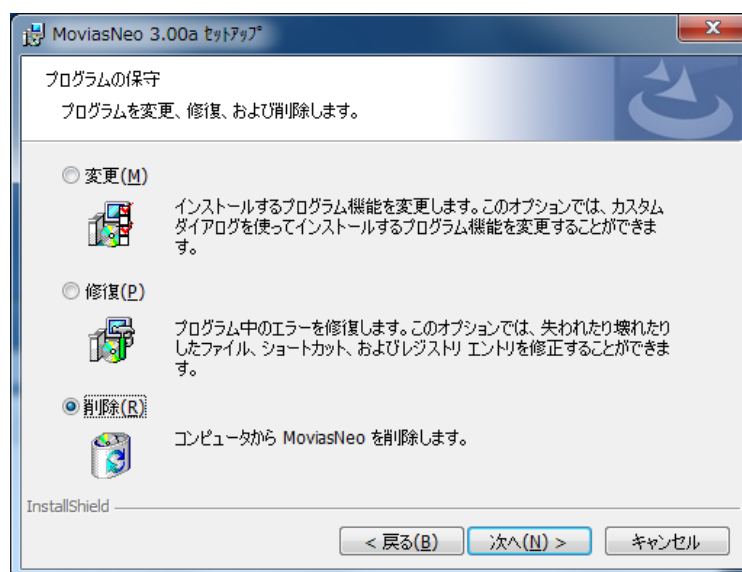
### 1.4.1 Uninstall MOVIAS Neo

To uninstall MOVIAS Neo from your computer, open the [Control Panel] and click [Add or Remove Programs] ([Add or Remove Applications] in Windows 2000 or [Programs and Features] in Windows 7 / Vista). Select [MOVIAS Neo] and click [Change/Remove].



MOVIAS Neo Program Selection

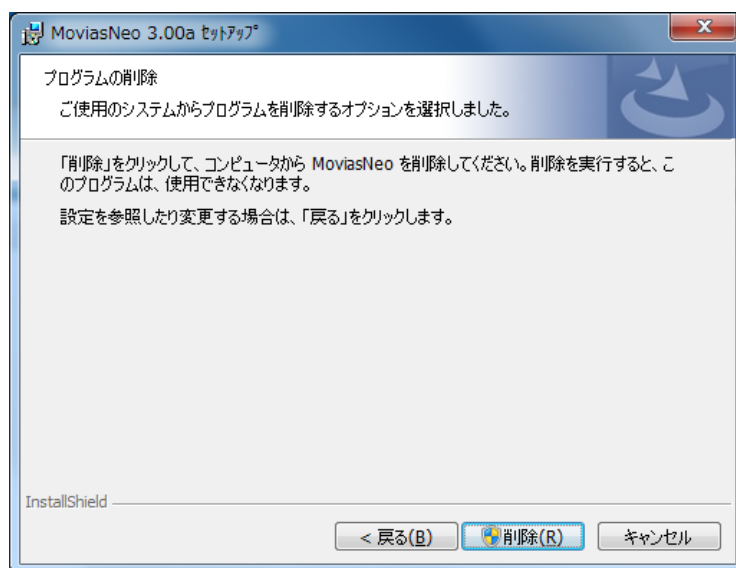
The [Remove Program] dialog will appear.



[Remove Program] Dialog

Select [Remove] in the [Remove Program] dialog and click [Next].

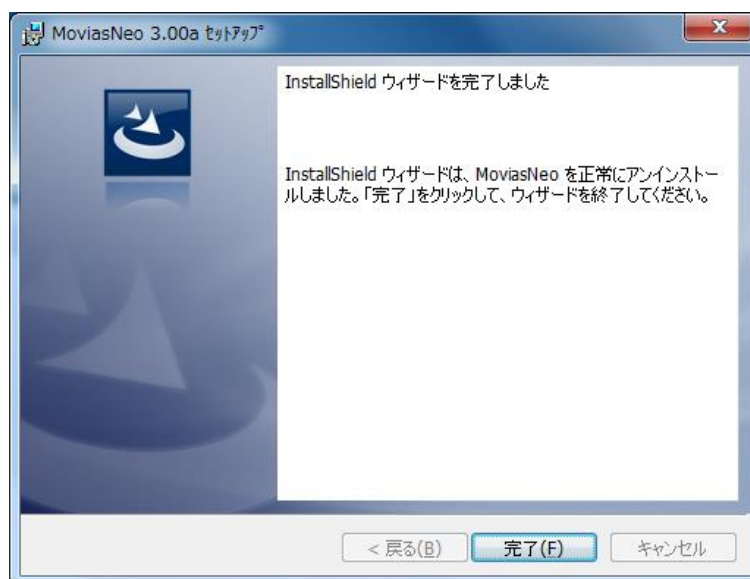


**[Remove Program] Dialog**

The [Remove Program] dialog will appear.

Click [Remove] to completely remove MOVIAS Neo. Otherwise, click [Back].

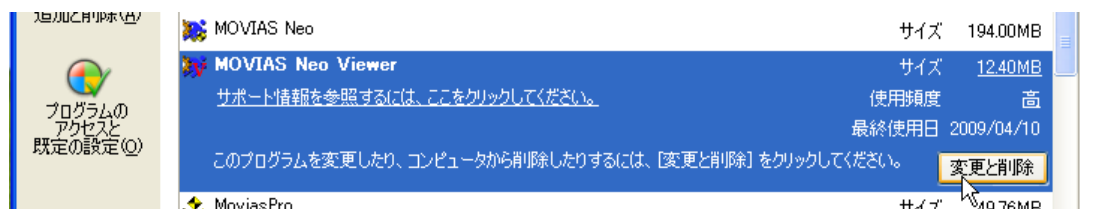
Click [Remove] to uninstall MOVIAS Neo and the [Finish Uninstall] dialog will appear.

**[Finish Uninstall] Dialog**

Click [Finish] to complete the uninstallation.

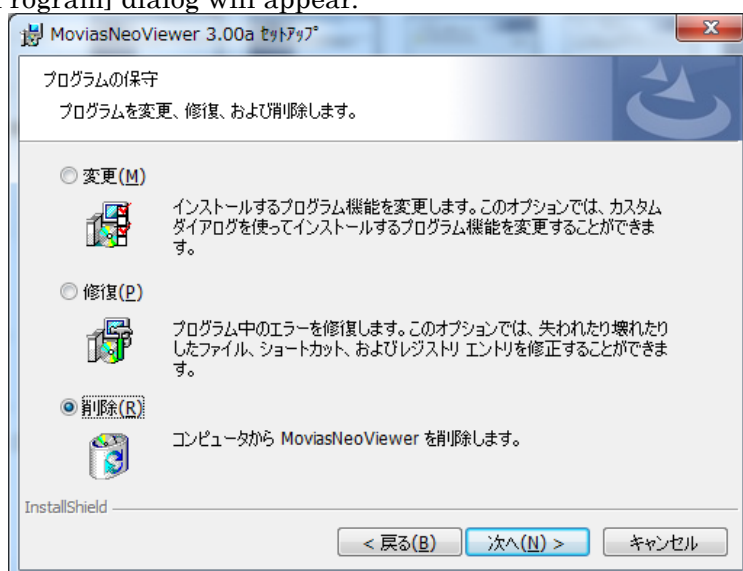
## 1.4.2 Uninstall MOVIAS Neo Viewer

To uninstall the MOVIAS Neo Viewer from your computer, open the [Control Panel] and click [Add or Remove Programs] ([Add or Remove Applications] in Windows XP or [Programs and Features] in Windows 7 / Vista).



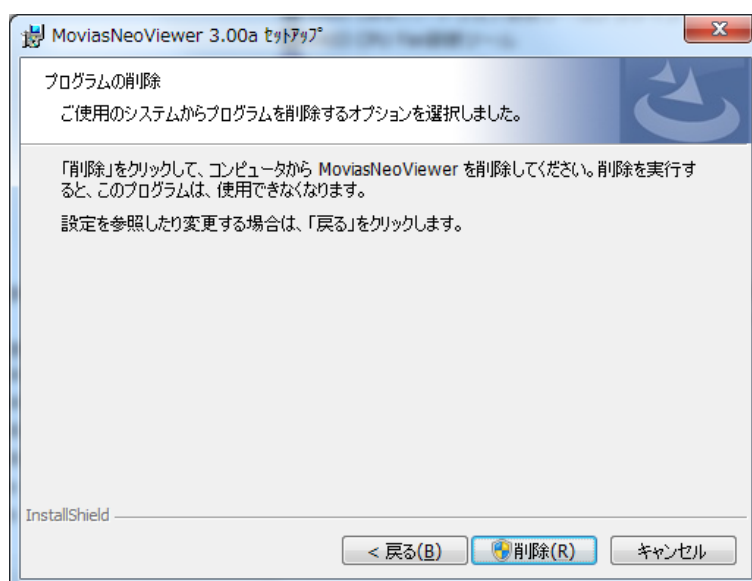
**Select MOVIAS Neo Viewer Program**

The [Remove Program] dialog will appear.



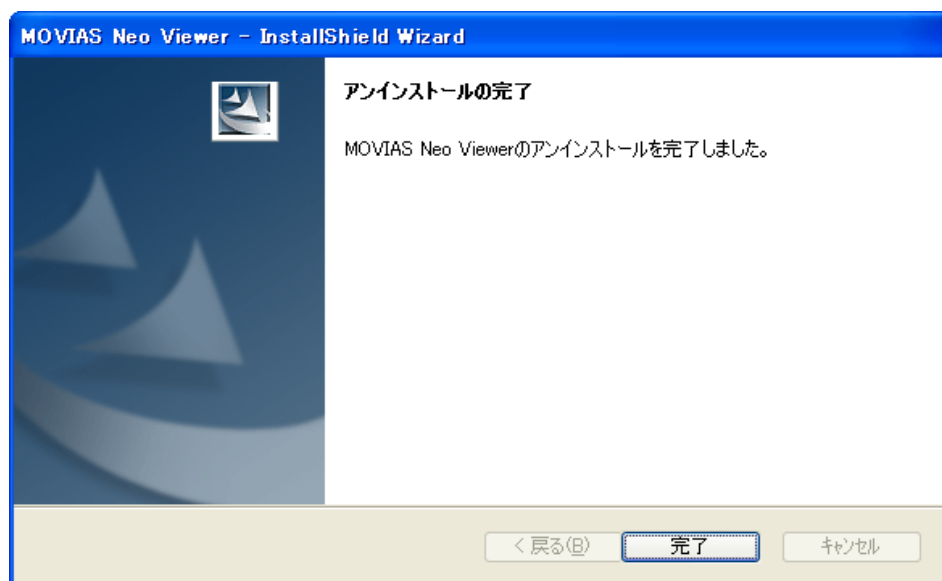
**[Remove Program] Dialog**

Select [Remove] in the [Remove Program] dialog and click [Next].

**[Verify Uninstall] Dialog**

The [Remove Program] dialog will appear.

Click [Remove] to completely remove the MOVIAS Neo Viewer. Otherwise, click [Back].  
Click [Remove] to uninstall the MOVIAS Neo Viewer and the [Finish Uninstall] dialog will appear.

**[Finish Uninstall] Dialog**

Click [Finish] to complete the uninstallation.

## 1.5 MOVIAS License Key

MOVIAS Neo utilizes a MOVIAS license key for software protection. If the license key is not properly inserted into the PC USB port of the computer or if the HASP HL driver is not installed, MOVIAS Neo will not work.



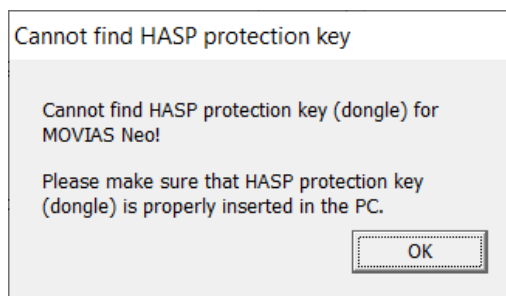
**MOVIAS License Key**

There are two types of MOVIAS Neo license keys: a 2D analysis version and a 3D analysis version. You cannot use the features of the 3D analysis version with the license key of a 2D analysis version.

The MOVIAS Neo License key is not compatible with a MOVIAS Pro license key.

### ● Warning Message when Starting MOVIAS Neo

If the MOVIAS Neo license key is not inserted when starting MOVIAS Neo or if it is inserted improperly, the following warning message appears. If this happens, make sure that the license key is inserted and restart MOVIAS Neo.



**[MOVIAS License Key Error] Warning**



If the error message appears even when the MOVIAS license key is properly inserted, the driver may not be properly installed or the license key itself may be damaged. Please contact us if this happens.

## 1.6 Operation with Windows Vista or Later Versions

If installing the 64bit version of MOVIAS Neo, the environment settings (.ini) will be stored in the following folder, regardless of where installed.

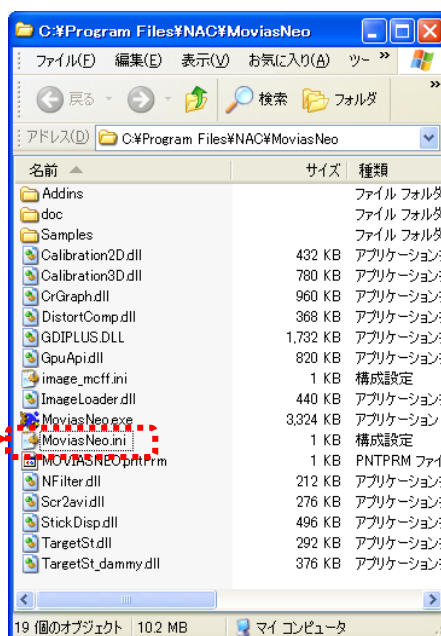
“C: \Users\<<User Name>>\AppData\Roaming\nac\MoviasNeo\”

If installing the 32-bit version of MOVIAS Neo and MOVIAS Neo is installed in the default location “C: \Program Files”, the environment settings (.ini) will be saved in different locations in Windows 7, Windows Vista and Windows XP. In addition to “C: \Program Files”, installation is identical for the OS managed folders such as “C: \Program Data” or “C: \Windows”.

### ● Windows XP

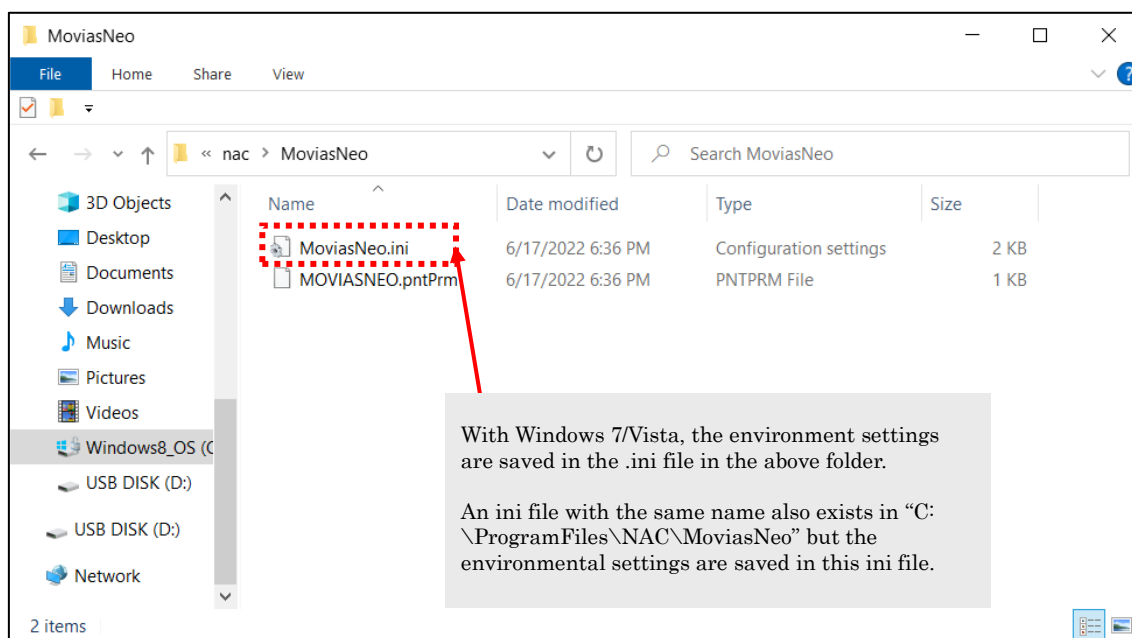
With Windows XP, the MOVIAS Neo environment settings will be saved in “C: \Program Files\NAC\MoviasNeo\MoviasNeo.ini”.

With Windows XP, the environment settings will be saved in the ini file in “C: \Program Files\NAC\MoviasNeo”.

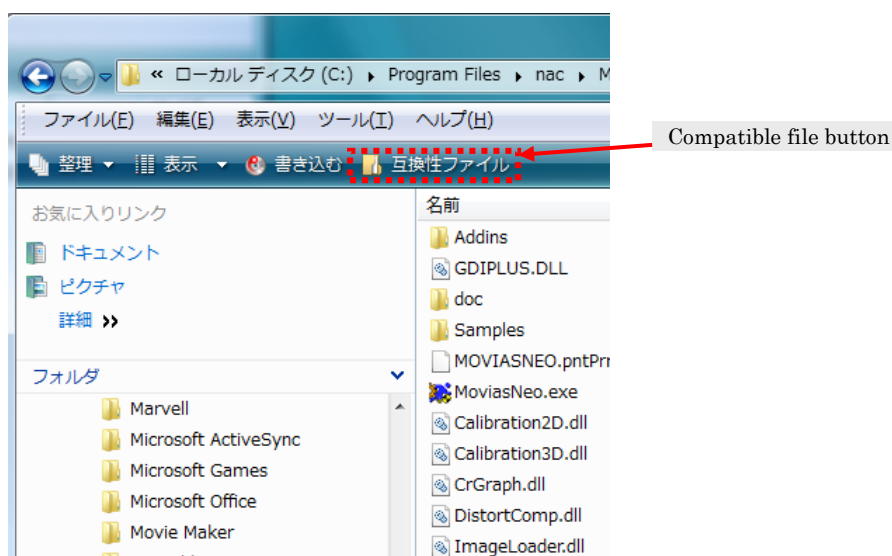


- Windows Vista and later

With Windows Vista and later, the MOVIAS Neo environment settings will be saved in  
 “C: \Users\<User Name>\AppData\Local\Virtual  
 Store\ ProgramFiles\nac\MoviasNeo\MoviasNeo.ini”.




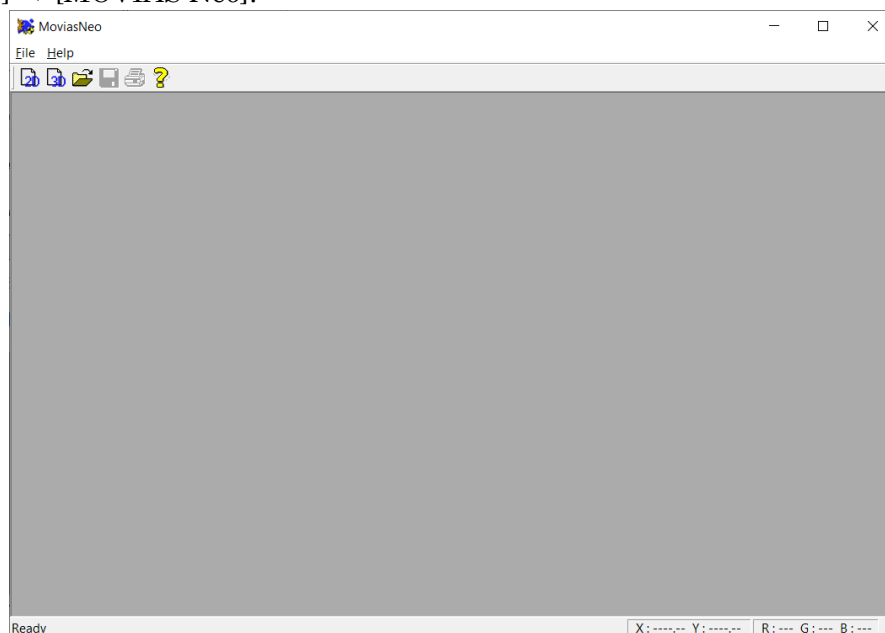
Even if the project files (.nmp) and other files (AVI/still image/CSV) are saved in the “C: \Program Files”, they are also saved in the Virtual Store folder for each user.  
 Open the destination folder set in [Environment Settings] in MOVIAS Neo in Explorer and click [Compatible Files] to verify the actual save location.



## 2. Quick Start Guide

### 2.1 Launch MOVIAS Neo

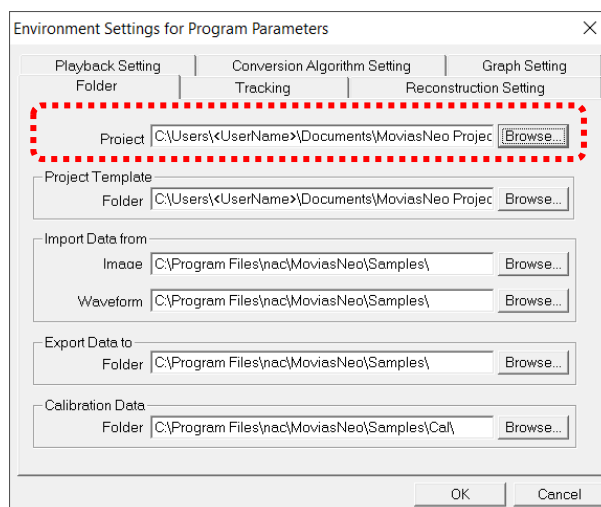
Click the icon  on the desktop to start MOVIAS Neo. Or click Windows [Start] ⇒ [Programs] ⇒ [MOVIAS Neo].



**MOVIAS Neo Start Screen**

The [Environment Settings] dialog will appear the program is first launched. Make the settings in the project directory under the [Folders] tab. The location set here is where new projects will be saved.

The default is the [MoviasNeo Projects] folder under [My Documents].




**[Environment Settings] Dialog**

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. 8-

29)for details on environment settings.

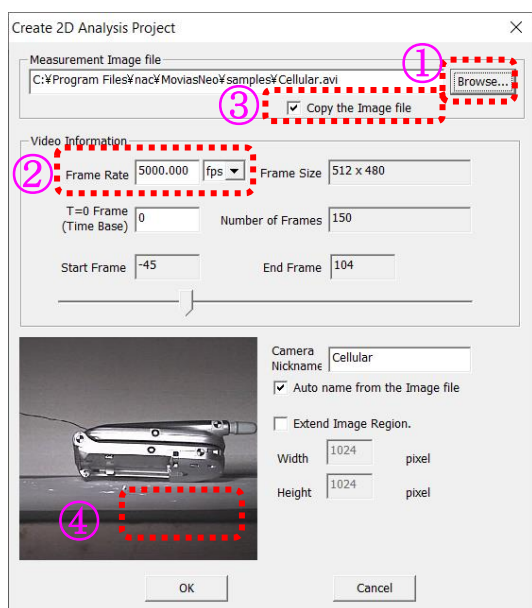
## 2.2 2D Analysis Tutorial

### 2.2.1 Create a 2D Analysis Project

Click  on the main control bar to create a new 2D project.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on projects.

The [エラー! 参照元が見つかりません。] dialog appears.



Perform the following.

- ① Click [Browse] and select a measurement image file to analyze.
- ② Set the frame rate. \*1)
- ③ Place a checkmark in the box for the measurement image to be copied to a project folder. \*2)
- ④ Click [OK].

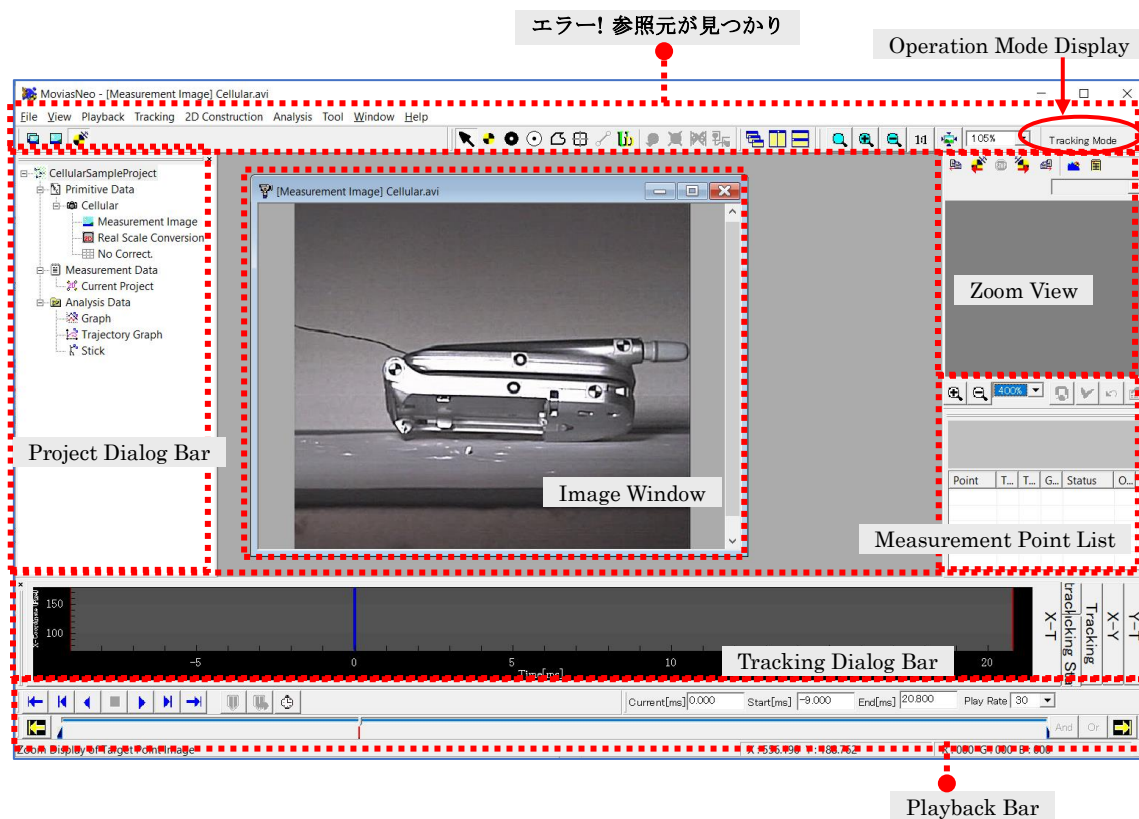
The tutorial uses the sample folder [Cellular.avi] as a measurement image file. (The default directory for this file is “C: \Program Files\nac\MoviasNeo\Samples \Cellular.avi”).

\*1) When analyzing AVI files created with our high-speed camera and the camera control software, the filming speed can be automatically set. Since the filming information is loaded from the \*\*\*.avi.txt file attached to the \*\*\*.avi file converted by the camera control software, we recommend putting the \*\*\*.avi.txt file into the same folder as the \*\*\*.avi file.








\*2) Refer to **3.2.1 Project Folder Structure** (P 3-4) for details.

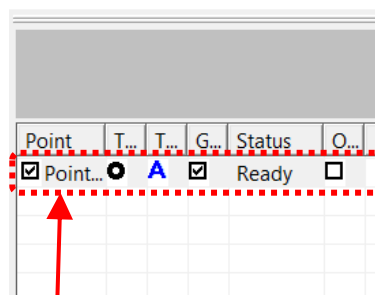
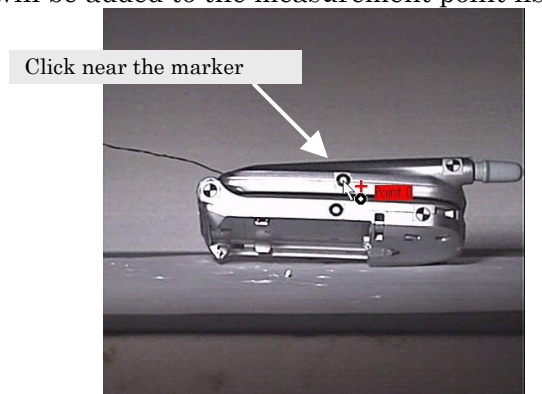
After the 2D analysis project is created, MOVIAS Neo switches to the tracking mode and the following screen appears.



Click the buttons on the main control bar to perform the corresponding operations. Buttons required for the active window and mode are shown on the main control bar.

## 2.2.2 2D Tracking

Select the white dot  from the target markers     (Quadrant, White Dot, Black Dot, and Feature Point), and click in the vicinity of the measurement point on the image window. If recognized properly, it will be shown as Point0 on the image and Point0 will be added to the measurement point list.





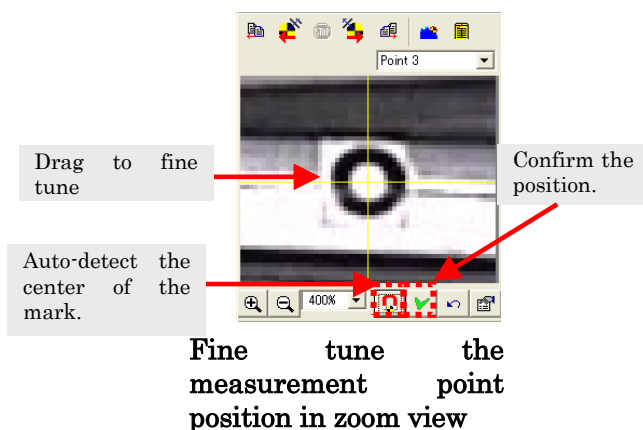
Point0 is added to the measurement point list


Repeat this operation to add multiple measurement points.

The measurement point position can be fine-tuned in zoom view. The zoom view shows the extended image that was clicked in the image window. The measurement point is shown in yellow in the zoom view, and the following two symbols show the status.

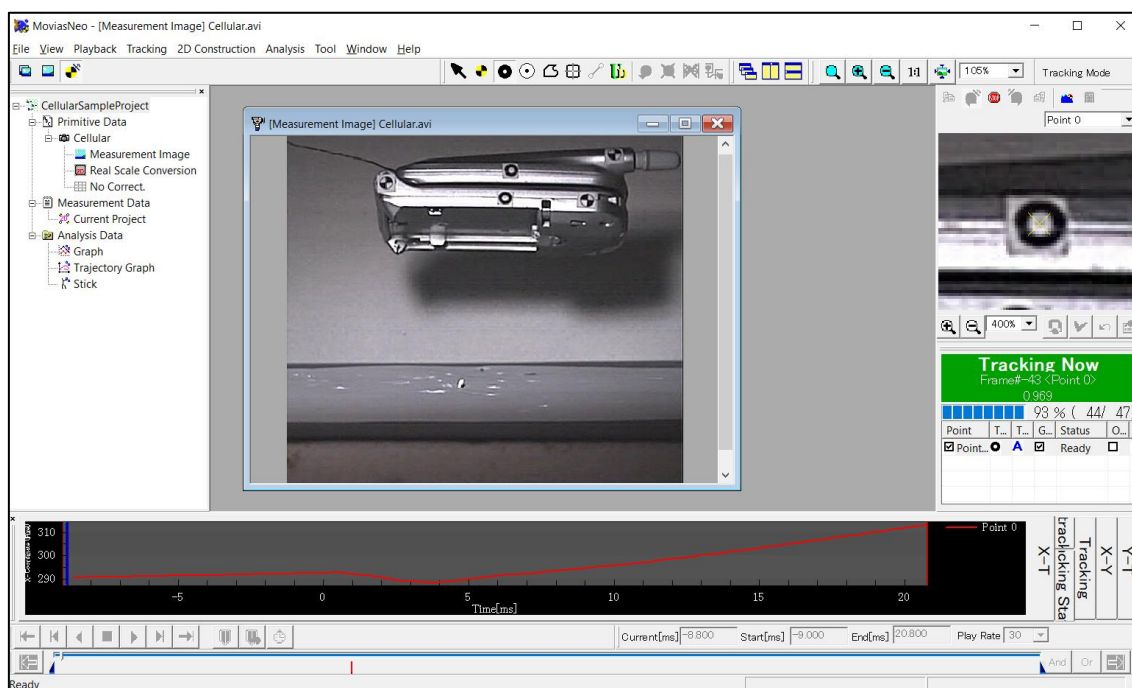
- + The measurement point is not set. Fine-tune the position in zoom view.
- X The measurement point is set.

To fine-tune, drag the + mark in zoom view or click  to automatically detect the center of the mark. After adjusting, click  to confirm the position of the measurement point.



After confirming the position of the measurement point, click  on the tracking control bar to start auto-tracking in the forward direction.

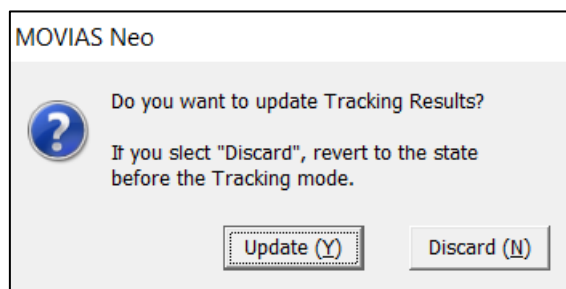




### Tracking Screen

If the tracking is interrupted, stop auto tracking and change the values of [Template Size] and [Search Area] in [エラー! 参照元が見つかりません。 (p. 4-11). Or switch to semi-auto tracking or manual tracking on the measurement point list.


After tracking is complete, click to exit the tracking mode. The update confirmation message appears. Click [Update].



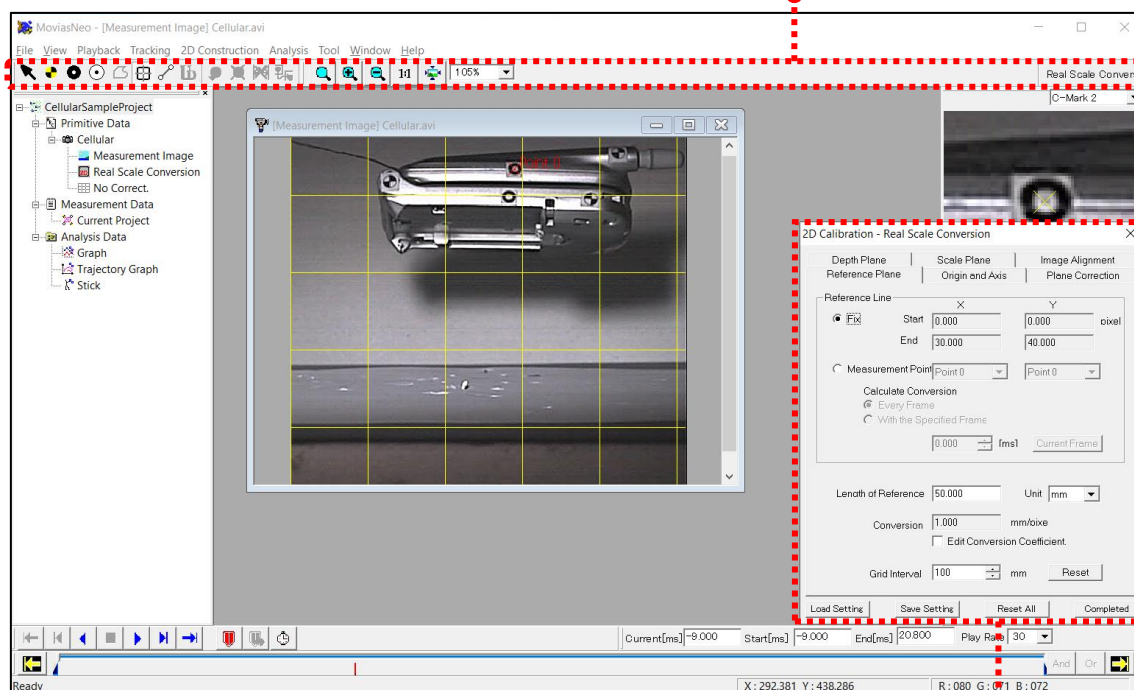
After the tracking mode is complete, it switches to the synchronized display mode.

## 2.2.3 2D Calibration


Converts the tracking results found in [2.2.2 2D] into real scale values.

Access the measurement image in the synchronized display mode and click on the エラー! 参照元が見つかりません。 . It switches to the real scale conversion mode for calibration and the following screen appears.

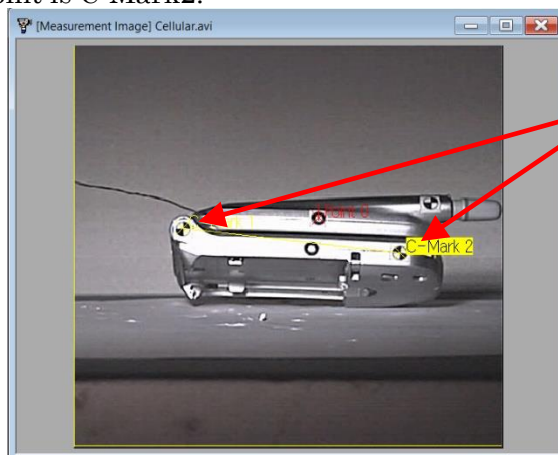
The buttons required for the real scale conversion mode are found on the main control bar.



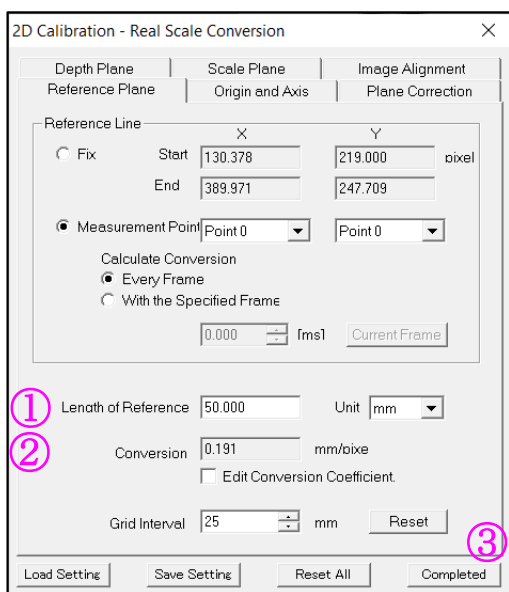
Real scale conversion dialog

On the measurement image, click two points of a known distance. These clicked points are called control points. Here, select quadrants  to set control points as the エラー! 参照元が見つかりません。.

On the measurement image, click near the marker. The first point is displayed as C-Mark1. The second point is C-Mark2.



Fine-tune the positions of the points in zoom view. The adjustment process is the same as with the tracking process.



After specifying the control points, perform the following steps in the [2D Calibration] dialog.

- ① Input the distance between the two points designated in [Length of Reference Line] in the [Reference Plane].
- ② Input the distance between two points to calculate the [Conversion Coefficient].
- ③ Click [Finish] to automatically apply the calibration results and access the synchronized display mode.

### Calibration Settings Screen

The calibration method currently in use can be verified under [Calibration Mode Node] in the [Project Tree].



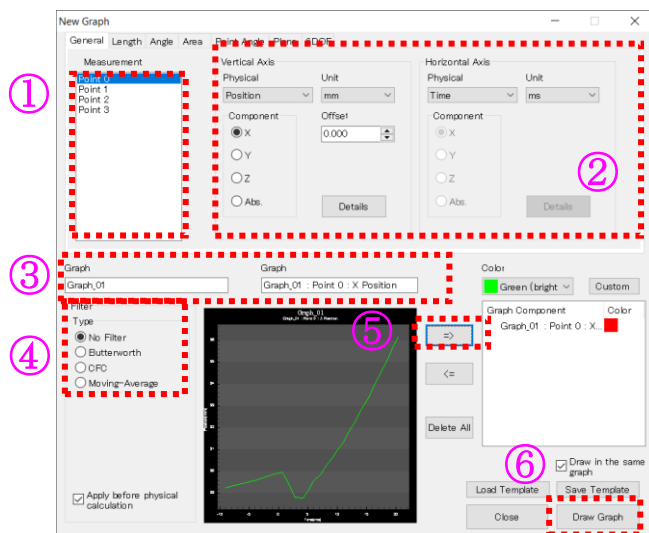
If necessary, set in the tabs for [Origin and Axis], [Plane Correction], [Depth Plane] and [Scale Plane].

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。), エラー! 参照元が見つかりません。エラー! 参照元

が見つかりません。s (p. エラー! ブックマークが定義されていません。 ) for details on 2D calibration.

## 2.2.4 Create Analysis Graphs

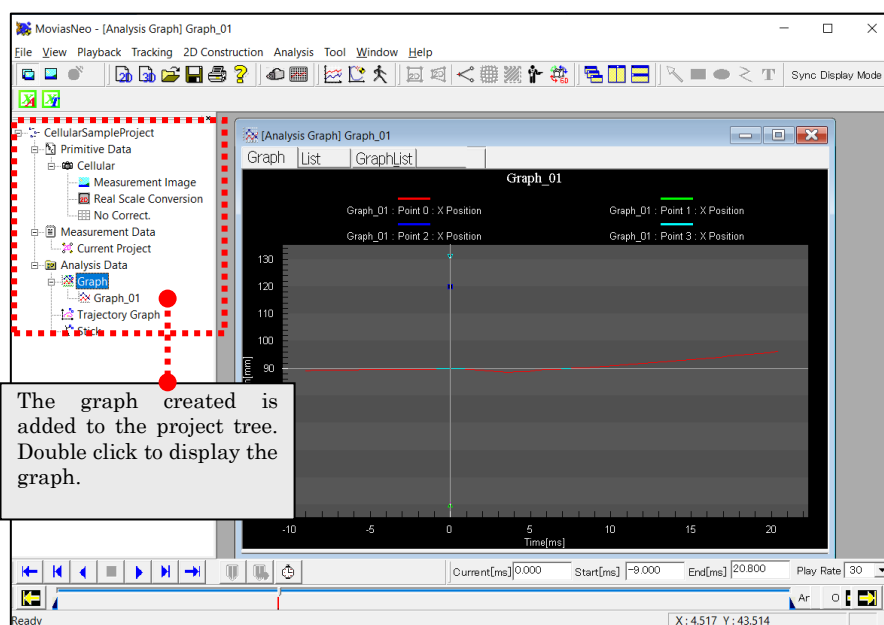
Access the measurement image window in the synchronized display mode and click on the エラー! 参照元が見つかりません。 to display the [Create a New Graph] dialog.



Perform the following.

- ① Select the measurement points from [Measurement Points] to create a graph.
- ② Select the [Physical Quantities], [Unit] and [Component] for the vertical and horizontal axes of the graph.
- ③ Input the [Graph Title], [Component] and [Color].
- ④ Select the [Filter]
- ⑤ Click => to add to the list of graphs displayed.
- ⑥ Click [Draw Graph].

If preparing multiple graphs, repeat these steps and add each graph to the list of graphs displayed. Check [Draw in the Same Graph] to draw all of the graphs added to the graph list on the same graph.



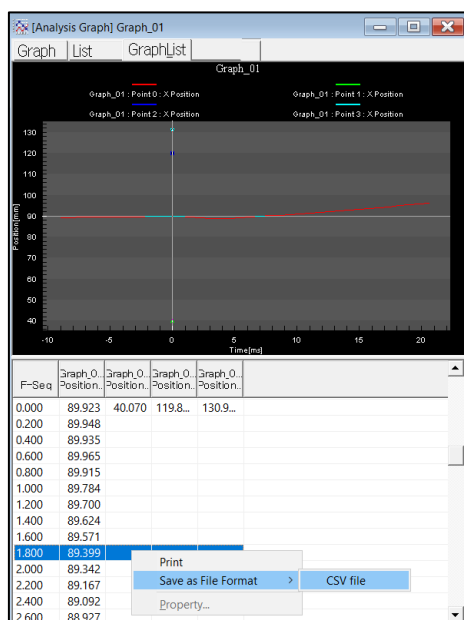
Graph Display

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on creating graphs.



## 2.2.5 Export as a CSV File

Export the tracking results, measurement results and analysis graph data to a CSV file. Go to the graph list and click [Save as File Format] → [CSV Format] on the right click menu to export the data.



Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on exporting as CSV files.


## 2.2.6 Save Measurement Results

Click the エラー! 参照元が見つかりません。 to assign a name and save the project.

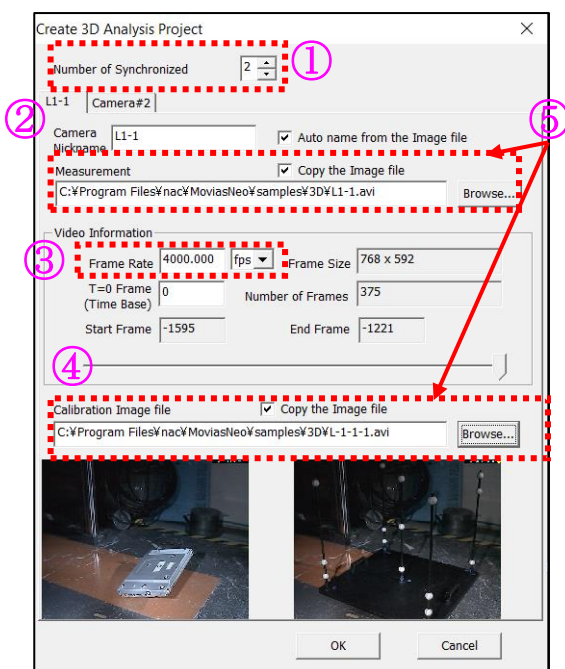
Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。), **3.2.6 Save Project As** (p. 3-13) for details on saving projects.

## 2.3 3D Analysis Tutorial

### 2.3.1 Create a 3D Analysis Project

Click  on the Main Control Bar to create a 3D analysis project.  
The [エラー! 参照元が見つかりません。] dialog appears.

For 3D analysis, designate measurement images photographed with at least two cameras as well as the calibration chart image.  
Perform the following.



- ① Set the number of cameras used in [Number of Synchronized Cameras].
- ② Select the measurement image file for analysis with [Browse] in the measurement image file
- ③ Set the frame rate. \*3)
- ④ Designate the calibration image file.
- ⑤ Check to copy the measurement image and calibration image to the project folder. Refer to 3.2.1 Project Folder Structure (P 3-4) for details.
- ⑥ Repeat ② ~ ⑤ for the [Number of Synchronized Cameras] and then click [OK].

This tutorial uses image files found in the sample folder. (The default directory of these files is in C:\Program Files\nac\MoviasNeo\Samples\3D).

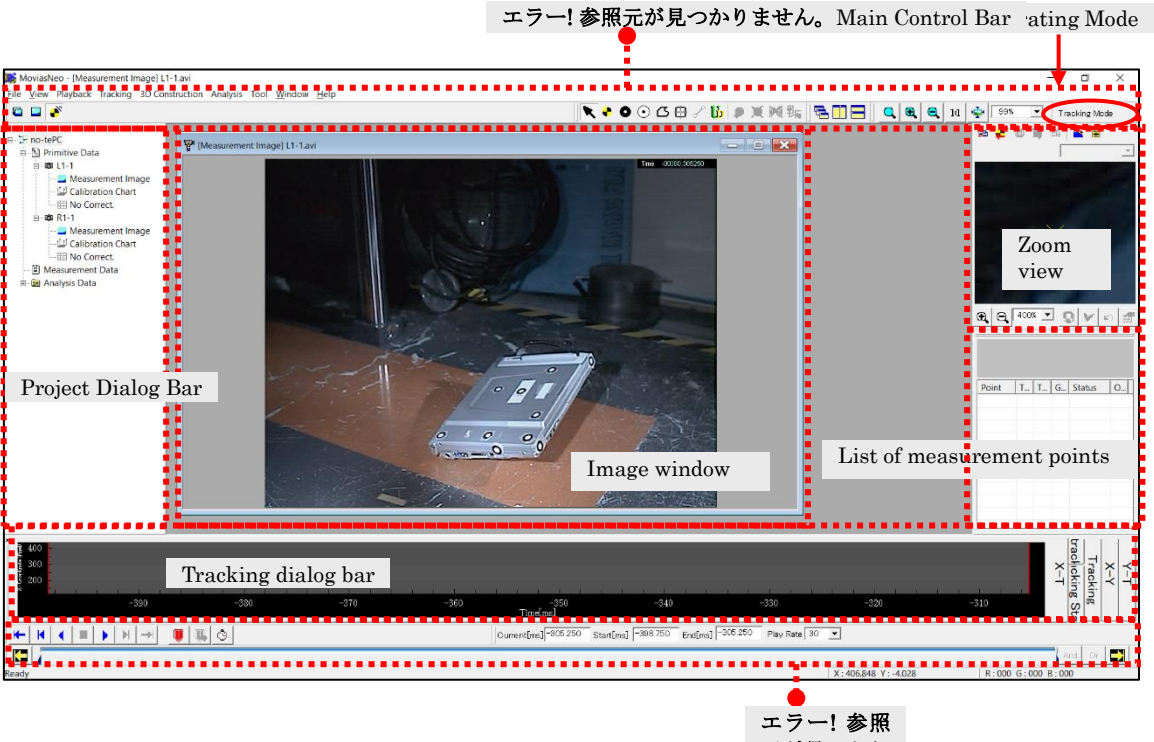
\*3) When analyzing AVI files created with our high-speed camera and the camera control software, the filming speed can be automatically set. Since the filming information is loaded from the \*\*\*avi.txt file attached to the \*\*\*.avi file converted by the camera control software, we recommend putting the \*\*\*avi.txt file into the same folder as the \*\*\*.avi file.

Make the settings for the measurement image files and calibration image files as follows.

Camera #1	Measurement image file	L1-1.avi
	Calibration image file	L-1-1-1.avi
Camera #2	Measurement image file	R1-1.avi
	Calibration image file	R1-1-1-1.avi

The same file can be set as the measurement image and the calibration image.  
Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on creating 3D projects.

If the 3D analysis project is done, MOVIAS Neo switches to the tracking mode and the following screen appears.



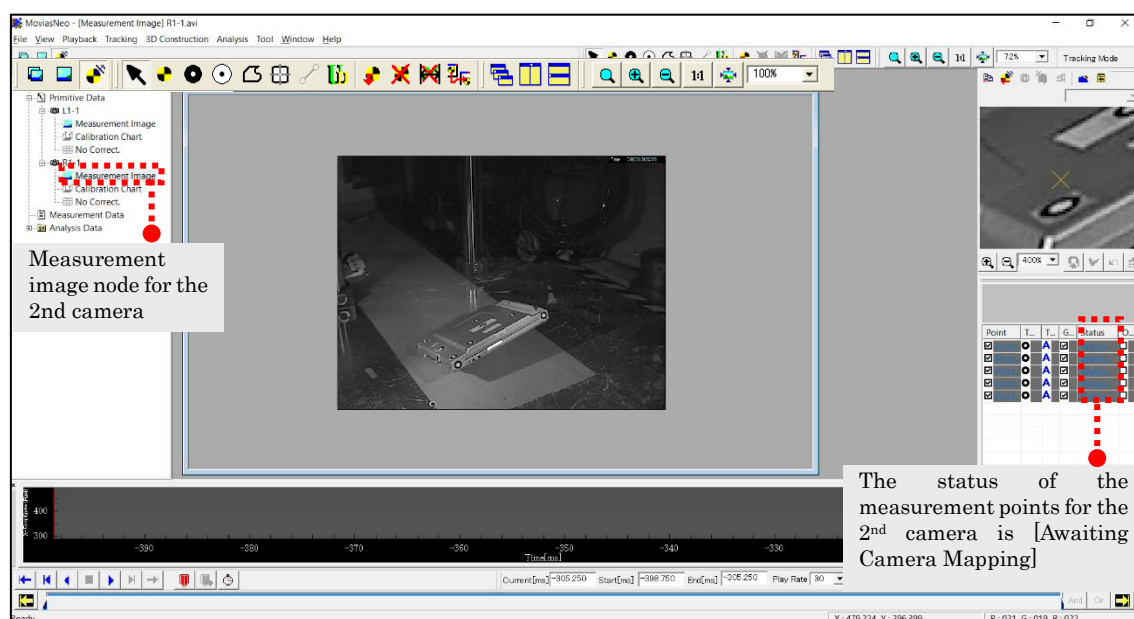
Click any button on the エラー! 参照元が見つかりません。 to perform the various operations. Buttons required for the active window and the mode can be found on the エラー! 参照元が見つかりません。 .

## 2.3.2 3D Tracking


Tracking is performed on the measurement points for the measurement images from each camera.

- ① Performs tracking for the first camera (identical to that for 2D tracking)
- ② Displays the measurement image from the second camera and switches to the tracking mode.

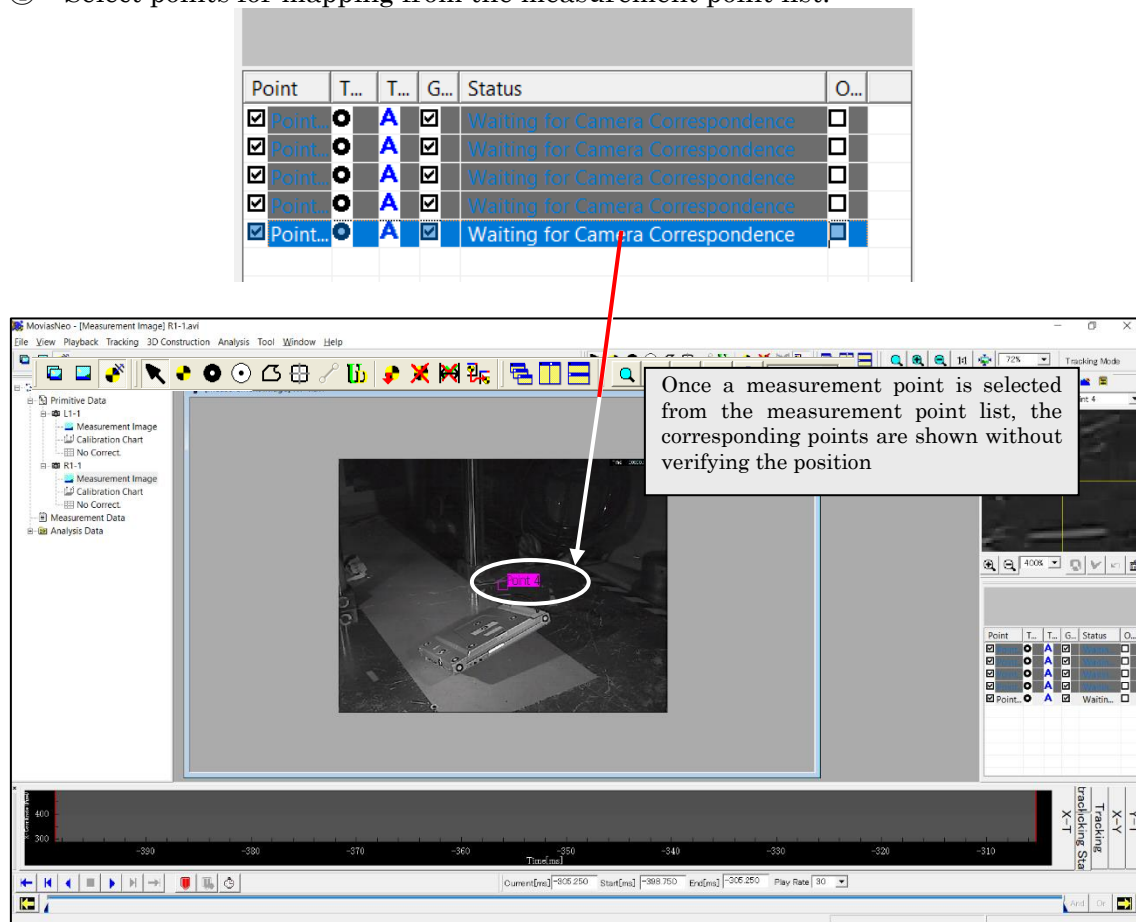
Double click on the second camera measurement image node on the project tree to show the measurement images for the second camera.



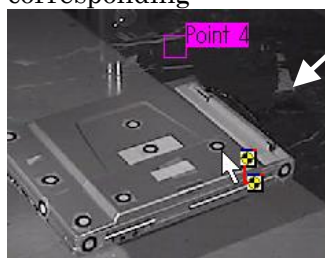
After adding the measurement points for the 1<sup>st</sup> camera, the status of the measurement points for the 2<sup>nd</sup> camera is [Awaiting Camera Mapping].

- ③ Click on the エラー! 参照元が見つかりません。  for mapping between cameras.

- ④ Select points for mapping from the measurement point list.

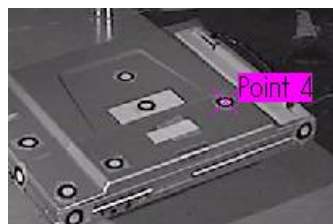


- ⑤ Click near the corresponding point on the image window to auto-detect the corresponding points.




After selecting the corresponding points from the measurement point list

Click the corresponding point



After clicking on the corresponding points on the image window to set the position

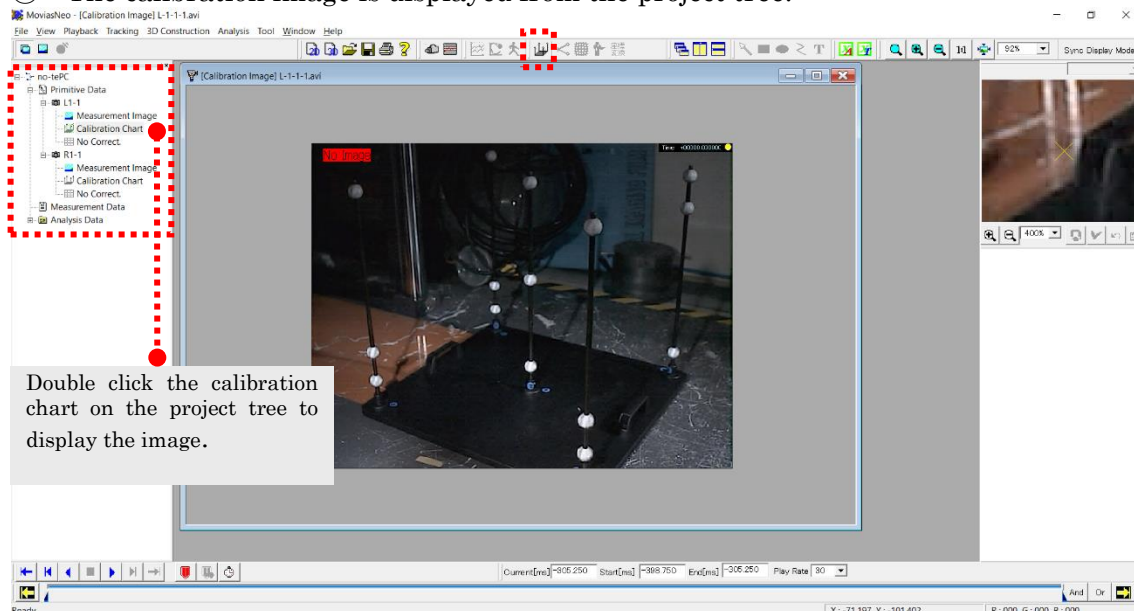
If auto detection fails, correct the position with the zoom view. After correcting, click the set zoom view button  to set the position.


- ⑥ Repeat ④, ⑤ to set the required corresponding points.
- ⑦ After finishing the required corresponding points, perform auto-tracking using the same process as that for 2D analysis.
- Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for details on 3D tracking.

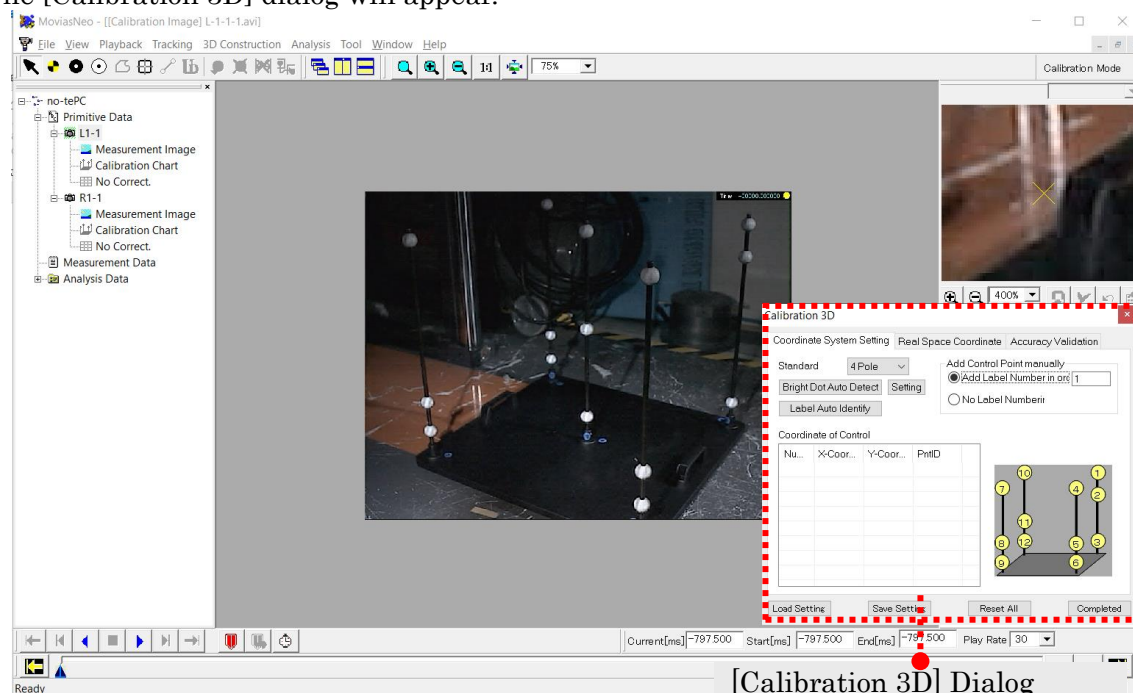
### 2.3.3 3D Calibration

Converts the tracking results from [2.3.2 3D] into real space coordinates. With 3D calibration, input the real space coordinates from the calibration chart and specify the control point position on the calibration image for each camera.

- ① The calibration image is displayed from the project tree.



- ② Click  on the Main Control Bar to switch to the calibration mode. The [Calibration 3D] dialog will appear.

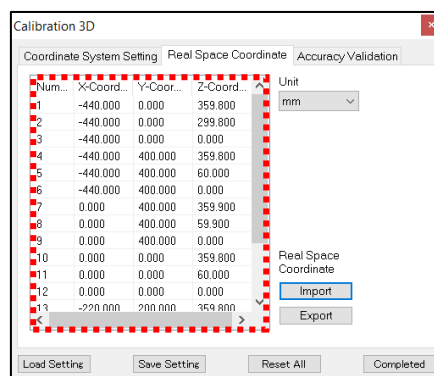
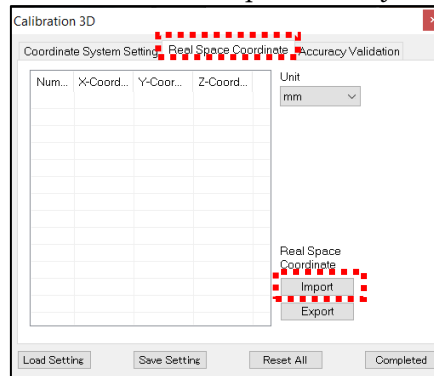




- ③ Input the real space coordinate values for the control points in the [Real Space Coordinate] tab of the [Calibration 3D] dialog. This tutorial loads the real space coordinates on the calibration chart from the CSV file created previously.

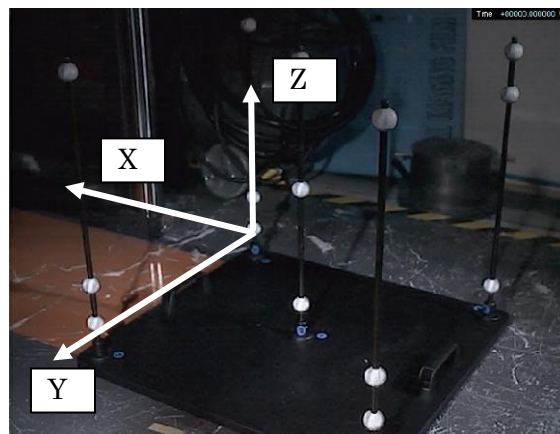
The real space coordinate file used is 5poles\_chart\_3d\_no1.csv in the Sample folder. (If installed using the defaults, it is C:\Program Files\nac\MoviasNeo\Samples\Cal\5poles\_chart\_3d\_no1.csv. Click [Import] to select the file.)

The real space coordinates can also be input directly to the list.

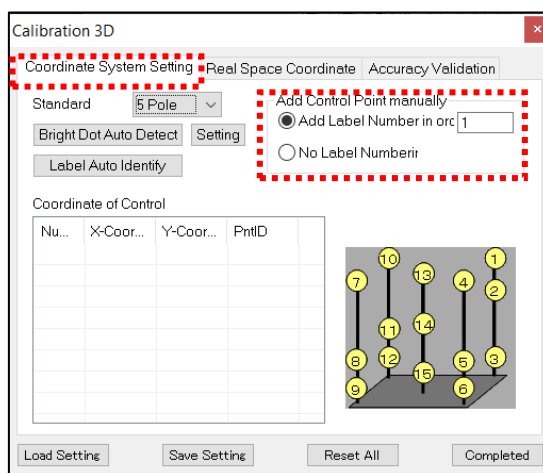


**Real Space Coordinates**

The coordinate system in this tutorial is the right-handed system, as shown in the following figure.

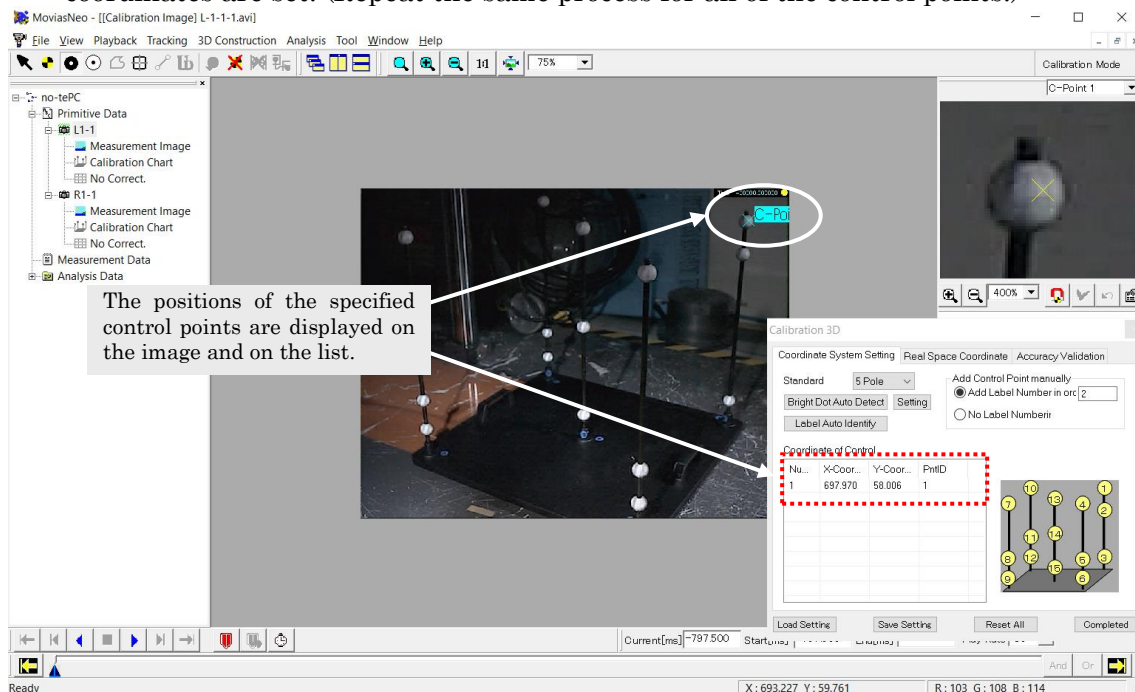


- ④ Set the corresponding control points under the [Image Coordinate Settings] tab. This tutorial uses the standard 5 pole chart. Select [Add Sequential Label Number] and input [1]. Select the white dot from the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 and click to set the control points corresponding to the selected calibration image.



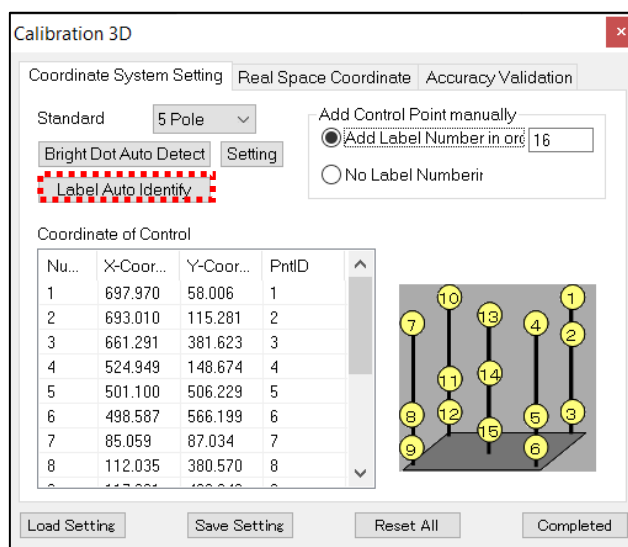
### Image Coordinate Settings

Fine tuning of the control point positions is performed in zoom view. Once the control points are properly recognized, C-Point1 appears on the screen and the control point coordinates are set. (Repeat the same process for all of the control points.)



Check to make sure the real space coordinate number and the control point number match.






If the order of the control points is incorrect, the numbers can be automatically corrected by clicking on [Auto Identify Labels] after designating all the control points. Make sure the real space coordinates and control point numbers are correct.

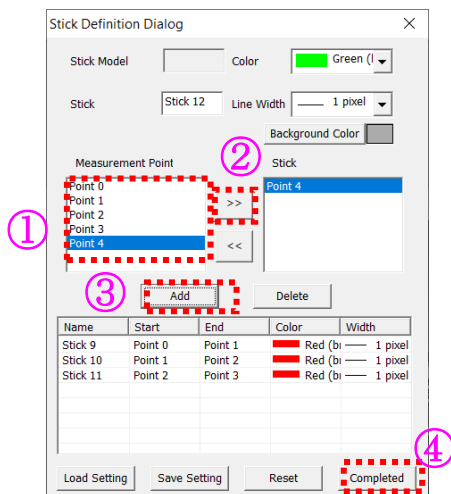
Click [Finish] in the [Calibration 3D] dialog after performing the same process for the calibration images for all the cameras and the 3D calibration will be complete.

If the default settings are used, the 3D measurement data calculations are performed after tracking or 3D calibration.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on 3D calibration.


### 2.3.4 Define Sticks

After constructing the 3D measurement data, click  on the エラー! 参照元が見つかりません。 while in the display or synchronized display mode to access the [エラー! 参照元が見つかりません。].



Perform the following.


Select a measurement point from the [Measurement Point List].

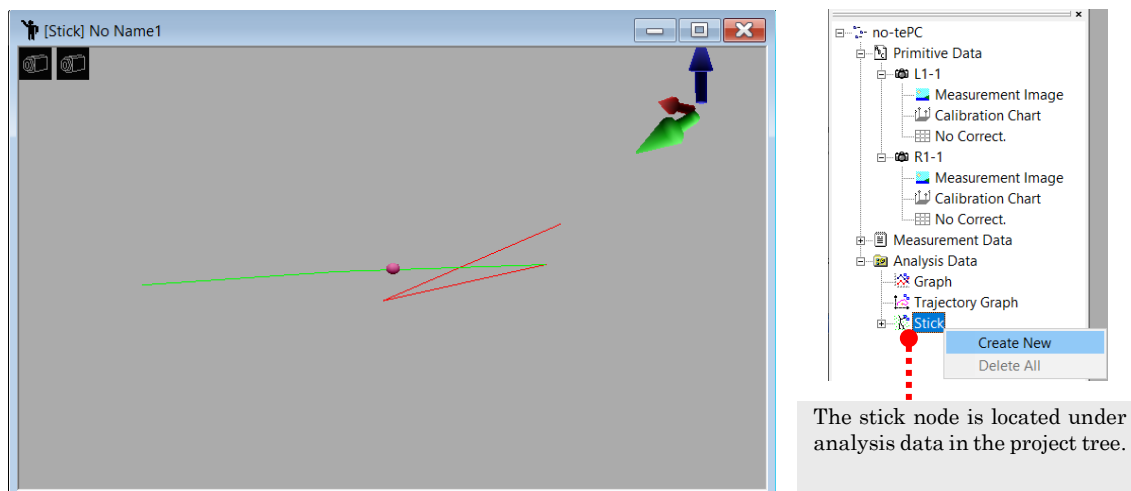
Click  to add the starting and ending measurement points to the [List of Stick Components].

Click [Add].

Click [Complete].

## **Define Stick Dialog**

Click  on the エラー! 参照元が見つかりません。 or select a stick node from the project tree and click on [Create New] from the right click menu to perform the 3D stick display




3D Stick Display

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on sticks.

### 2.3.5 Print

You can print images, lists, graphs, and sticks from the right click menu on the window displayed.

### 2.3.6 Save Measurement Results


Click  on the エラー! 参照元が見つかりません。 to assign a name and save the project.

Refer to **3.2.6 Save Project As** (p. 3-13) for details on saving.



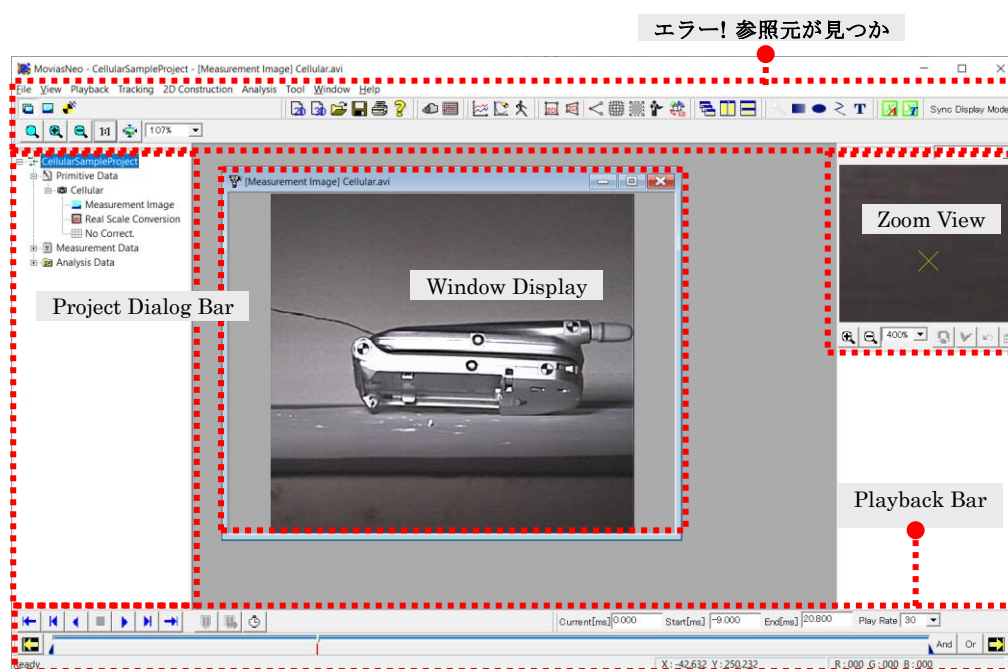
## 3. MOVIAS Neo Operations

### 3.1 MOVIAS Neo Overview

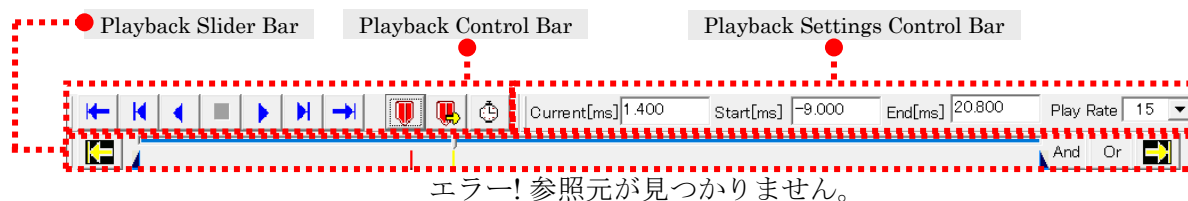
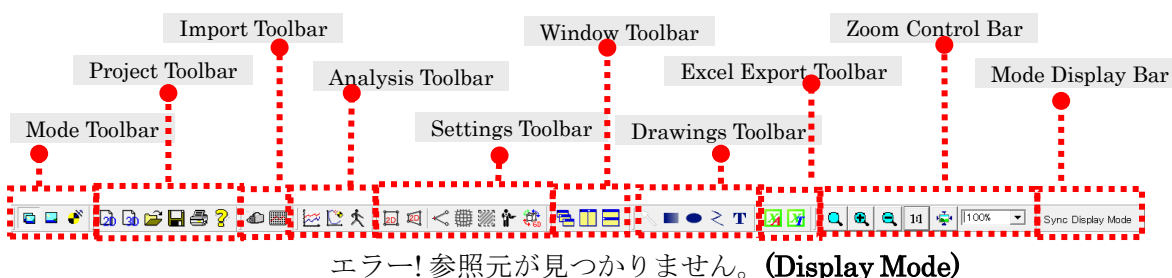
Double click  on the desktop to launch the application. The figure below shows the screen when a project is opened in the sync display mode.

Active window operations are performed with the main control bar and playback bar. Only the required items for the active window and mode are shown on the エラー! 参照元が見つかりません。.

Project operations and window displays (images, graphs, lists, sticks) are performed from the project dialog bar.

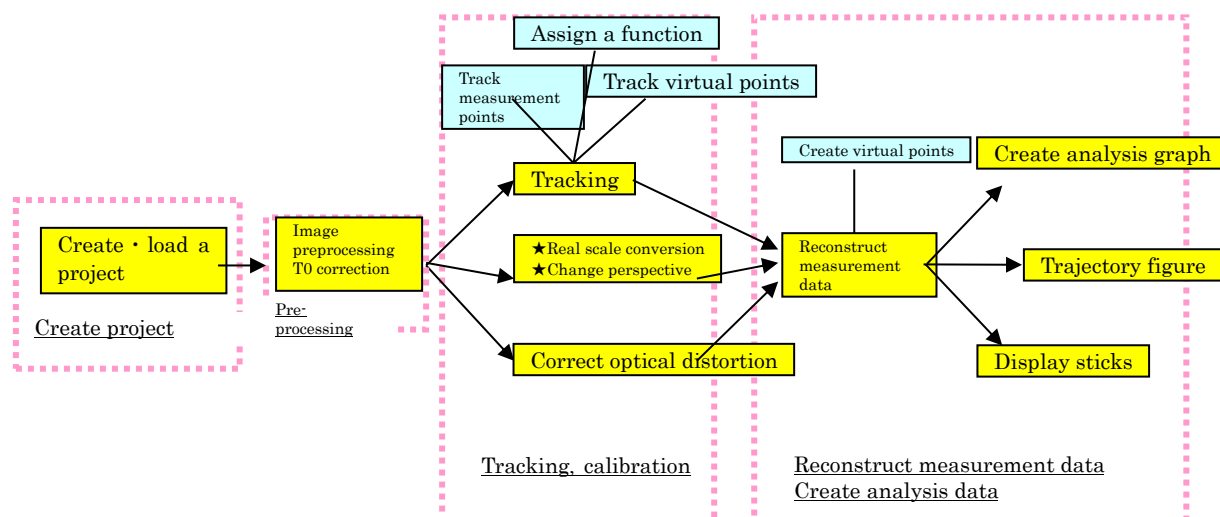


Application Overview



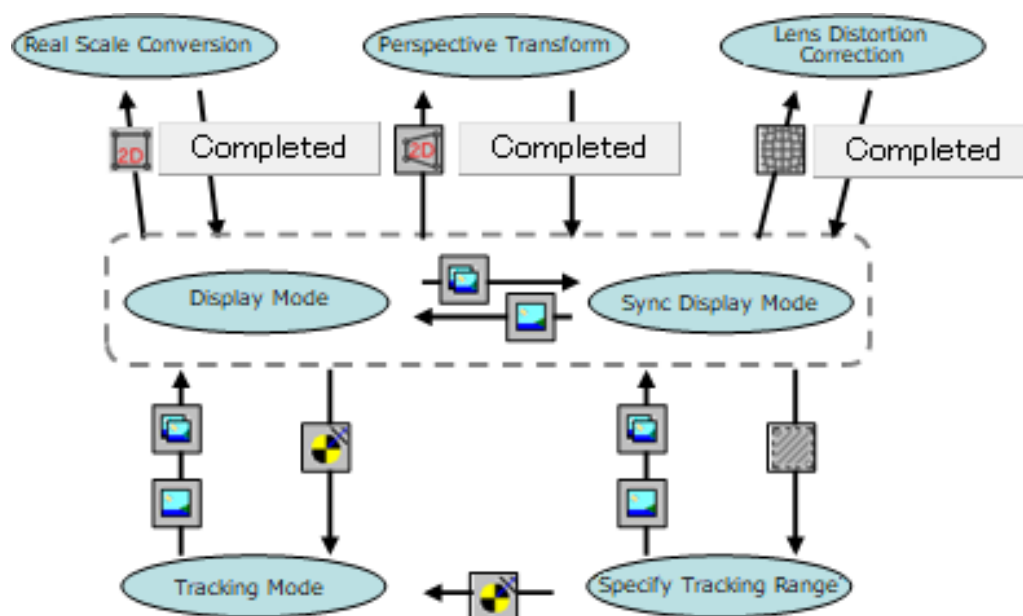
### 3.1.1 2D Analysis Process

In general, the process for 2D analysis follows a flow of [Create a Project] → [Pre-processing] → [Tracking and Calibration] → [Construct Measurement Data and Create Analysis Data].



#### Overview of the 2D Analysis Process

An overview of [Tracking – Calibration] is shown below.  
The operation mode is shown [Mode Display Bar] of the [Main Control Bar].



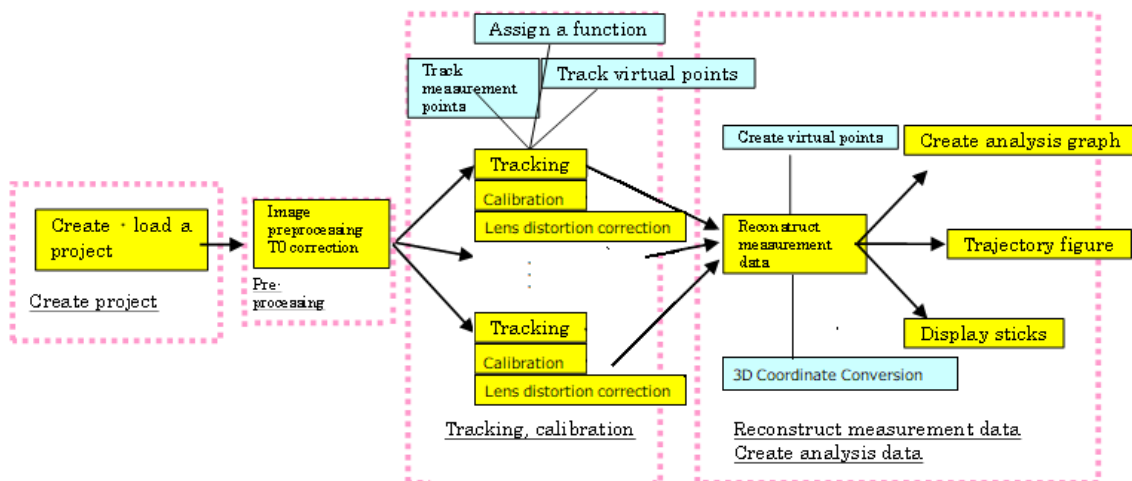
Operation Mode Figure for 2D [Tracking – Calibration]

[Preprocessing] and [Construct Measurement Data – Create Analysis Data] are performed in the Display / Synchronized Display modes.

### 3.1.2 3D Analysis Process

The process for 3D analysis is identical to that for 2D analysis, with a flow of [Create Project] → [Preprocessing] → [Tracking and Calibration] → [Reconstruct Measurement Data and Create Analysis Data]

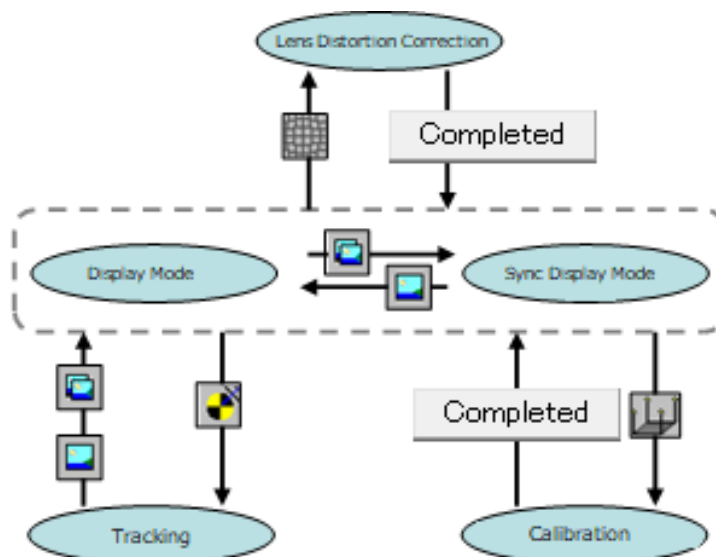
However, since multiple cameras are involved in 3D analysis, tracking and calibration (including lens distortion correction) is performed multiple times.



#### Overview of the 3D Analysis Process

An overview of [Tracking and Calibration] is shown below.

The operation mode is shown in the [Mode Display Bar] in the エラー! 参照元が見つかりません。].



#### Operation Mode Figure for 3D [Tracking · Calibration]

[Preprocessing] and [Reconstruct Measurement Data and Create Analysis Data] are performed in the display and synchronized display modes.

## 3.2 Projects

MOVIAS Neo handles tracking and analysis data in project units, and all information is saved in project files (.nmp).

In MOVIAS Neo, a maximum of 8 project files can be opened at the same time, and multiple open projects can be saved and loaded as a session file (.nms)



Attn: Users of MOVIAS Neo Ver.1

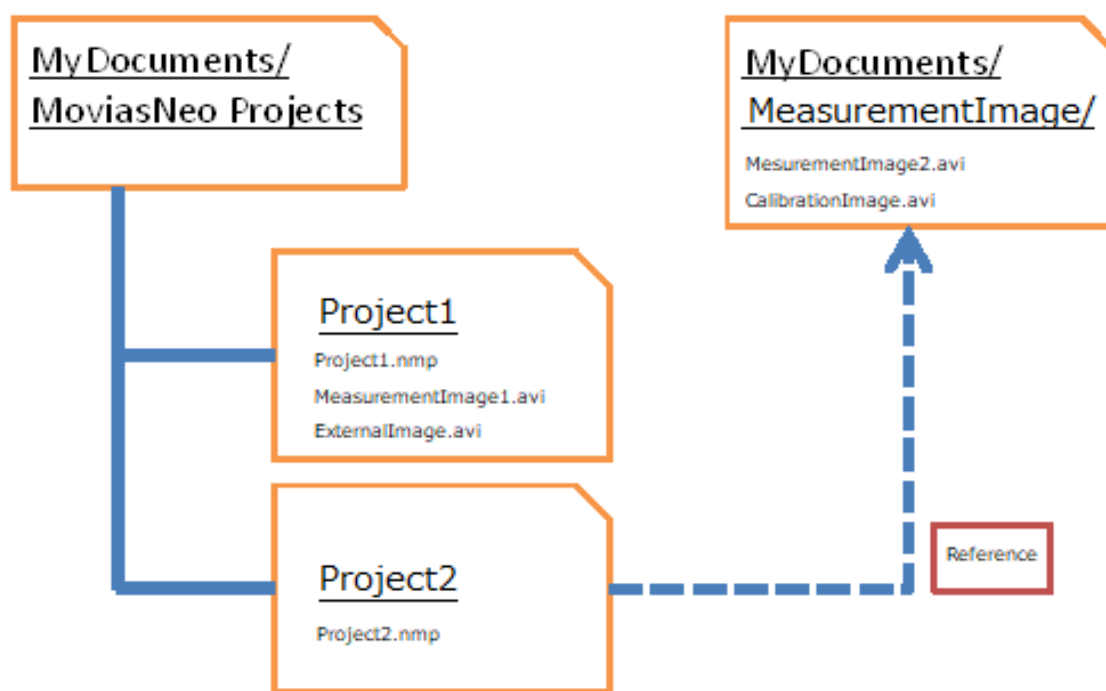
The operating functions of the project files has changed somewhat from Ver. 2. Please refer to **3.2.10 For For Users of MOVIAS Neo Ver.1** (p. 3–19) for details.

### 3.2.1 Project Folder Structure

In the [Folders] tab under [Environment Settings], MOVIAS Neo creates [project folders] with the same name as the project in specific folders called [Projects]. The necessary files are created for projects and saved in the [Projects Folders]. Make sure to create a project file (with an extension of “.nmp”).

The structure of the project folder is as follows. For example, [Projects] are in [MoviasNeo Projects] in [My Documents], with the names of projects called [Project 1] and [Project 2]. Processing is conducted using the measurement image and calibration image (as well as the optical distortion image and the external image for processing) specified during the creation of the project.

The images from [Project 1] are copied into the [Project 1] folder to create the project. [Project 2] references the images in the image folder to create the project.

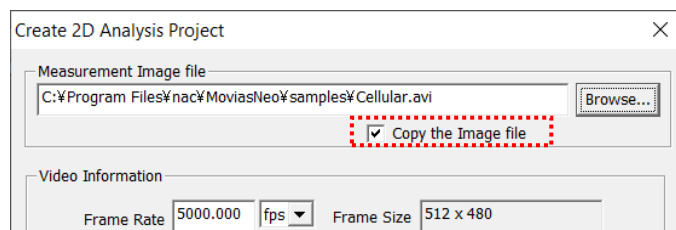


Project Folder Structure



Settings can be made in this manner to either copy images to the project folder or to reference images. Select copy/do not copy the image file in the same way as when importing an image (p. 8-18) or adding an optical distortion correction chart (p. 5-25). Settings are made during creation of the project.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for details on creating projects.



- **Copy Image Files**

Check [Copy Image Files] to copy images to a project folder.

Projects can be moved or copied to each project folder for managing.

This setting is used when you must move project folders such as when conducting analysis on multiple computers.

- **Do Not Copy Image Files**

Uncheck [Copy Image Files] when not copying images to a project folder and when referencing specific locations to create projects.

This setting is used for batch handling measurement images that are not moved and when analyzing projects with images that have large file sizes

When measurement images are open, MOVIAS Neo searches locations by referencing images from project creation. Project folders can be referenced if an image cannot be found with this.


If opening projects by moving referenced image files to another location, copy the image from the referenced location to the project folder.



### 3.2.2 Create a Project

#### ● Create a 2D Analysis Project

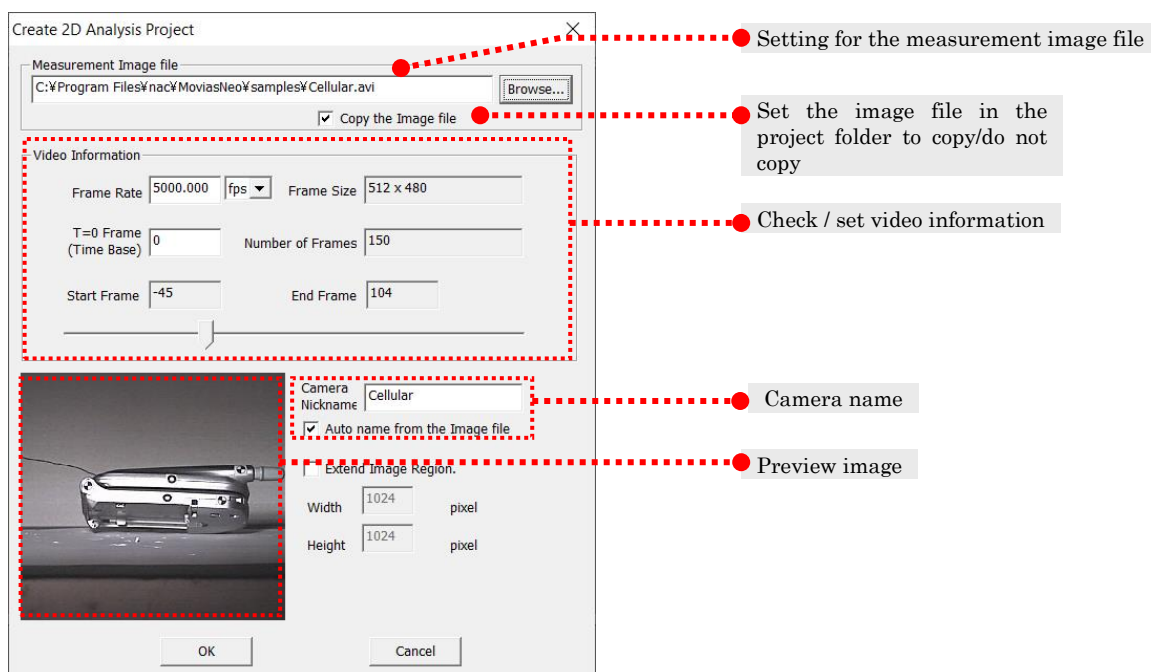
Create a project for 2D analysis. Perform either of the following operations to create a 2D analysis project.

- ✓ Click  on the project toolbar on the エラー! 参照元が見つかりません。 .
- ✓ Click [File] ⇒ [New 2D Project] on the menu.

The [Create a 2D Analysis Project] dialog appears.

Specify the measurement image, image information and camera name. Click [OK] to create a 2D analysis project.

The measurement image appears after creating a project and then it switches to the tracking mode.



#### Measurement Image File

Designates the measurement image for the target camera. The measurement image file formats that can be set include AVI, MCFF, BMP, JPG, PNG and TIF

#### Copy the Image File

Sets the image file in the project folder to copy/do not copy.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details.

#### Frame Rate

Sets the frame rate (fps).

**Image Size**

Shows the size of the loaded image.

**“T0” Frame (Time Starting Poitn)**

Sets the “T0” frame (time starting point).

**Number of Frames**

Displays the total number of frames for the image.

**Start Frame**

Displays the starting frame of the loaded image.

**End Frame**

Displays the ending frame of the loaded image.

**Camera Name**

Sets the camera name shown on the project tree. The default is the name of the measurement image file. \* Do not use the characters \/: ! in the camera name.


Check [Auto Create from the Image File Name] to automatically set the camera name from the image file name.

**Preview Image**

Shows a preview of the measurement image currently selected. Not shown if there is an invalid name or if a file that MOVIAS Neo cannot process is selected.

## ● Create a 3D Project

Create a project for 3D analysis. Perform either of the following operations to create a 3D analysis project.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [File] ⇒ [New 3D Project] on the menu.

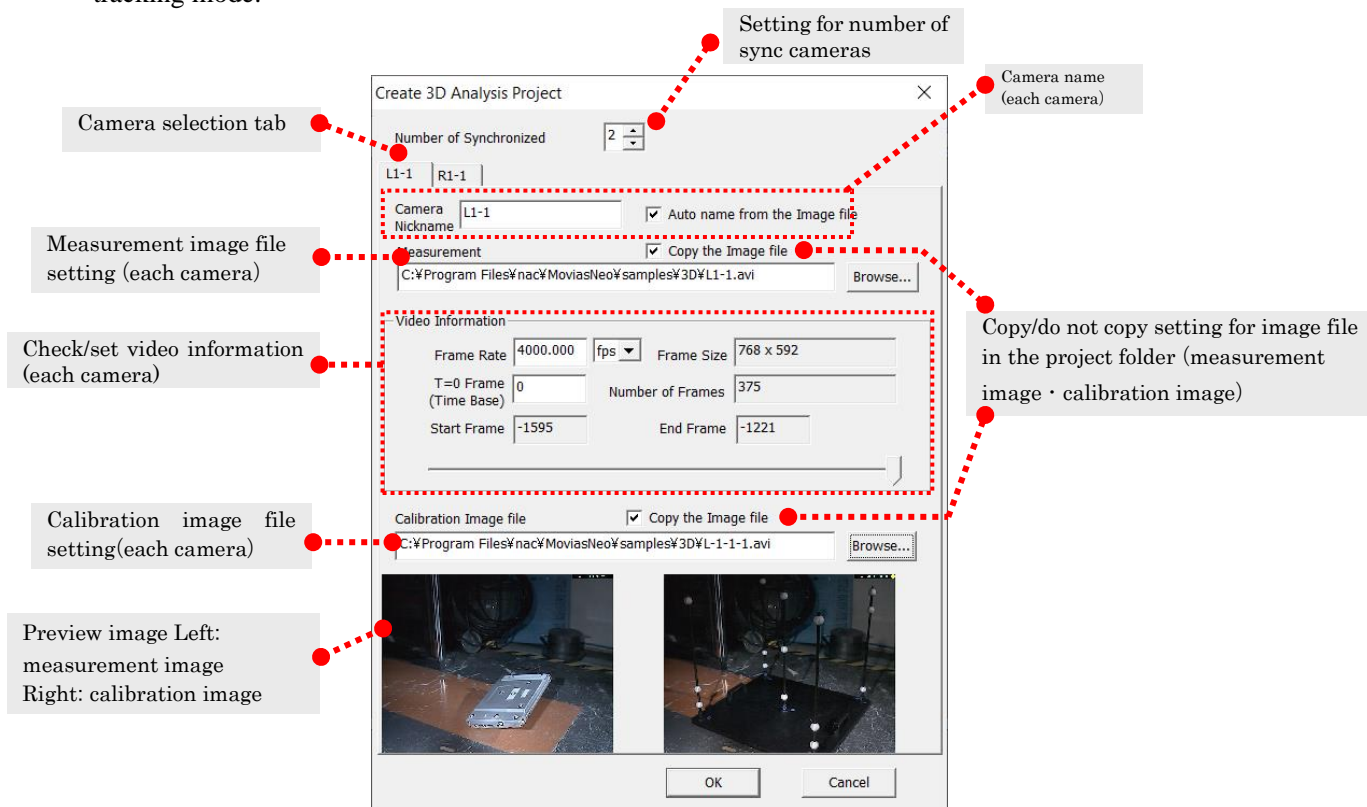
Two or more measurement image files and calibration image settings are required to create a 3D project.

First, set the number of cameras used for analysis. Next, set the following for each camera

- ✓ Camera name
- ✓ Measurement image file
- ✓ Video information settings
- ✓ Calibration image
- ✓ Copy/do not copy the image to the project folder

Click [OK] to create a 3D analysis project.

After creating a 3D project, the measurement image for the first camera appears and it switches to the tracking mode.



### Number of Synchronized Cameras

Designates the number of cameras used for measurement. Required for the measurement images.

### Camera Selection Tab

Select the camera.

**Camera Name**

Sets the camera name shown on the project tree. The default is the name of the measurement image file. Set for each camera. Do not use the characters \/: ! in the camera name.

Check [Auto Create from the Image File Name] to automatically set the camera name from the image file name.

**Measurement Image File**

Designates the measurement image for the target camera. Set for each camera.

**Copy the Image File (Measurement) (Calibration)**

Sets the designated measurement image file and the calibration image file in the project folder to copy/do not copy.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p.エラー! ブックマークが定義されていません。) for details.

**Frame Rate**

Sets the frame rate (fps).

**Image Size**

Shows the size of the loaded image.

**“T0” Frame (Time Starting Point)**

Sets the “T0” frame (time starting point).

**Number of Frames**

Displays the total number of frames for the image.

**Start Frame**

Displays the starting frame of the loaded image.

**End Frame**

Displays the ending frame of the loaded image.

**Calibration Image File**

Designates the calibration image for the target camera. Set for each camera.


If there is a 3D calibration parameter file (\*.3dc) in the calibration image folder, that file is automatically loaded, and a project created with those calibration parameters is set. For example, if the calibration image file is "Calib.avi", the file "Calib.3dc" in the same folder is automatically loaded. If there is no 3D calibration parameter file, only the image is loaded.

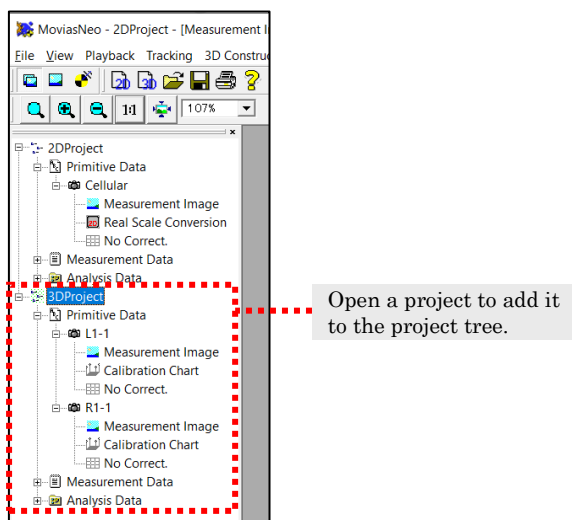
**Preview Image**

Preview of the measurement image and calibration image currently designated. The measurement image is on the left and the calibration image is on the right.

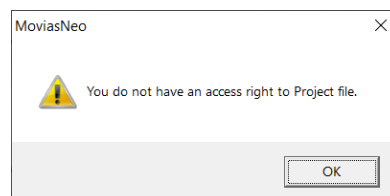
### 3.2.3 Open a Project

Open a saved project file (.nmp). A maximum of 8 projects can be opened at the same time. When a project is opened, you can continue from the point when it was last saved. Perform any of the following to open a project.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [File] ⇒ [Open Project] on the menu.
- ✓ Drag the project file (.nmp) to the main window.



To open a project file, MOVias Neo must be able to load it and write to it. If there was an error opening the projects, as shown in the dialog box on the right, check and make sure the load attributes for that file are correct.




### 3.2.4 Close a Project

Close a project selected from the current project tree. Perform either of the following operations.

- ✓ Click [File] ⇒ [Close a Project] on the menu.
- ✓ Select the project node on the Project Tree and click [Close Project] from the right click menu.

### 3.2.5 Save a Project

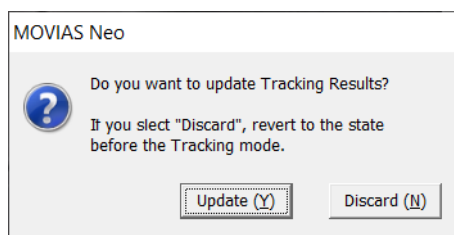
Save tracking data, calibration data or analysis data. Perform any of the following operations.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [File] ⇒ [Save Project] on the menu.
- ✓ Press Ctrl + S.
- ✓ Select the project node on the エラー! 参照元が見つかりません。 and click [Save Project] on the right click menu.
- ✓ Click OK on the [Save?] dialog to close a project.

A message displays the results when the tracking, calibration and optical distortion correction mode is complete.

Select [Update] to save the current results to a file.

Select [Discard] to delete the current results and return to the previous mode.



Set to confirm refresh operations when mode ended.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) [Restore Settings] tab for details.



Attn: Users of MOVIAS Neo Ver.1

The operating functions of the project files has changed from Ver. 2. Please refer to **3.2.10 For Users of MOVIAS Neo Ver.1** (p. 3 – 19) for details.



Attn: Users of MOVIAS Neo Ver.2.10 and later

Confirmation when ending modes has been changed.

In **Ver2.20**, when selecting [Discard] in the dialog above, the preceeding contents are discarded and the project file is reloaded.

With versions before **Ver2.10**, if you select [No] to [Save?], the preceeding contents are not saved to the file but are retained as data.

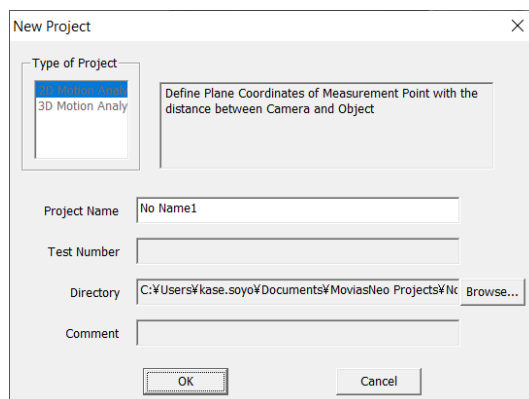


### 3.2.6 Save Project As

Assigns a name to save the project selected on the current project tree.

For a project with a setting of [Copy Image File] when a new project was created, the image file is also copied when saving under an assigned name.

Click [File] → [Save Project As] on the menu to display the save dialog. Assign a new project name and save. Do not use the characters ?\*<>\"/>



[New Analysis Project] dialog

#### Type of Project

Shows the type of project saved.

#### Project Name

Sets the project name.

#### Test Number

Shows the test number set in [Project Information] (p. エラー! ブックマークが定義されていません。).

#### Folder

Creates a folder to save projects. The default is the folder set in “Projects” in “Environment Settings” (p. 8-28).

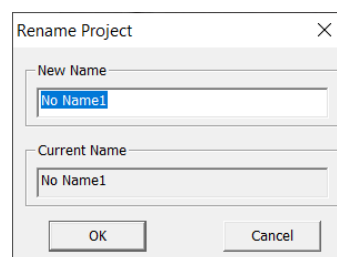
#### Comments

Shows comments for the project set in [Project Information] (p. エラー! ブックマークが定義されていません。).

### 3.2.7 Change a Project Name

Changes the name of the project selected in the current project tree. Perform any of the following.

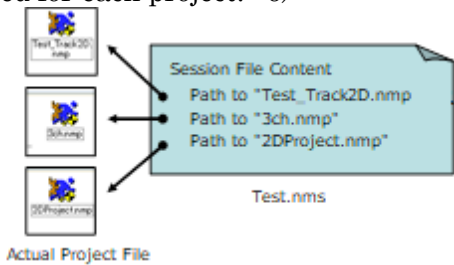
- ✓ Edit route nodes on the project tree.
- ✓ Select route nodes on the project tree and click [Rename Project] on the right click menu.
- ✓ Click [File] → [Change the Project Name] on the menu.



Do not use the characters ?\*<>\"/>

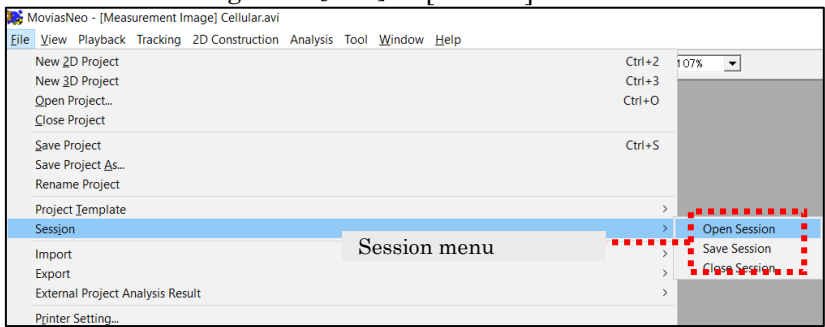
3.2.8 Sessions

You can save and load multiple open projects as a [Session]. Sessions are handled as files (.nms) and the full path is saved for each project. \*6)



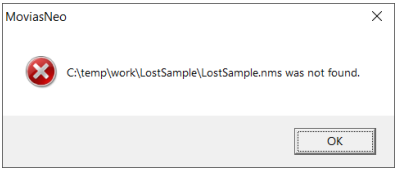
Overview of a Session File Content

Perform the following from [File] → [Session] in the menu.



**Open a Session**  
Open a full path project saved in a session file (.nms).  
At this point, all of the currently open projects are closed.

If a project file saved in the session file cannot be found when a session is opened, a warning appears and only the projects found are opened.



**Save a Session**  
Saves the full path of multiple projects currently open as a session file (.nms).

**Close a Session**  
Closes all of the projects currently open.

\*6) The session file saves only the full path to each project file currently open. You must separately save each project file.

### 3.2.9 Project Template

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Project templates save existing projects as project template files (.nmt) and function to create projects from template files.

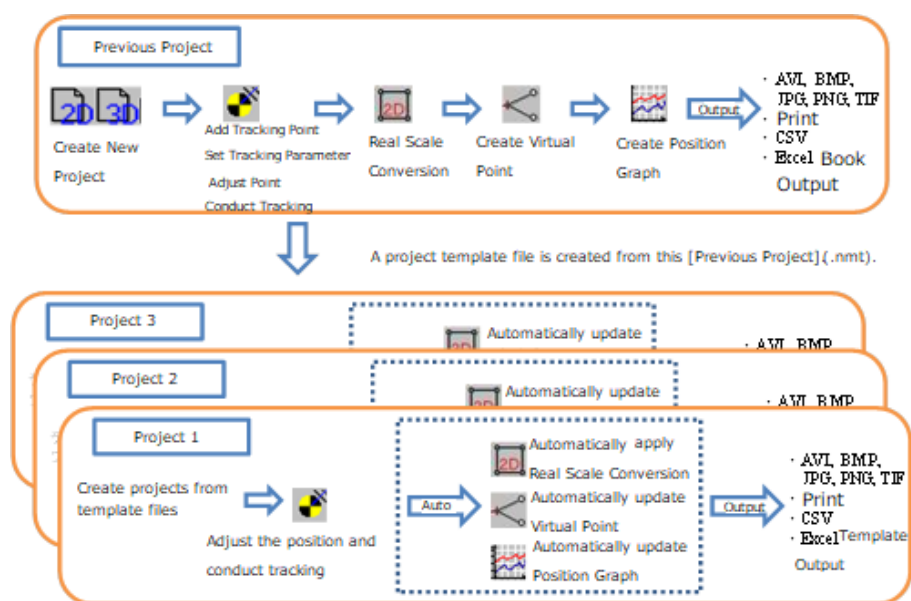
Projects are created from the template files using all of the parameters other than tracking results (tracking settings, calibration data and such).

Project template files (.nmt) are used in conjunction with the auto update function for control points, center of gravity points, analysis graphs, sticks, tracking figures, and the analysis procedure can be automated. This function is used to perform the same analysis on duplicates of different measurement images.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for automatic updates of visual points and center of gravity points and refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for automatic updates of graphs.

Next is an example that uses the project template function, creates a project template file from a [Previous Project] and creates multiple projects from the same project template.

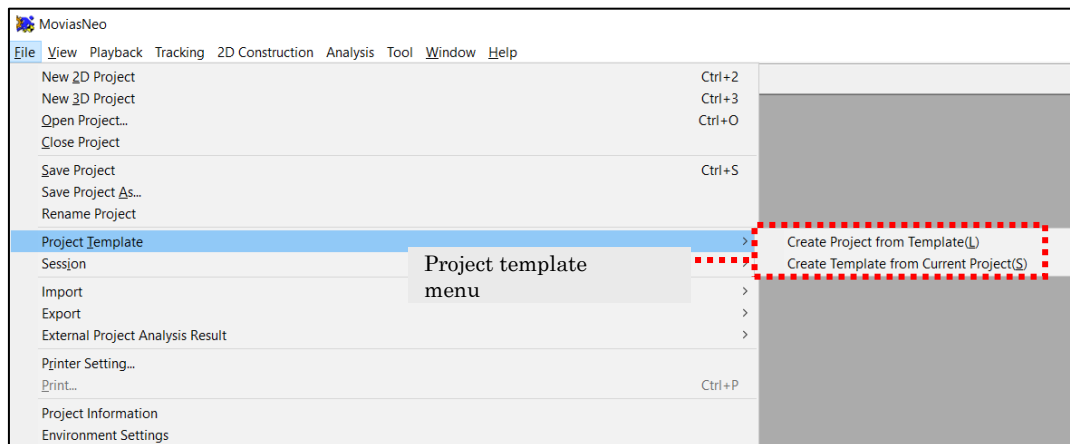
- ① A [Previous Project] creates tracking, real scale conversion, control points and analysis graphs from the new project created.
- ② A project template file is created from this [Previous Project].
- ③ Next, [Project 1] is newly created from the project template created in ②. Switch to the tracking mode to arrange the tracking points, adjust the position and conduct tracking. Once tracking is done, create the measurement data that recalculates the control points and analysis graph with the tracking data and performs auto updates.
- ④ In the same manner as in ③, [Project 2] and [Project 3] are created from the project template using different images, in order to create multiple projects.



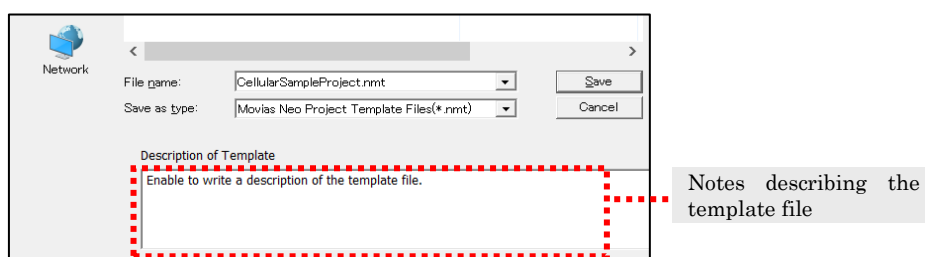
Example Using the Project Template

## ● Create a Template from a Current Project

Click [File] → [Project Template] → [Create a Template from a Current Project] on the menu to create a project template file (.nmt) from a currently selected project.



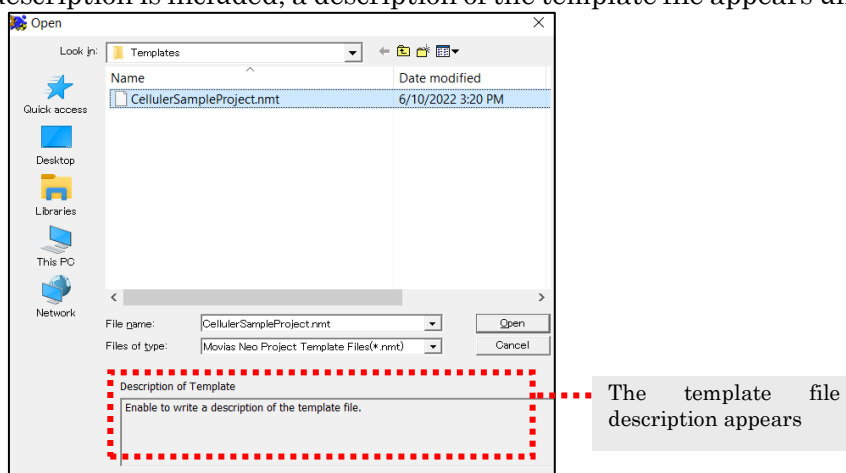
Since the file save dialog is shown, input the file name and save. At this point, a description of the template file is given.



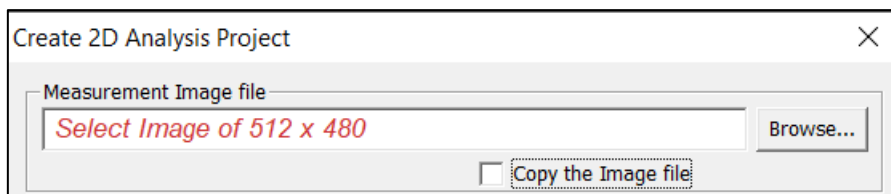
## ● Create a Project from a Template

Click [File] → [Project Template] → [Create a Project from a Template] on the menu to create a project from a project template file (.nmt)

Open the project template file (.nmt) from the open file dialog. While the file is saving, if the file description is included, a description of the template file appears under the dialog.



Open the project template file to show the create project dialog. Select the measurement image and create a project. Specifying an image with the same size as the project template file is required. For 3D analysis projects, the size of the measurement images and the size of the calibration images for all the cameras must match with the template files.

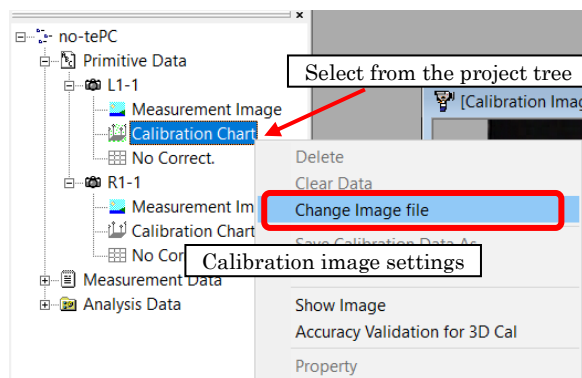


projects are created by applying all of the saved project parameters (tracking settings and calibration parameters) to the template.

If creating a 2D measurement project from 2D measurement project template files, the project template calibration settings are applied to the 2D calibration parameters.

If creating a 3D measurement project from a 3D measurement project template file, the project template calibration settings are applied to the 3D calibration parameters. If creating 3D measurements, there is no need for calibration image settings. Calibration image settings are required to verify or correct calibration settings for project templates.

For 3D projects created from project templates, the calibration image can be set from [Change Image File] on the right click menu of the project tree after creating the project.



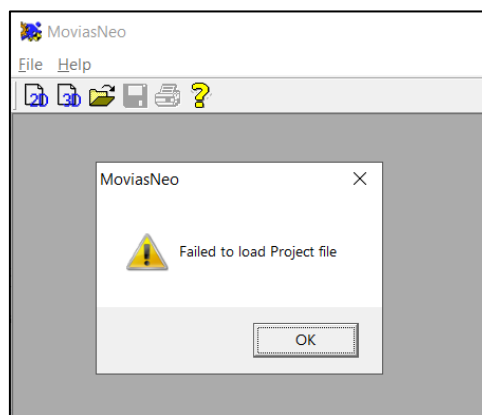
### 3.2.10 For Users of MOVIAS Neo Ver.1

---

MOVIAS Neo Ver2 is different from Ver1.

- **Project Files**

The project file format is different from Ver. 2.00. When saving projects created with MOVIAS Neo Ver.1, they are saved as Ver. 1. Projects created in Ver. 2 cannot be opened with MOVIAS Neo Ver.1.



**When Opening a Ver. 2 Project with MOVIAS Neo Ver.1**

When changing project files created with Ver.1, save confirmation message appears. If you select [Yes], it is saved as a MOVIAS Neo Ver.2 project file. If you select [No], the save will be cancelled.

If you must keep Ver.1 project files, make sure to use [Save As].

- **External Project Link Function**

MOVIAS Neo Ver.2 does not support the new linking function for external projects. Instead, use the open multiple projects function to compare analysis results. Ver.2 cannot perform links to external projects created in Ver.1.

Click [File] → [External Project Analysis Results] → [Delete] on the menu to delete the link with an external project.

### 3.3 Operating Modes


With MOVIAS Neo, playback, synchronized playback, tracking, calibration and measurement data creation is conducted in each of those modes.

The mode display bar for the operation main control bar is displayed for the current operation mode.



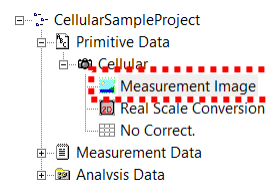
#### 3.3.1 Display Mode

The display mode is the mode to perform playback operations on the active window. Perform either of the following.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the main control bar.
- ✓ Click [Playback] → [Display Mode] on the menu.

Perform any of the following to open a new window.

- ✓ Click [Show Video] on the right click menu on the project tree mode.
- ✓ Double click on the project tree mode.



You must switch to the display mode to access エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。), Export as AVI (p. エラー! ブックマークが定義されていません。), [T0 Frame (Time Starting Point)] (p. 8-27), エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).



### 3.3.2 Synchronized Display Mode

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Synchronized display mode of the window currently displayed.

If frame jumping a window, all the windows displayed jump to the same frame.

Perform either of the following to access the sync display mode.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the main control bar.
- ✓ Click [Playback] → [Synchronized Display Mode] on the menu

The sync display mode is activated immediately after a new window is open.










If playing back in this mode, all the windows perform synchronized playback. The order of operations is identical to that for the display mode. You can adjust the loop playback and the playback range. The playback frame range is the maximum range for all the windows. The update time interval during synchronized display is the frame rate on the selected window.

The sync display mode will remain even when switching to an active window that cannot be a window to active from a window processing any mode. For example, if the graph window is made the active window during tracking, the graph window switches to the sync display mode

3.4 Playback Operations

3.4.1 Playback

Plays back in an active window.  
Playback using the エラー! 参照元が見つかりません。

		Jump to starting or ending frame
		Frame by frame forward, frame by frame rewind
		Play (Loop play)
		Reverse playback (reverse loop play)
		Stop



During playback, each window functions as follows.

Image Window	Plays images
Graph	Cursor moves along with the current frame.
List	Selection moves along with the current frame.
Stick	Displays the current frame stick data.



3.4.2 Loop Playback

Performs loop playback within the playback range. Click [Play] once during playback for loop playback. The playback range is repeatedly played during loop playback. Click [Stop] or switch to another mode to end the loop playback.


Loop Play

<p>Access playback to enable only playback in the current direction and stop. Press [play] again for loop playback. When there is a short range for a loop, it is easiest to temporarily set a longer range for loop playback and then set it to a shorter range for playback. (Forward loop playback cannot be made at the final frame. Likewise reverse loop playback cannot be made at the first frame.)</p>	<div> (while playing)</div> <div> (during loop playback)</div>
---	--

### 3.4.3 Index Frame Setting

Registers the designated frame as the index frame.  
Click   on the エラー! 参照元が見つかりません。 of the エラー! 参照元が見つかりません。 to set.



**Register and Cancel Index Frame**  
Registers the current frame as the index frame. If cancelling the index frame, move to the target index frame and click  again.  
Index frames for all the images displayed in the synchronized display mode are registered or cancelled.





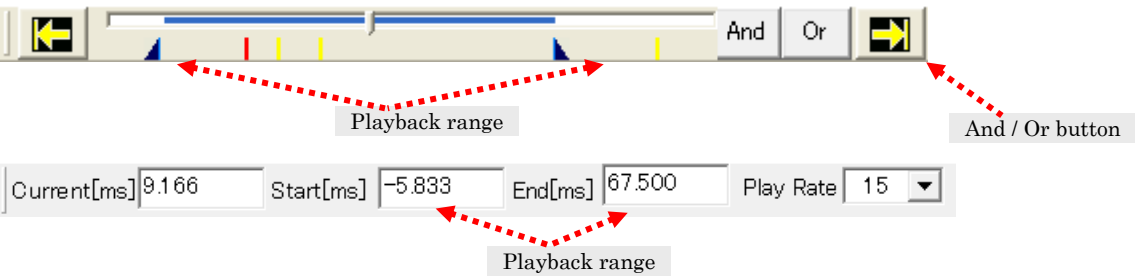
**Jump Index**  
Jump to the next index frame.

### 3.4.4 Playback, Tracking Range Settings



Conducts playback and tracking processing for the playback range.  
After creating a project, the playback range is set for the entire range of video data.

Drag the playback range with the playback slider on the playback bar or input a number into the playback setting control bar on the playback bar to set the playback range.

Or, set the current frame as the [Start Frame] with , or set the current frame as the playback end frame with .



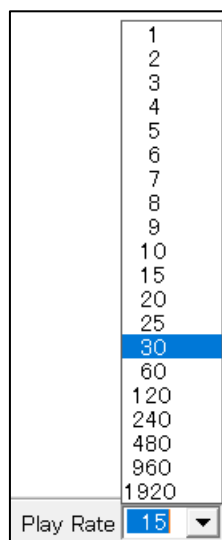
With synchronized playback, you can set the synchronized playback range from the playback range for all windows shown.

- |   |              |  |
|---|--------------|--|
|  | [And] button | Sets the overlapping range for the playback range on all the display windows as the synchronized playback range.   |
|  | [Or] button  | Sets the range including all the playback range for all of the display windows as the synchronized playback range. |

### 3.4.5 Frame Rate

The frame rate is set from the playback control bar on the playback bar.

The following values can be set for the frame rate. The frame rate can be input directly.



## 3.5 Correct the Image Displayed

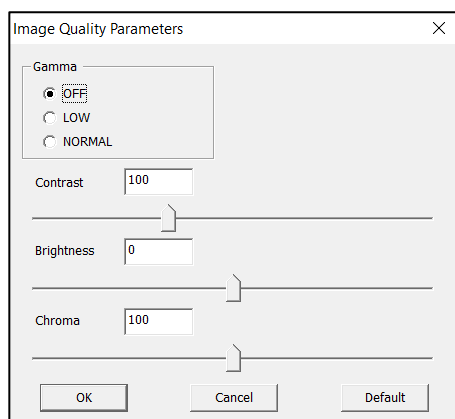
Adjusts the image quality in the active window.

Switch to the display mode and click [Playback] → [Image Quality] in the menu to show the image quality adjustment setting dialog.

This adjustment only applies to the image shown. It is not reflected in the tracking mode. If conducting image quality adjustment for tracking, refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).

#### Gamma Correction

Select from OFF, LOW, NORMAL



#### Contrast Adjustment

Set in a range of 0~300.

(Default value: 100)

#### Brightness Adjustment

Set in a range of -200~200.

(Default value: 0)

#### Chroma Adjustment

Set in a range of 0~200.

(Default value: 100)

#### Default Button







Restores all the settings to the default values.

### 3.6 Zoom In or Zoom Out the Image Displayed

Zoom the displayed image with the zoom control bar on the main control bar.

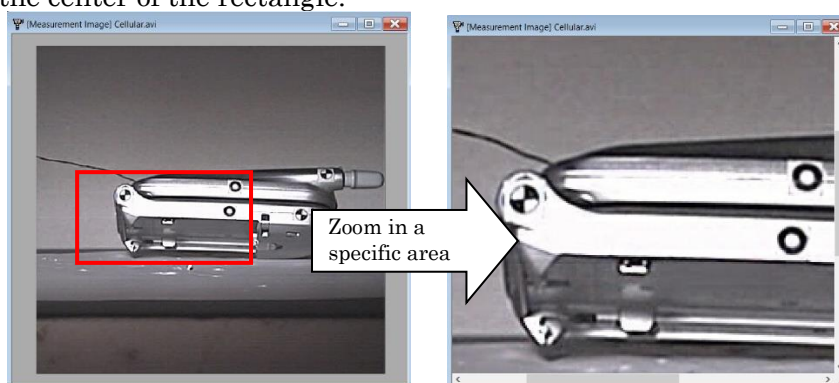


**Zoom Control Bar**

-  Switch to enable and disable zoom. Use when zooming into a specific area.
-  Extended display.
-  Zoom rates are as follows. Minimum 25% ⇔ 33% ⇔ 50% ⇔ 100% ⇔ and then in increments of 100% to a maximum of 1600%
-  Shrunk display.
-  Display the image at the original size.
-  Display the image fit to the size of the window.

#### 3.6.1 Zoom In to a Specific Area

The cursor changes into a magnifying glass on the image when the zoom tool is enabled. At this point, left click the image to zoom in, centered around the location clicked. Also, drag on the image and a rectangle with a red border will appear. Stop dragging to zoom in at the center of the rectangle.



### 3.6.2 Zoom In or Zoom Out Using the Mouse Wheel

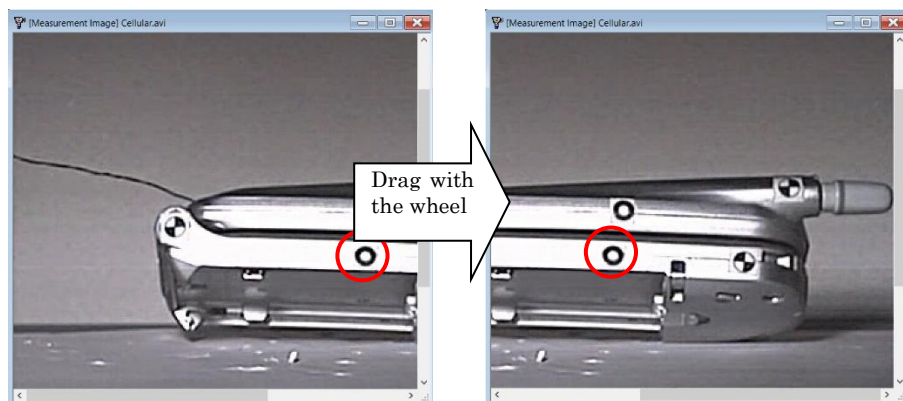
---

Zoom in on an image by turning the wheel towards the back and zoom out by turning to the front. Zooms without changing the position of the cursor.

### 3.6.3 Scroll Across the Image

---

Press and drag the wheel on the image to scroll across the image.




## 4. Tracking

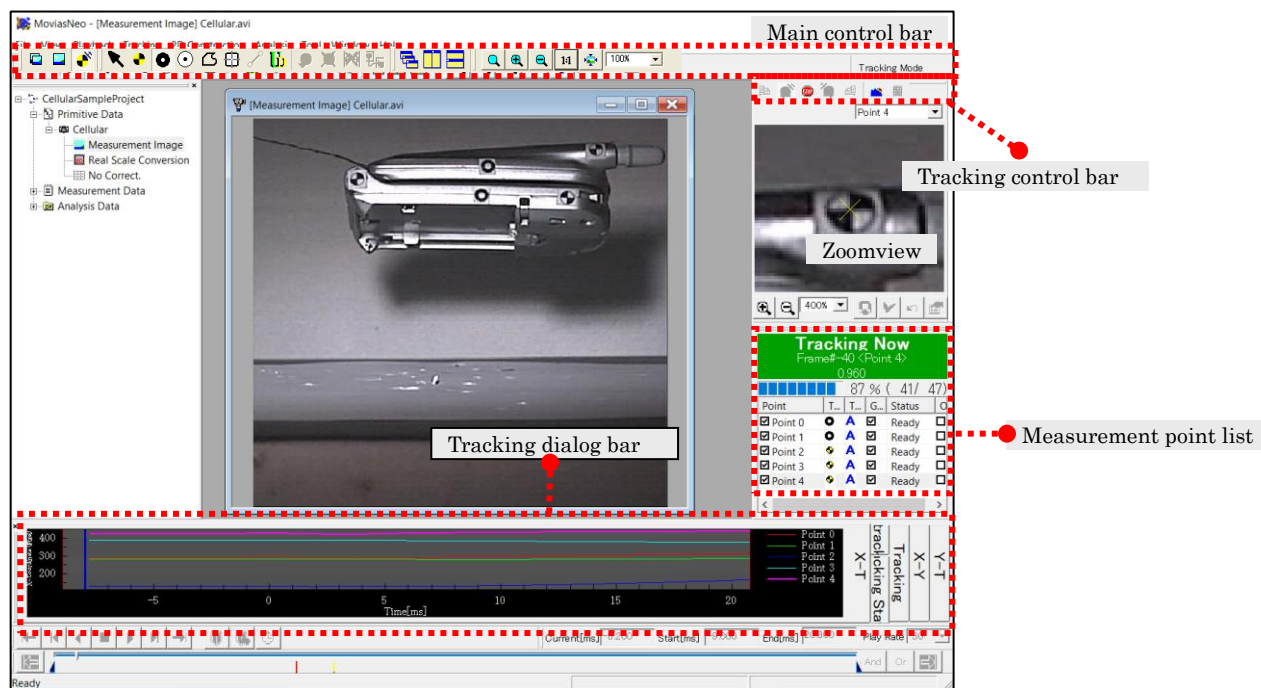
### 4.1 Tracking Mode

The tracking mode is the mode to perform interpolation or tracking of the display settings, tracking settings and functions for the measurement points.

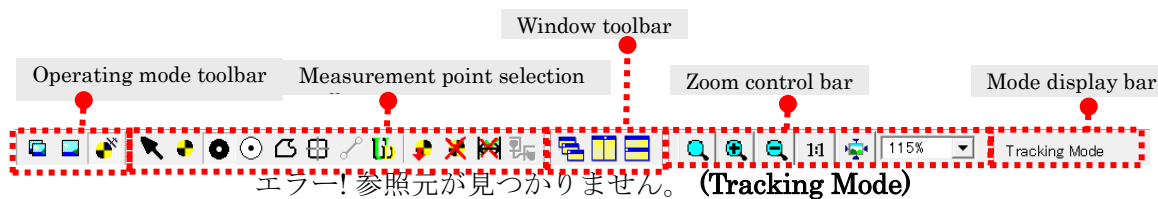
To switch to the tracking mode, access the measurement image window and perform any of the following.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Playback] ⇒ [Tracking Mode] on the menu.
- ✓ Click [Change to Tracking Mode] on the right click menu in the measurement image window.

Switch to the tracking mode to display the measurement point list and the tracking dialog bar.



Overview of the Tracking Mode



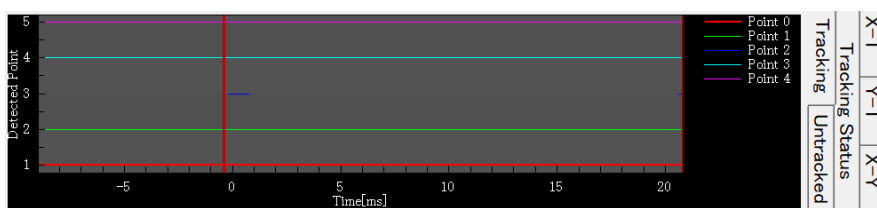
### 4.1.1 Tracking Dialog Bar

Shows the tracking results and tracking status. Shown only in the tracking mode.  
The tracking dialog bar displays the following.

- ✓ X - T graphs, Y - T graphs, X - Y graphs
- ✓ Tracked, untracked frames
- ✓ Tracking status (regardless of interpolation).

#### ● X - T, Y - T, X - Y

Shows the tracked coordinate values. Displays the X coordinates and time or frame graph, Y coordinates and time or frame graph, X and Y coordinate graph.

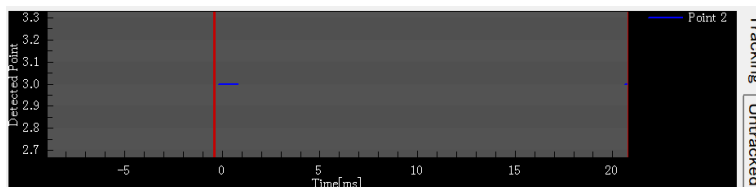


#### ● Tracked or Not Tracked

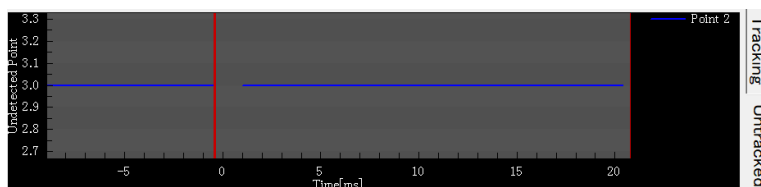
This is a graph with Point ID on the vertical axis and time or frame on the horizontal axis. Determines whether tracking is based on the presence of plots. If the location confirmation is successful, a tracked graph is shown.

If location verification is not performed (such as when tracking fails, or measurement points are deleted) an untracked graph is shown.

Point ID can be verified in エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).



Example of the tracking shown for Point 0 (ID #: 1). Tracked frames are plotted.



Example of the untracked section shown for Point 0 (ID #: 1). Untracked frames are plotted.

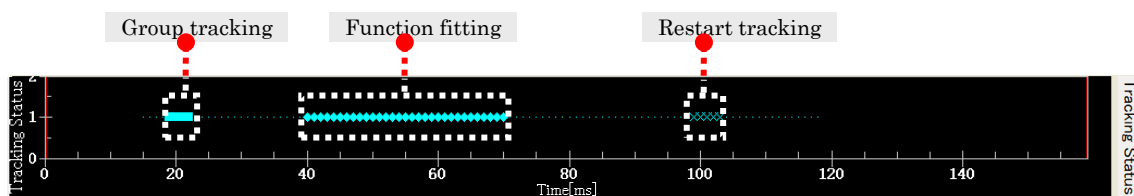


- **Tracking Status**

Graph with Point ID on the vertical axis and time/frame on the horizontal axis.

Shows the status of interpolation conducted during tracking.

“.” is shown if tracking was successful and “X” is shown when tracking is restarted (hidden point tracking). “■” is shown during group tracking and “◆” is shown with function fitting.



Example of Tracking Status shown for Point 0 (ID #: 1)

- **Mouse Right Click Menu on the Tracking Dialog Bar**

**Select Measurement Point**

Measurement point selection mode. Select a graph point to jump to that frame.

**Zoom**

Zoom mode. Zooms the designated range by dragging.

**Cancel Zoom**

Cancels the zoom and shows the data for the entire range.

**Interpolation**

Shows the interpolation dialog. (p. エラー! ブックマークが定義されていません。)

**Fix Display Range**

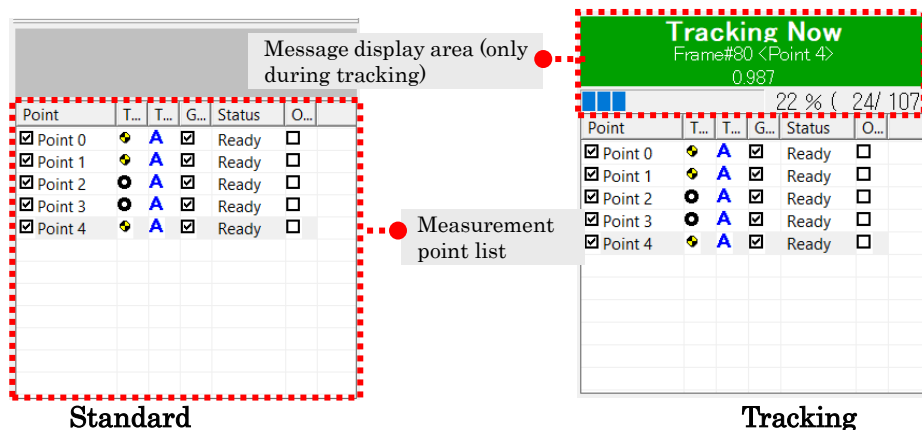
Setting to change the display range or fix the image size for the X-T or Y-T or X-Y graphs.

**Tracking Status Display**

Displays the interpolated frames. Select the status shown under the [Tracking Status] tab.

### 4.1.2 Measurement Point List and Tracking Control Toolbar





The tracking status for measurement points currently zoomed is shown on the measurement point list. It is also shown in the message display area during auto tracking.






- **Points**

Shows the names of the measurement points. Points checked in the boxes to the right of the point name are subject to tracking or interpolation with the fitting function.

- **Type**

Displays the type of target marker. Select from quadrant , white dot , black dot , and feature point .


- **Tracking Method**

Select from auto  or semi-automatic  or manual . Frame by frame is automatic in any method.

**Auto** Automatic tracking of measurement points and verification of location. Processing is suspended if detection of measurement points fails. After manually verifying the positions, restart auto tracking.

**Semi-automatic** Automatic tracking of measurement points and manual verification of location.

**Manual** Manual tracking of measurement points and verification of location.





Click  or press the space bar in the zoom view to check the measurement point location.

- **Graphs**

Check points to display on the tracking dialog bar.

## ● Status

Displays the status of the measurement points in the current frame. The statuses are as follows.

- ✓ **Ready**  
Coordinate values for measurement points have been made. This is also the status when auto tracking is successful.
- ✓ **Correlation Value Dropped**  
During tracking, the correlation coefficient dropped below the threshold value so tracking failed.
- ✓ **Failed to Detect Center**  
Failure to detect the center of the marker.
- ✓ **Not Set**  
Tracking not performed.
- ✓ **Disappeared**  
Tracking failure.
- ✓ **Awaiting Verification of Point Position**  
Auto detection  performed. Awaiting the verification button  to be clicked.
- ✓ **Awaiting Point Position Specification**  
Manually correcting the location. Awaiting the verification button  to be clicked.
- ✓ **Awaiting Camera Response (Only for 3D Analysis)**  
The measurement point positions are set for other cameras but not for this camera.  
Link the cameras  and add the measurement points to this camera.






## ● Overwrite Tracking of Measurement Points

Track while overwriting the previous tracking results.

Check the box for auto tracking to correct auto tracking in all the tracking ranges. Make sure to perform auto tracking on tracking points subject to overwrite tracking each time that auto tracking is performed. Once tracking is finished, remove the check for [Overwrite Tracking].

To fine tune the range for retracking, use [Delete Tracking Results in the Specified Range] (p. エラー! ブックマークが定義されていません。 ) to delete the results of the specified range and then conduct auto tracking.

To enable overwriting tracking after adding new measurement points, set [Enable Overwrite Tracking when Adding New Measurement Points] (p. エラー! ブックマークが定義されていません。 ) in the エラー! 参照元が見つかりません。 [Tracking] tab.

Overwrite settings						
Point	T...	T...	G...	Status	Overwrite Tracking	
<input checked="" type="checkbox"/> Point 0		A	<input checked="" type="checkbox"/>	Ready	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Point 1		A	<input checked="" type="checkbox"/>	Ready	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Point 2		A	<input checked="" type="checkbox"/>	Ready	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Point 3		A	<input checked="" type="checkbox"/>	Ready	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Point 4		A	<input checked="" type="checkbox"/>	Ready	<input type="checkbox"/>	<input type="checkbox"/>

### 4.1.3 Zoom View

Fine tune and set the measurement point location with the zoom view.



Zoom in and zoom out.  
Magnifications of “100%”, “200%”,  
“400%”, “800%”, “1600%”.



Automatic detection of  
measurement points.



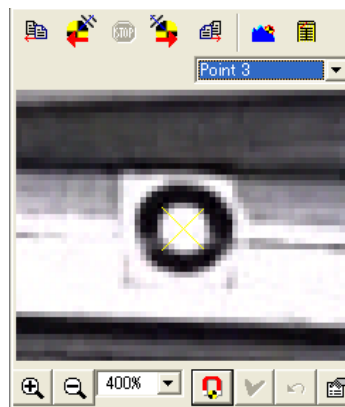
Verification of measurement point  
location.  
(use the space bar)



Back.

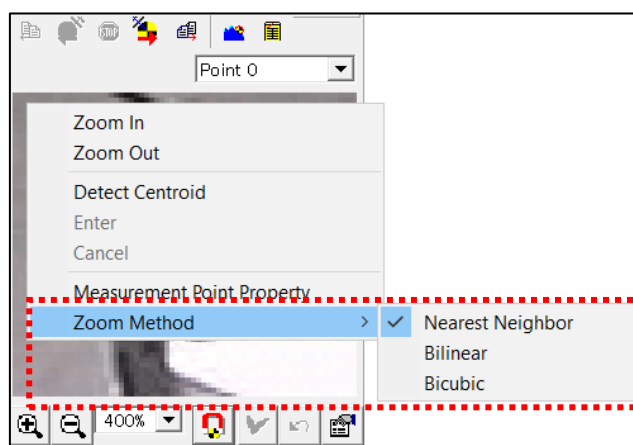


Display the [Measurement Point  
Properties] dialog (Refer to p. エラー! ブックマークが定義されていま  
せん。)



- **Set the Zoom Method**

Select [Set the Zoom Method] on the right click menu, and then select “Nearest Neighbor”, “Bilinear” or “Bicubic” to set the zoom method in the zoom view.



**Set the Zoom Method**

## 4.1.4 Tracking Control Bar

Shows at the top of the zoom view when in the tracking mode.  
Tracks and implements the stop and tracking settings.



Tracks the current frame and then switches to the next frame.



Tracks the current frame and then moves to the previous frame.



Starts auto tracking in the forward direction.



Starts auto tracking in the reverse direction.



Stops auto tracking.

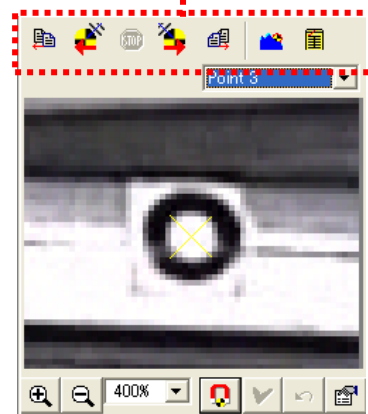


Performs interpolation for the fit function.  
(Refer to p. エラー! ブックマークが定義されていません。)



Shows the tracking properties. (Refer to p. エラー! ブックマークが定義されていません。)

Tracking Control Bar  
(only while tracking)



## 4.2 Measurement Points

### 4.2.1 Target Markers

The four types of target markers that MOVIAS Neo uses for auto tracking include quadrant markers, white dot markers, black dot markers and feature point markers. Fixed points can also be set.

- **Quadrant Markers**

Quadrant markers are circular or square target markers that are divided into four sections, as shown in the examples to the right.

MOVIAS Neo first searches for markers or their locations in correlating images. Next, it uses the feature where the marker is divided into four sections to detect the center of the marker in sub-pixel units.

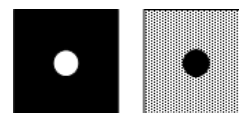


When conducting quadrant tracking, the quadrant angles are calculated while tracking. Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for the method to verify the angles calculated.

Also, use the calculated angles with the drawing function to apply to any analysis that includes rotation. For details, refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).

- **White Dot Markers, Black Dot Markers**

White dot markers have a white dot in the middle of a black background while black dot markers have a black dot in the middle of a gray background, as shown to the right. MOVIAS Neo first searches for markers or their locations in correlating images. Next, the center of gravity for the object containing the point with the greatest correlation is determined in sub-pixel units. Select either the area center of gravity method or the weighted brightness area center of gravity method to detect the center of gravity.



- **Feature Point Markers**

Unlike the quadrant markers or the white dot or black dot markers, these markers have no defined shape. MOVIAS Neo searches for correlating images and tracks the area with the greatest correlation (the area that best resembles the image).

- **Fixed Points**

Unlike the above-mentioned measurement points, these points are not tracked. They are measurement points with the same coordinates for all the frames.


- **User Defined Points**

Measurement points where the coordinates are calculated from the previous measurement point. Measurement points already tracked are required to add user defined points.

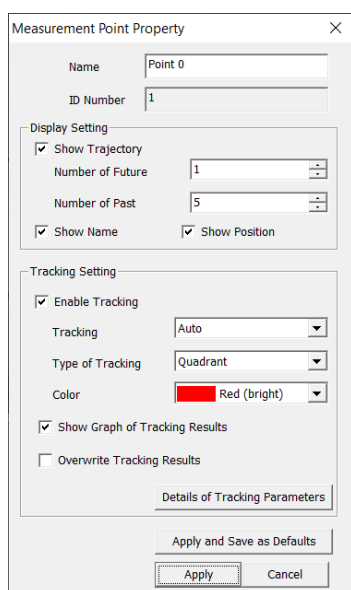
## 4.2.2 Measurement Point Properties Settings

Sets the properties for the selected measurement points. Performs settings for name changes and display and the tracking method.

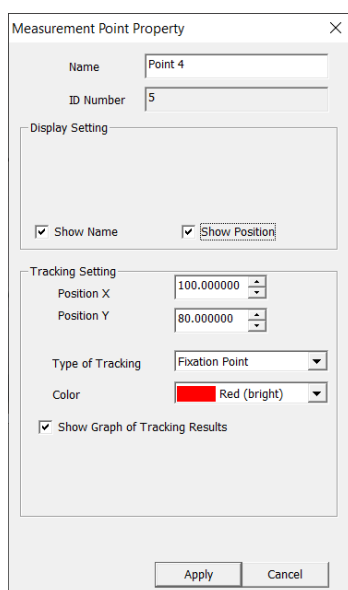
Use any of the following operations to set the measurement point properties.

- ✓ Click  in the zoom view.
- ✓ Click [Measurement Point Properties] on the right click menu in the zoom view.
- ✓ Click [Tracking] ⇒ [Measurement Point Properties] on the menu.

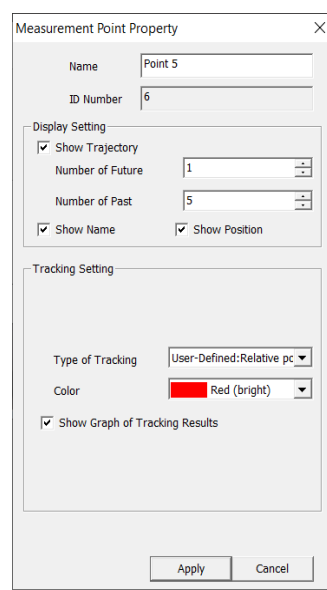
Depending on the type of measurement point, the following measurement point properties dialog will appear.



**Quadrant, White Dot, Black Dot, Feature Point**



**Fixed Points**



**User Defined Points**

- **Name**

- Name and ID Number**

- Shows the name and ID number of the measurement points.

- **Display Settings**

- Show Trajectory**

- Check to show the trajectory on the image.

- Number of Previous Frames and Number of Subsequent Frames**

- Sets the length of the trajectory shown on the image.

- Show the Name of the Tracking Points**

- Check to show the name of the tracking points on the image.

- Show the Location of the Tracking Points**

- Check to show the location of the tracking points on the image.






- **Tracking Settings**

**Perform Tracking**

Check to perform tracking.

**Tracking Mode**

Specifies the tracking method. Select from auto  or semi-automatic  or manual . (Refer to p. 4–4)

**Type of Tracking Point**

Specifies the type of target marker for the measurement point.

**Tracking Point Color**

Selects the color shown for the measurement point tracked.

**Show Graph of the Tracking Results**

Check to display the graph of the tracking results on the tracking dialog bar.

**Overwrite Tracking Results**

Check to enable エラー! 参照元が見つかりません。 (refer to p. エラー! ブックマークが定義されていません。).

**Detailed Settings for the Tracking Parameters**

Shows the [Adjust the Tracking Point Parameters] dialog (refer to p. 4–11).

**X Coordinates, Y Coordinates (only with Fixed Points)**

Sets the coordinates.

- **Apply and Save As Defaults**

Used to save the tracking settings as the initial values for subsequent measurement points. The tracking settings are saved in the application, so they are used as the initial values even when MOVIAS Neo is restarted. Use [Load Factory Parameters] in Environmental Settings to disable the saved values.

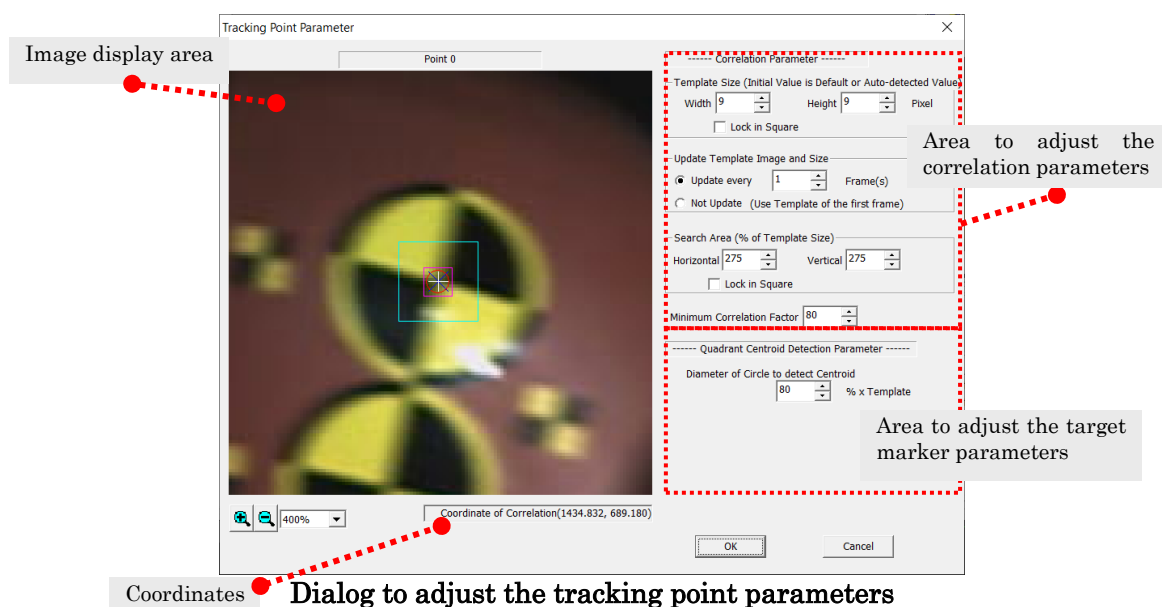
Refer to the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) in エラー! 参照元が見つかりません。 for details.

### 4.2.3 Detailed Settings for Tracking Parameters

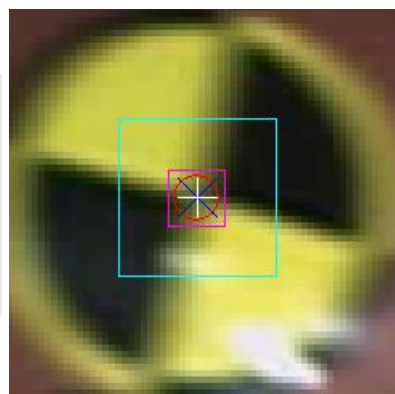
Several parameters must be properly set for auto tracking target markers with MOVIAS Neo.

These parameters are called [tracking parameters].

Tracking parameter settings are set in the [Adjust the Tracking Point Parameters] dialog. Click [Details of Tracking Parameters](#) in the [Measurement Point Properties] dialog (p. エラー! ブックマークが定義されていません。 ) to open [Adjust the Tracking Point Parameters].



- Blue border : Search area
- Pink border : Template size
- Blue × : Location currently set
- White + : Location detected with current setting
- Red circle : Center point detected (quadrant only)
- (Not shown when white + not detected)



## ● Correlation Parameters

The four correlation parameters include “Template Size”, “Update Template”, “Search Area” and “Correlation Coefficient Lower Limit”.

### Template Size

Templates refer to the original image used as the correlation standard. The size of the template is set in pixels.

MOVIAS Neo searches images for the image with the highest correlation to this template. The size of the template impacts the tracking rate.

### Update Template

Sets the template to refresh at each frame.

There is no need to change from the default settings (update at each frame) for the quadrant marker, white dot marker or black dot marker. With feature point markers, the center point detection accuracy decreases as the template is updated so in principle, try not to refresh. However, if the target rotates or is odd shaped, the template must be updated so update as infrequently as possible.

### Search Area

The search area is the area searched for sections with high correlation. In the search area, the template image is moved bit by bit to detect sections with high correlation.

The size of the search area is set in %, using the template as the standard.

If the target has a high motion velocity, expand the search area.

If there are other targets of the same time in the vicinity of the target, make the search area smaller to avoid errors in identification.

The size of the search area impacts the tracking rate.

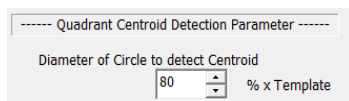
### Correlation Coefficient Lower Limit

The correlation coefficient is the level of correlation, expressed as an integer from 0 to 100.

If the correlation coefficient is 100, the two images match completely, and the level of correlation decreases and the number decreases.

During auto tracking, if the correlation coefficient drops below the lower limit, tracking stops.

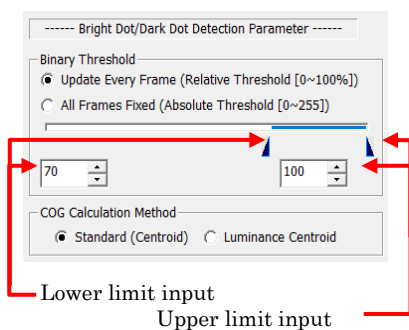
## ● Quadrant Marker Parameters



### Diameter of the Center Point Detection Circle

This is a parameter stipulating the diameter of the circle to detect the center point of the quadrant marker. Set as a % of the template size. The center point detection circle is shown as a red circle on the image. The detection circle must be within the marker.

## ● White Dot/Black Dot Marker Parameters



### Binary Threshold

Set the brightness range for identification as white dot/black dot. The binary threshold value settings cannot be changed from MOVIAS Neo Ver2.20.

To track in the same manner as with Ver2.10, use “255” or “100%” as the upper limit for white dots and adjust the lower limit. For black dots, use “0” as the lower limit and adjust the upper limit.

### Update Every Frame (Correlation from the max/min brightness)

Set the threshold value [0-100%] for the brightness within the current template.

Upper threshold  $\leftarrow \frac{(\text{Max brightness within the template})}{(\text{Min brightness within the template})} \times \text{Upper limit input [0-100\%]}$

Lower threshold  $\leftarrow \frac{(\text{Max brightness within the template})}{(\text{Min brightness within the template})} \times \text{Lower limit input [0-100\%]}$

to identify the white dot/black dot from the range. The threshold value changes every frame. The image is enabled so the brightness gradually changes.

### All Frames Fixed

Sets the threshold values as a brightness value [0-255].

Upper threshold  $\leftarrow \text{Upper limit input}$

Lower threshold  $\leftarrow \text{Lower limit input}$

to identify the white dot/black dot from the range.

### COG (Center of Gravity) Calculation Method

Specify the method of determining the center of gravity in the area extracted, using the threshold value as the standard.

The center of gravity is calculated for the detection point when using area center of gravity.

The center of gravity is calculated according to the brightness of each point when using the brightness center of gravity.

## ● Feature Point Marker Parameters

Specify Position for Coordinate Detection

Horizontal  Vertical

(Fix the specified position and shift the Template)

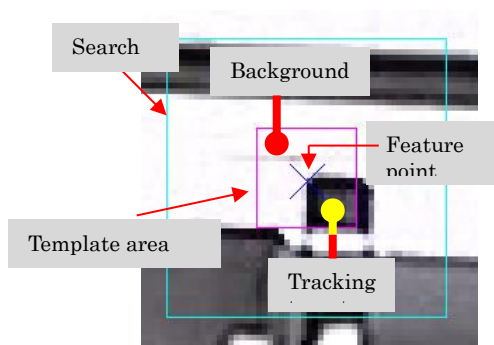
Line-Edge Tracking

☒ Use Tracking Angle  deg.[0~360]

### Specify Position for Coordinate Detection

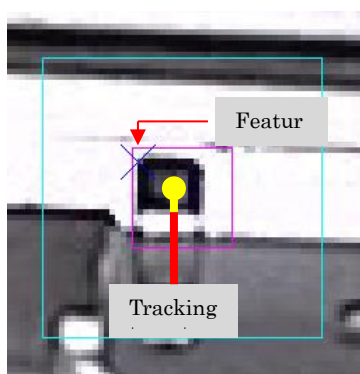
Designates the location of the template for the feature points (points clicked).

For example, enable when tracking sections with sharp angles.

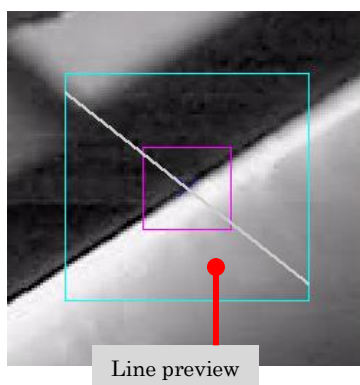


Here is an example of a tracking target in the square black area of the figure to the left.

Click on the upper left corner of the tracking target to add the feature point. After adding the feature point, the template becomes a square centered around the feature point and the detection coordinate location becomes H: 0, V: 0.



To improve the tracking accuracy, move the template to the area where the feature is the tracking target.



### Line Edge Tracking

Designate the tracking direction as well as the square search area.

To specify the direction, check [Use Tracking Angles] and specify the angle (0~360°). If the angle is specified, a line appears on the image at the set angle (preview). After setting, tracking occurs in the direction specified.

## 4.2.4 Operation of User Defined Points

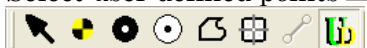
User defined points are measurement points that are detected from the coordinates of existing measurement points. Add on the image window and perform the detailed settings in the [User-defined Points] dialog.

User defined points can be used in [Superimpose], [Show Graph], [Show List], [2D Calibration], [Origin Point, Axis, Reference Points] and [Reference Points for Image Alignment] in the same manner as other measurement points.

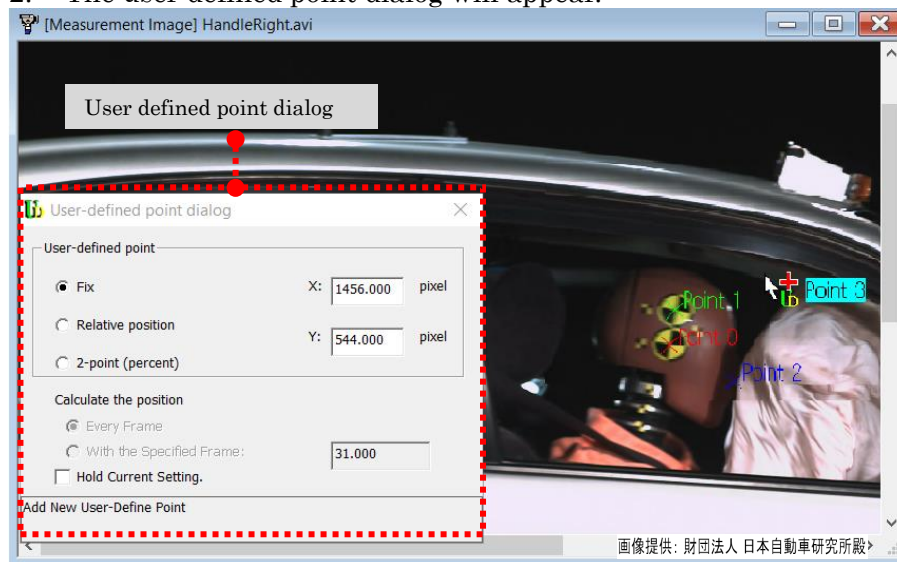
### ● Example of the Operation of User Defined Points

The basic operation of user defined points is as follows.

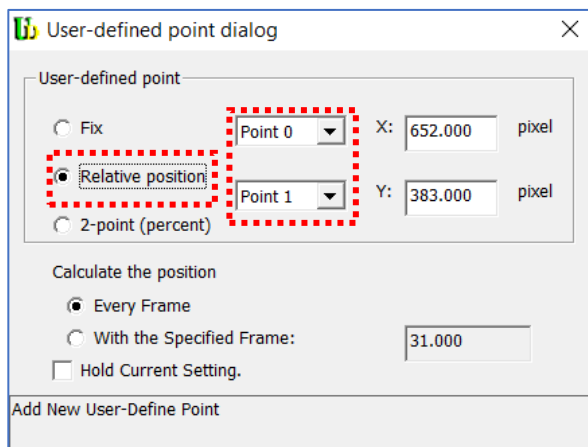
1. Select user defined points  from the measurement point toolbar



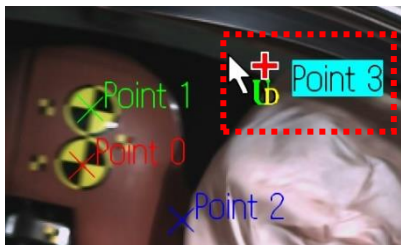
2. The user defined point dialog will appear.



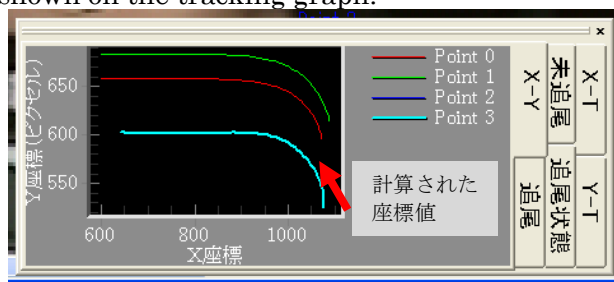
3. Select the type of user defined points and set the parameters.  
In the following diagram, select [Relative Position] and select [Point 0] and [Point 1] in [Reference Points].



- Click the measurement location to add user defined points.  
After adding, the coordinates of the user defined points are automatically calculated, and the trajectory is shown on the tracking graph.



Add user defined points

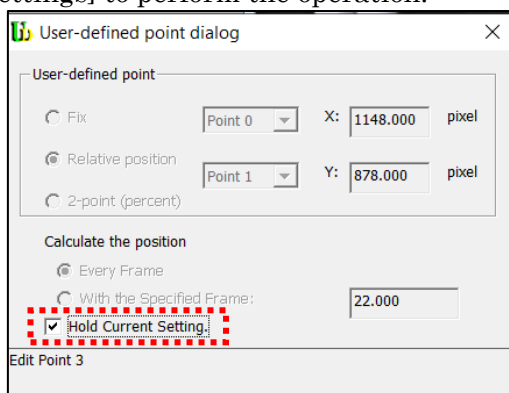


Tracking graph after adding user defined points

- After adding, detailed settings can be made in zoom view or in the dialog.  
Refer to [エラー! 参照元が見つかりません。] (p. エラー! ブックマークが定義されていません。 ) for detailed settings for user defined points.



If you close the user defined points or select another type of measurement point, the user defined point operation ends, and the settings are locked. To correct the completed user defined point settings again, click on the defined point corresponding to the measurement point list and the user defined point dialog will reappear. Delete the check on [Keep the Current Settings] to perform the operation.





## ● Types of User Defined Points

Three types of user defined points can be used. Use according to the location relationship of the target measurement.

### **Fixed**

User defined points that have the same coordinates for all frames. Measurement points that are identical to fixed points.

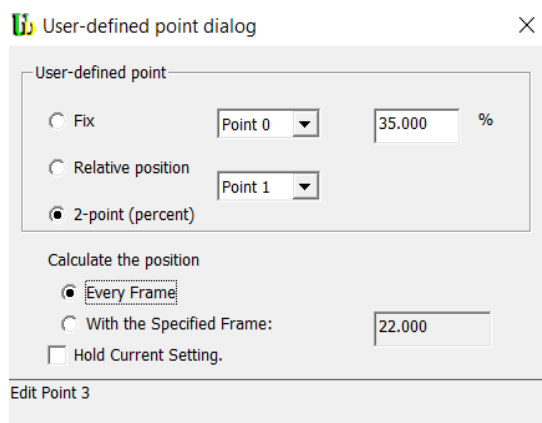
### **Relative Location**

User defined points with coordinates that retain their shape from two designated measurement points. The geometrically relative location is calculated for the point clicked on the image to the two reference points to make the user defined points. This can be used, for example, when measurement points are hidden during tracking or when performing measurements in locations where the markers are difficult to find.

### **2 Point (Ratio)**

User defined points with coordinates of a specific ratio on lines connecting two designated points. Use this for measurement targets that you know exist on a line. For example, if you wish to set measurement points at the center of a disk and you cannot set the measurement points due to the axis, set markers at two symmetrical locations surrounding this axis and if you set the ratio [50%] for this user defined point, the center of the two markers, specifically, the center of the axis, can be calculated.

## ● Detailed Settings for User Defined Points



User Defined Point Dialog

### **User Defined Points**

Select • set the type of user defined points.

#### **Fixed**

The same as for fixed points.

#### **Relative Location**

Calculates the relative location from two measurement points.

#### **2 Points (Ratio)**

Calculates the ratio of the distance between two measurement points. In the figure to the left, if the ratio is 0, it is Point0 and if the ratio is 100, it is Point1.

### **Calculates the Coordinate Location for Each Frame**

Calculates the coordinates for user defined points for each frame.

### **Applying the Coordinate Location for the Current Frame**

The coordinates for the user defined points for the time shown are applied to all times.

### **Keep the Current Settings**

Locks the set parameters so they cannot be changed. Automatically locks when the dialog is closed.



## 4.2.5 Hints for Tracking Parameter Settings

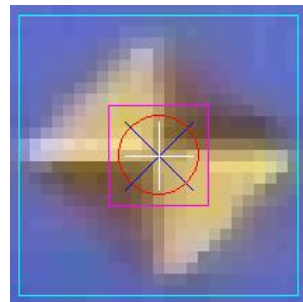
---

### ● Quadrant Markers

The size of the red circle shown with quadrant markers (called the “center point detection circle”) depends on the image quality so set the quadrant markers at about the level of that in the figure at right.

The larger the circle, the better the accuracy but if the marker disappears, auto tracking is not possible. Also, the accuracy may suffer if the shape changes.

The smaller the circle, the worse the accuracy but if the marker disappears or changes shape, auto tracking can still be done.

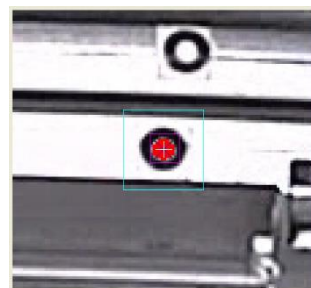


### ● White Dot or Black Dot Markers

Set the size of the template relative to the white dot/black dot at about the level of that in the figure at right.

The template must be large enough, so the white dot or black dot does not meet the outside edge of the template.

Adjust the binary threshold value and extract the white dot or black dot from the background.



When tracking white dots, the white dots may be included in bright areas due to reflections from shiny surfaces and may result in white dot tracking failure.

In this case, adjust the upper limit of the threshold value for white dots so the white dots are not impacted by the bright areas and the desired white dots can be tracked.

The center of gravity calculation methods for white dot or black dot includes the “area center of gravity” and the “brightness center of gravity”.

Generally, if the shades of the tracking target are clearly defined, use “area center of gravity”.

If the brightness values along the edges of the tracking target do not clearly change, you may be able to enable “brightness center of gravity”.

A trick when using “brightness center of gravity” is to make the range for the threshold value broader than with “area center of gravity”. If the range of the threshold value is broader, it is easier to calculate areas where the brightness changes.

### ● Feature Point Markers

Adjust the template size containing the feature points in the template.

With targets that rotate significantly or change shape, the template must be updated. However, since the tracking accuracy drops when the template is updated, adjust the parameters to update as infrequently as possible. With a slight rotation or change in shape, the correlation coefficient drops but not having to update the template has a positive effect.

If tracking small objects moving on a background, set so most of the background is not in the template

Use the detection coordinate designations to track sections with sharp angles.

Also, if tracking as shown in the figure below, the positions of the measurement points shift during normal tracking. If this occurs, use line edge tracking (p. エラー! ブックマークが定義されていません。 ) to track in a particular direction.



### ● User Defined Points

Use user defined points to calculate points that are difficult to track automatically or points with markers that cannot be inserted.

Examples of situations where auto detection is difficult or where markers are obscure include when the markers are hidden while tracking or when measuring a point in the center of a disk to track locations that are floating in space.

The user defined calculations use geometric shapes so make sure to have reference points for the user defined points in locations with crisply defined shapes. User defined points cannot be used with soft objects such as cloth.

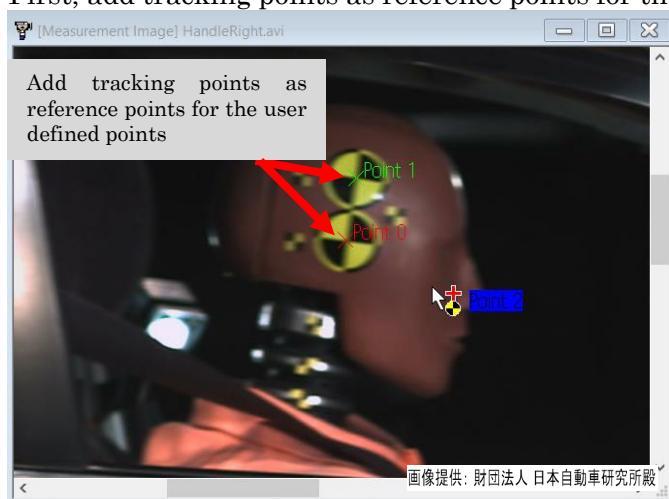
## (a) Example of the Operation with User Defined Points 1 Marker is Hidden

Here is an example of user defined points where a marker is hidden.

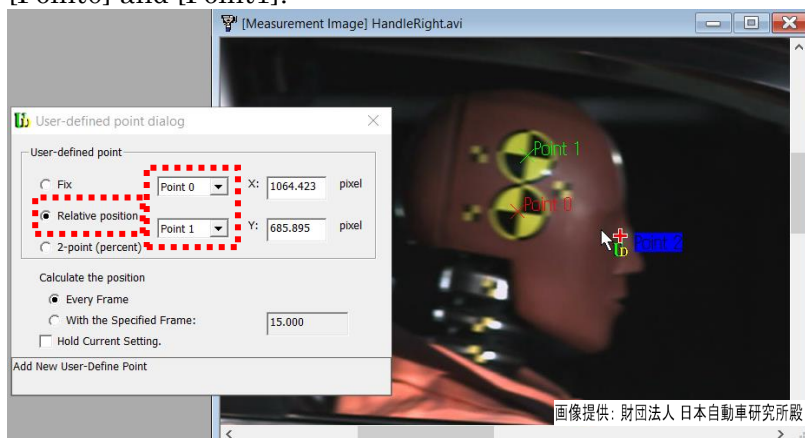
The head of a dummy is measured in the image below. However, in one frame, since the head is hidden, measurements using markers are not possible. Thus, user defined points are used to calculate the coordinates.



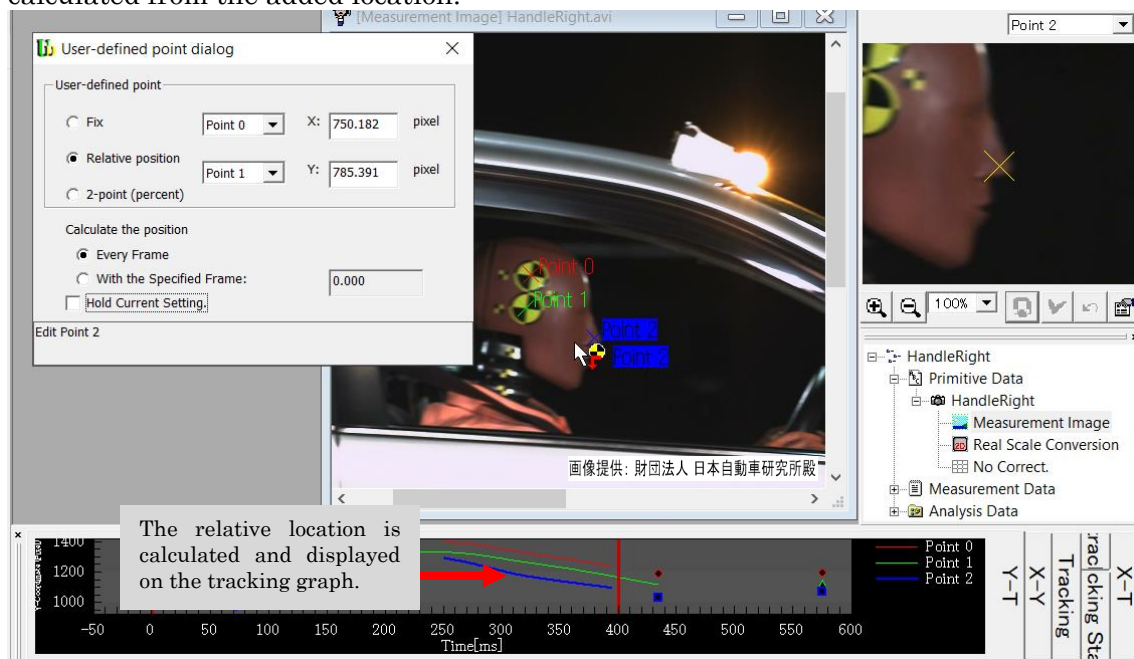
First, add tracking points as reference points for the user defined points and then track.



After tracking is complete, add the user defined points. Select [Relative Location] in the user defined points dialog and set the points tracked before the reference points as [Point0] and [Point1].



Once the user defined points are added, the relative locations for all frames are calculated from the added location.



Even in frames where measurements cannot be made because the tracking target is hidden, the coordinates of the relative location can be calculated, as shown below.



(b) Example of the Operation with User Defined Points 2 Measure Using Time Values Generated by an Event

This is an example of the operation performing measurements and analysis using time values generated by an event.

User defined points have a function called [Apply the coordinates for the current frame to the entire range]. Use this to compare the coordinates from an event generated with other time coordinates.

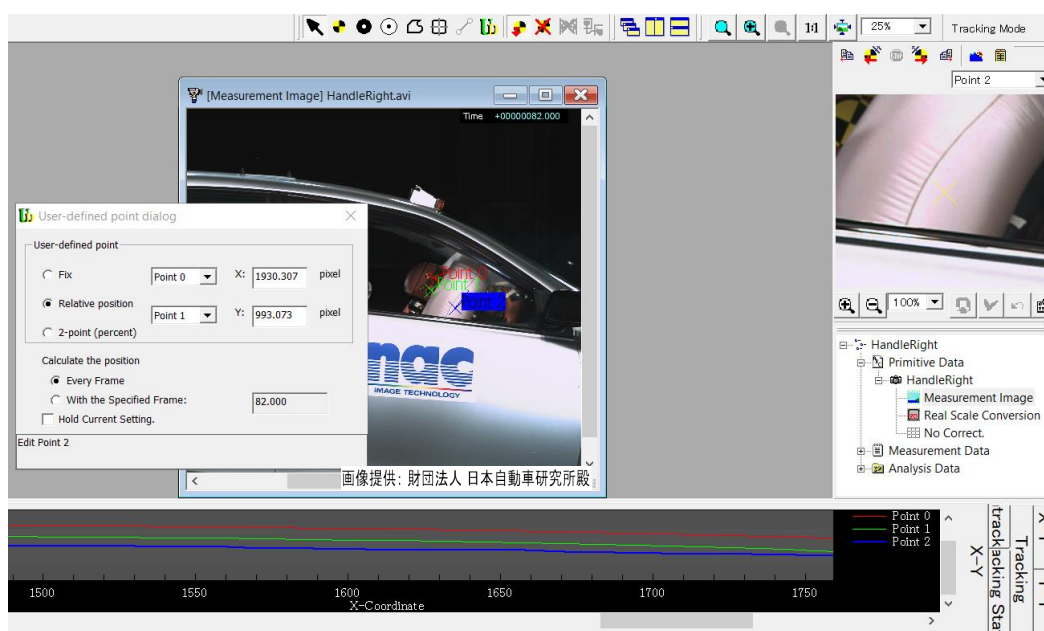
Consider using the time coordinates generated by an event when you want to make calculations for each type of physical quantities.

(The following figure is a continuation of the first operating example for user defined points when a marker is hidden.)

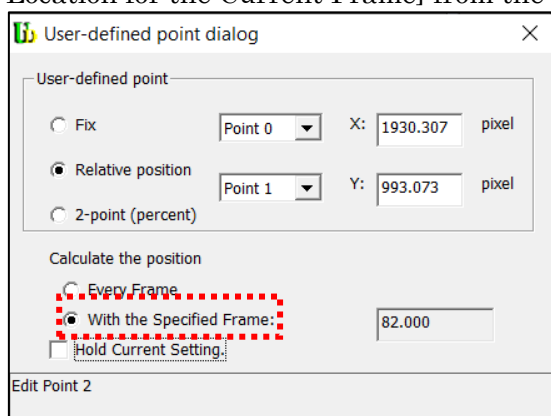


The image for the time generated for an event is shown. Here, the event is when the dummy is thrown forward during impact.

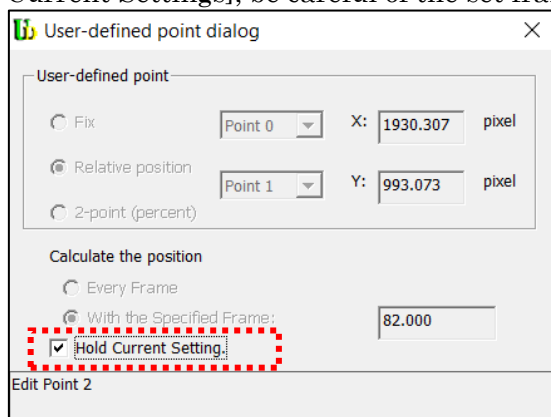




With the time image for the generated event still displayed, select [Apply the Coordinate Location for the Current Frame] from the user defined point dialog.



Check [Keep the Current Settings]. If you move the frame before checking [Keep the Current Settings], be careful of the set frame shifting.



You can verify if the coordinates for the frame generated by the event are applied to all the frames.



## 4.3 Tracking

### 4.3.1 Add Measurement Points

---

Add measurement points to the measurement image to conduct tracking.  
The procedure for adding measurement points is as follows.

- ① Access the measurement image window and switch to the tracking mode.
- ② Select the target markers used for the measurement points with the [Measurement Point Toolbar].
- ③ Click on the measurement points on the image.

At this point, auto detection is performed for quadrant and white dots/black dots.

- ④ After adding, fine tune the coordinates with zoom view.
- ⑤ After completing the fine tuning, click [Confirm] to finish the preparations for the measurement points.

Repeat ①～⑤ for the number of measurement points.


For 3D tracking, in addition to the procedures given above, you must also link the cameras. For details, refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).



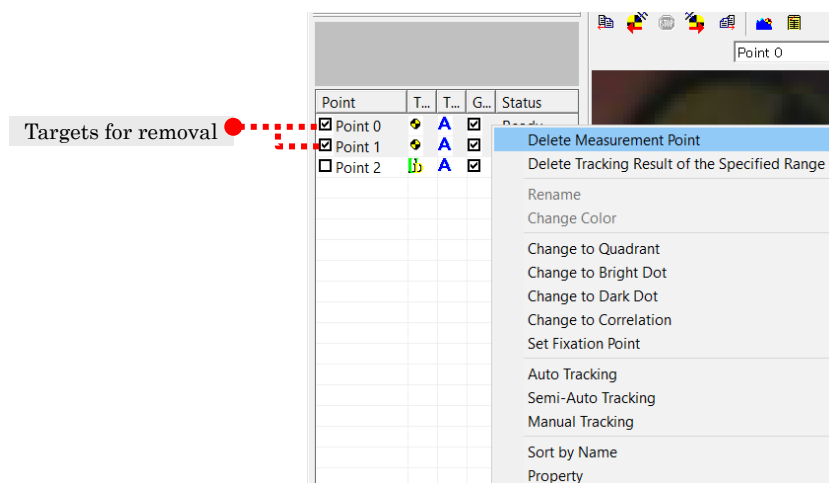
### 4.3.2 Delete Measurement Points

Deletes the measurement points selected from the measurement point list. If measurement points are deleted, the measurement results are also deleted.

Perform any of the following to delete measurement points.





- ✓ Click [Tracking] ⇒ [Delete Measurement Points] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Delete Measurement Points] on the right click menu in the エラー! 参照元が見つかりません。

Point0, Point1, Point3 are deleted in the following figures.



### 4.3.3 Automatic Tracking

After adding measurement points, conduct tracking.

Use     on the エラー! 参照元が見つかりません。



: Track only the frame currently displayed, then move to the next frame.

: Starts auto tracking.

: Stops auto tracking.

Tracking methods include auto · semi-automatic · manual, and any of them can be set for each measurement point.


The tracking range is processed in the same range as the playback range.

Corrections can be made manually when auto tracking fails. (Refer to p. エラー! ブックマークが定義されていません。 ).

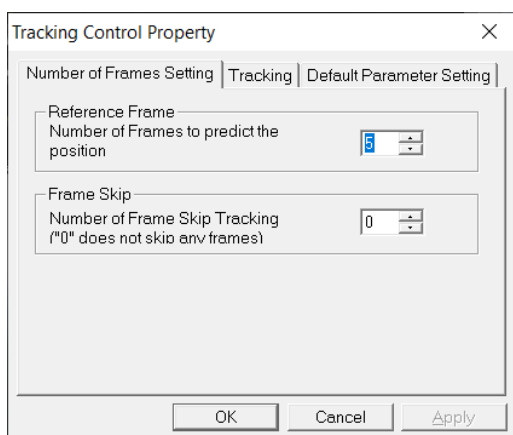
Also, operations during tracking failure include Group Tracking (Refer to p. 4-33) and エラー! 参照元が見つかりません。 (Refer to p. エラー! ブックマークが定義されていません。 ).

### 4.3.4 Tracking Properties

Sets the tracking failure settings, skip frames and tracking methods. Perform any of the following to display the tracking properties dialog.

- ✓ Click [Tracking] ⇒ [Tracking Properties] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 .

- **Tab for [Setting the Number of Frames]**



#### Reference Frames

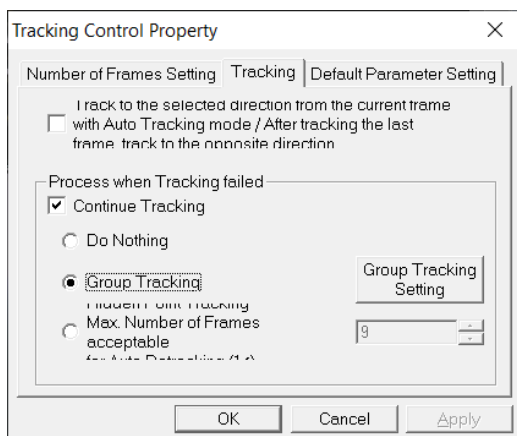
Set the number of frames expected for tracking. The default is 5.

#### Skip Frames

Set the number of frames to jump during tracking. For example, with a playback range of [0: 20], a start of 2, and 4 skip frames, tracking is performed on frames 2, 7, 12, 17.

The default for the number of skip frames is 0, with tracking on all frames.

- **『トラッキング』タブ**



#### Tracking in the Reverse Direction

Setting to automatically start tracking in the opposite direction after tracking in the direction specified.

#### Process when Tracking Fails

Setting for processing when tracking fails.

If [Continue Tracking] isn't checked, a warning appears in the message display area of the measurement point list when tracking fails and tracking stops. If checked, select from [Do Nothing], [Group Tracking] or [Track Hidden Points] to continue processing when tracking fails.

With "Do Nothing", tracking is not performed after the frame where the tracking failure occurred. Tracking continues for all other tracking points.

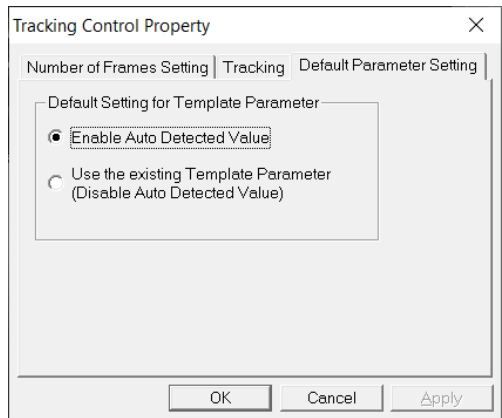
Refer to [Group Tracking] (p. 4-33) and エラー! 参照元が見つかりません。 ] (p. エラー! ブックマークが定義されていません。 ) for more details.

Refer to エラー! 参照元が見つかりません。 ] (p. エラー! ブックマークが定義されていません。 ) for operations that stopped due to tracking failures.

● [Default Parameter Settings] Tab

Default Settings for Template Parameters

Setting for auto detection of template parameters when adding tracking points. If enabled, the template parameters are automatically adjusted after adding tracking points. If disabled, the standard template parameters will be used.




4.3.5 Correcting Tracking Failures

Uncheck [Continue Tracking] when tracking fails under the tracking properties since manual correction will be required when tracking fails. The cause is shown in the message display area of the measurement point list, so make any corrections based on that. If tracking points overlap, it is considered a tracking failure of [Duplicate Tracking Points]. In the example to the right, Point 4 is a duplicate.




The actions to perform corrections are shown below.

Action	Details
Fine tune and set the measurement points in the zoom view	Tracking restarts after the measurement point locations are set.
Correct the properties for the measurement points	After setting the tracking parameters, auto detection and setting is performed. If the detection is successful, tracking restarts.
Uncheck the point name from the measurement point list	After that, tracking is not preformed on points that are not checked. Tracking is automatically restarted on the points that are checked.
End tracking mode	Ends tracking and switches to another mode.
Click Stop 	Ends the auto tracking state.

### 4.3.6 Correcting and Interpolating Tracking Results

#### ● Reposition Measurement Points

Perform any of the following to reposition measurement points.

- ✓ Click [Tracking]⇒ [Reposition Measurement Points] on the menu.
- ✓ Click  on the the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .

Move to the point selected from the measurement point list.

When repositioning, the location of the measurement points in untracked frames is established. For tracked frames, you can adjust the position in the measurement image window or in zoom view.


#### ● Interpolating for Fitting

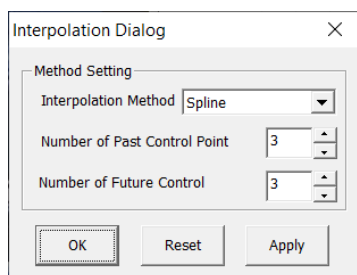
Interpolation can be conducted on a batch for fitting with untracked frames or frames where tracking fails. Functions to use are as follows.

“Linear” ・ “Least Squares” ・ Cubic” ・ Spline”

A series of targets are measurement points that are checked on the エラー! 参照元が見つかりません。 .

Perform any of the following to show the interpolation dialog and conduct interpolation.

- ✓ Click [Tracking] ⇒ [Interpolate Hidden Points] on the menu.
- ✓ エラー! 参照元が見つかりません。 Click  on the エラー! 参照元が見つかりません。 .
- ✓ Click [Interpolate] on the right click menu on the tracking dialog bar.



#### Interpolation Method

Select the function to be used for interpolation.  
Select from linear ・ least squares ・ cubic ・ spline.

#### Number of Previous Control Points ・ Number of Future Control Points

Set the number of control points used for the interpolation method.

#### OK

Conducts interpolation with the current settings and closes the dialog.

#### Reset

Restores the interpolation status from when the dialog was launched.

#### Apply


Conducts interpolation with the current settings.



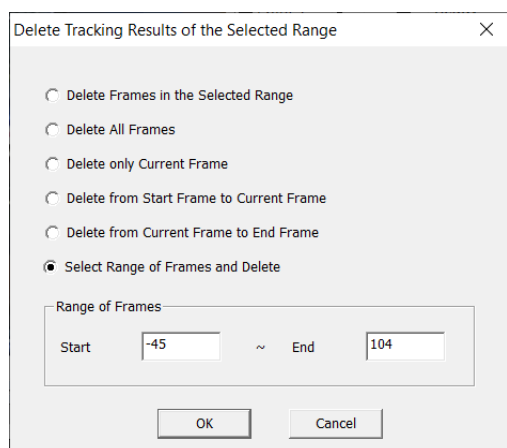
## ● Delete Tracking Results

Delete the tracking results for specified measurement points in a designated range. The tracking results for the points selected on the measurement point list are subject to removal.

Perform any of the following to delete tracking results.

- ✓ Click [Tracking] ⇒ [Delete the Tracking Results from the Specified Range] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Delete the Tracking Results from the Specified Range] on the right click menu on the measurement point list.

The dialog is displayed for selecting the range to be deleted.



### Delete from the Selected Range

Deletes the measurement results from the playback range.

### Delete All Frames

Deletes the measurement results from all frames.

Measurement points remain even when all frames are deleted.

### Delete only the Current Frame

Deletes only the current frame.

### Delete from Start Frame to the Current Frame

Deletes the measurement results from the start of the playback range to the current frame shown.

### Delete from the Current Frame to the End Frame


Deletes the measurement results from the current frame to the end of the playback range.

### Delete Range of Frames Specified

Deletes the measurement results for the input range.

### 4.3.7 Tracking for 3D Analysis

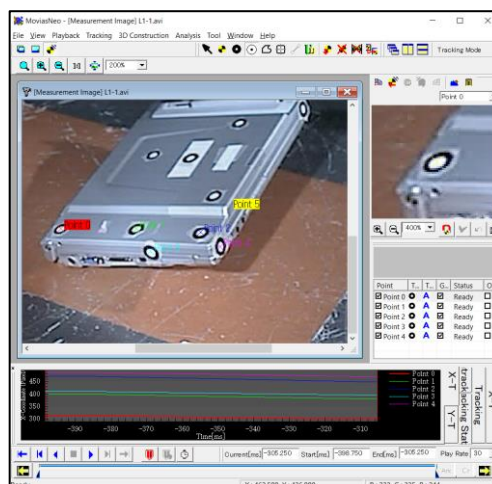
Tracking is identical to tracking for 2D analysis. However, since cameras must be linked for 3D analysis, processing for 2D analysis and 3D analysis differs in the following ways.

- ✓ Tracking is required for each camera
- ✓ Group tracking and tracking of specified areas is not available
- ✓ Link  cameras by setting the linked measurement points between cameras

For 3D analysis of measurement points, the same measurement points must be filmed by two or more cameras at the same time.

The process for tracking during 3D analysis is in ①～⑤ below.

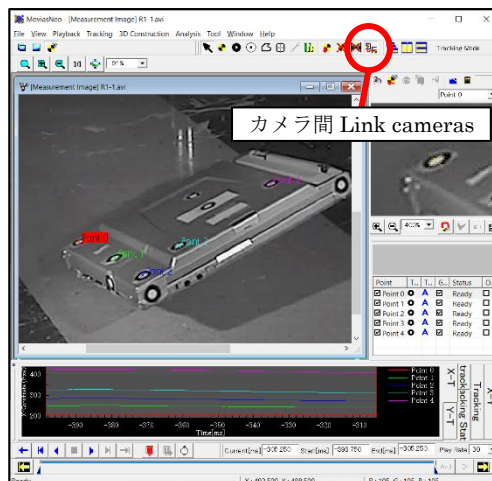
① Add measurement points for the first camera. Tracking can be performed immediately or after tracking from other cameras.



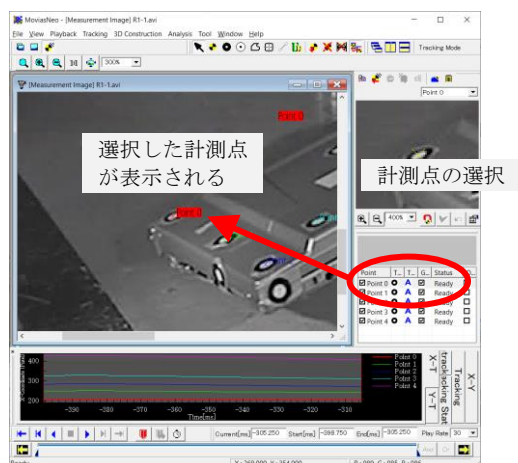
② Display the measurement image for the second camera and switch to the tracking mode.


Click  to start linking cameras.

If adding measurement points for the second camera, they are added as new measurement points.



③ Select the corresponding measurement points from the measurement point list. The selected points are shown in the center of the image. They are only displayed and their positions are not set.

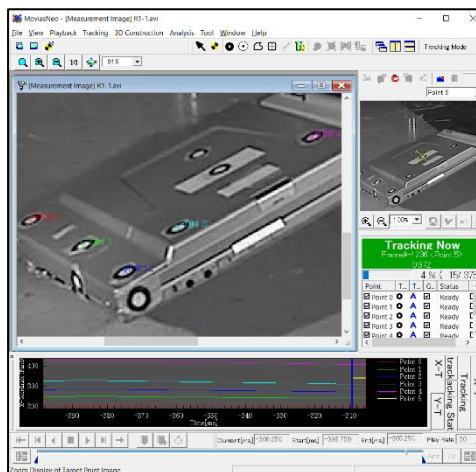


④ Click the corresponding location on the measurement image window for auto detection of the corresponding point. If auto detection fails, correct the location with the zoom view. After correcting, click  in the zoom view to set the location.

The types of markers are the same as the types set for other cameras. A different type can be set for each camera.



⑤ If linking is necessary, track using the same procedure for 2D analysis.



Measurement points tracked with two or more cameras use the tracking results for all of the cameras to construct 3D data. Measurement points tracked with a single camera cannot be used to build 3D data.



### 4.3.8 Group Tracking

This is a method of tracking that performs interpolation using the geometric relationship with other points when tracking fails. The geometric relationship between the previous tracking results and the tracked point in the current frame is used to interpolate the frames where tracking failed. To enable group tracking, the tracking points must be set to [Auto] tracking. Refer to [Tracking Methods](p. 4-4) for the setting method. Groups can be created with 3, 4 or 5 points for group tracking.

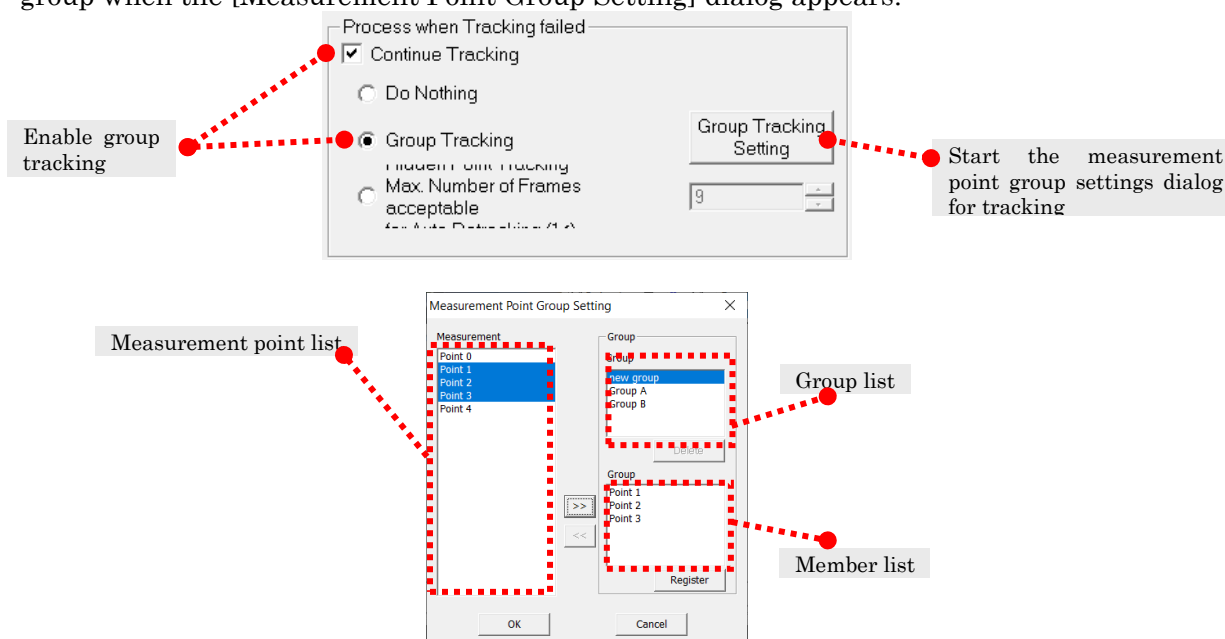
Group of 3 points	Interpolation taking into consideration the relationship with parallel transport, rotation and scaling
Group of 4 or 5 points	Interpolation taking into consideration the relationship with parallel transport, rotation, scaling and shearing deformation

When conducting group tracking, the angle of the group shape is calculated at the same time as tracking. The angle calculated can be checked in the graph • list. By using this calculated angle together with the drawing function, it can be applied to analysis that includes rotation.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for the method of checking the angle and refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for applications to analysis that includes rotation.

The group angle is automatically calculated immediately after the group is created • when the measurement data is built.

To use group tracking, enable [Continue Tracking] in the [Tracking] tab of the tracking properties and select [Group Tracking]. Click on the group tracking settings and set the group when the [Measurement Point Group Setting] dialog appears.



Tracking Measurement Point Group Settings dialog




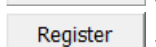


**Measurement Point List:** List of measurement points that can be registered

**Member List:** List of groups being created

**Group List:** List of groups already created. The names are automatically assigned.

Select “New Group” when adding a group, add the measurement points to the member list and click [Register].

		:	Add or remove from the member list.
	:	Delete from the group list.	
	:	Register to the group list.	



Groups registered to the group list can be used for group tracking. While the same point can be assigned to multiple groups, the exact same group combination cannot be created.

### ● Create a Group

Creates a new group. The same combination cannot be created. One group is created from 3~5 points.


Create groups using either of the following procedures.

#### Procedure 1

- 1) Select 3~5 measurement points from the measurement point list to create a group.
- 2) Click  to add.
- 3) Temporarily register to the member list.
- 4) Click  to register.


#### Procedure 2

The member list must be empty.

- 1) Select 3~5 measurement points from the measurement point list to create a group.
- 2) Click  to register.

### ● Delete a Group

Deletes a group. The group cannot be used for subsequent tracking. Perform the following to delete a group.

- 1) Select a group from the group list.
- 2) Click  to delete.

### 4.3.9 Tracking Hidden Points

This is a tracking method that attempts tracking with only a certain number of frames after a tracking failure. If tracking in the designated frames is successful, normal tracking can be restarted. Frames where tracking has failed are interpolated with quadratic least square regression.

To perform hidden point tracking, enable [Continue Tracking] in the [Tracking] tab of the tracking properties and select [Tracking Hidden Points] to designate the number of frames

The number of frames that can be designated is 1~99.

For example, if tracking a range of [0: 20] using hidden point tracking, set the number of frames to 5. If tracking is successful up to frame 8 but tracking fails at frame 9, tracking will attempt to restart at frames: 10, 11, 12, 13, 14.

If measurement points are in the frames where tracking was attempted, tracking is performed on the next measurement points. If measurement points are not located within the designated frames, tracking of measurement points in subsequent frames is not performed.



## 4.4 Checking Tracking Data

You can check the image coordinates for the tracked target markers, or the data generated for the angles when tracking quadrant markers/groups.

Check the measurement data to verify the calibrated data.

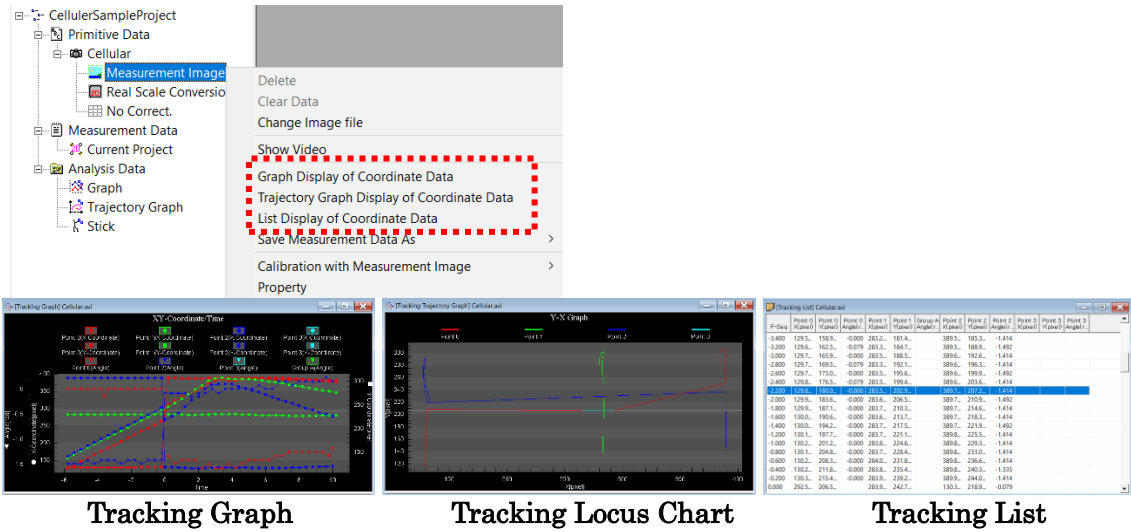
Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for measurement data.

To check tracking data, click on any of the following items from the right click menu on the measurement image node.

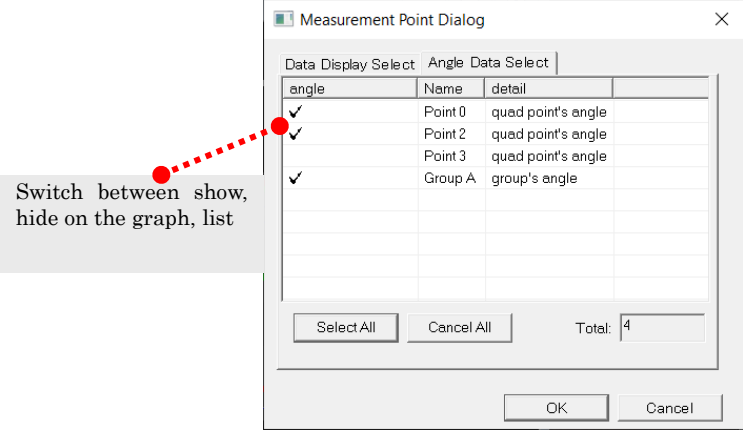
**Show Graph of Coordinate Data** Show the graph (XY coordinates/time) for the tracked coordinate

**Show Locus Chart for the Coordinate Data** Show the locus chart (X-Y graph) for the tracked coordinates.

**Show List of Coordinate Data** Show the list of the tracked coordinates and angles.



To switch each coordinate and angle between show and hide, click [Properties] in the right click menu of the graph.



Choose the [Select Display Data] tab for the coordinates or choose the [Select Angle Data] tab for the angles. Check the items you wish to display and then click OK.

## 4.5 Other Tracking Settings

### 4.5.1 Image Pre-Processing

Adjusts the image used for tracking. Can be set only in the display mode.

Set the image resize, rotation, reverse, deinterlace, image quality adjustment and color components used for tracking (brightness value, red, green, blue).

These settings are reflected on the image displayed during the tracking mode and image resize, rotation, reverse, deinterlace are even reflected on the image displayed during the display or synchronized display modes.

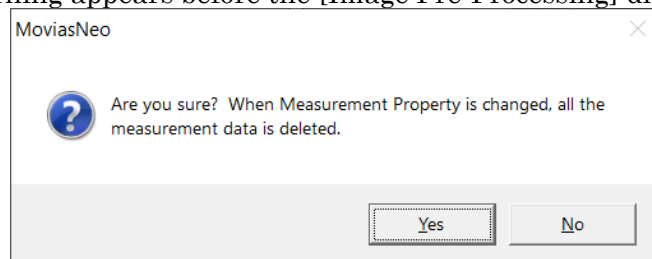


Processing for tracking results such as image resizing should be performed before tracking.

After pressing [OK] in the image pre-processing dialog, the tracking results are deleted. They are not deleted if [Cancel] is pressed. After making the tracking settings, track using the image set.

Click [Playback] -> [Image Pre-Processing] on the menu.

The following warning appears before the [Image Pre-Processing] dialog is displayed.



Click [Yes] and the image pre-processing dialog will appear.

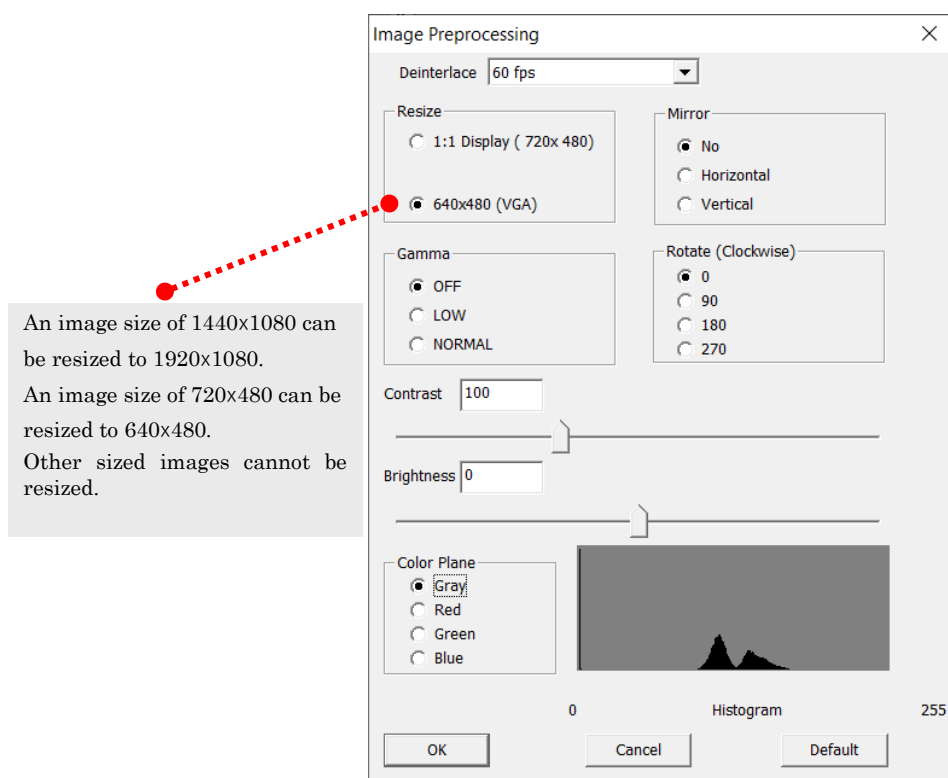


Image Pre-Processing Dialog

**Deinterlace**

Performs settings for deinterlacing when selecting “Resize to 1920x1080” or “640x480” with image resize

Select from “Odd”, “Even”, “Duplicate”, “60fps”, “60fps (reverse field)”.

**Resize Image**

Resizes the image according to the selected format.

Make sure to set when measuring using real scale conversion used in DV format images or image files filmed with HDV cameras or AVCHD cameras. Otherwise, the aspect ratio for the image will be incorrect.

- ✓ 1: 1 display  
No image resize performed.
- ✓ Resize to 1920x1080  
Resizes a 1440x1080 image to 1920x1080. Images filmed with HDV and AVCHD cameras must be converted to the AVI format using special conversion software.
- ✓ Resize to 640x480  
Resize to 720x480 image for DV format.

**Reverse Image**

Reverses the image. Select from [No], [Horizontal] and [Vertical].

**Image Rotation Angle (Clockwise)**

Rotates the image clockwise. Select from [0], [90], [180] and [270].

**Gamma Correction**

Select from OFF, LOW, NORMAL.

Default:	OFF	For normal image files
	NORMAL	For MCFF

**Contrast Adjustment**

Set in a range of 0~300. (Default: 100)

**Brightness Adjustment**

Set in a range of -200~200. (Default: 0)

**Color Plane Used**

Select a color from gray, red, green, or blue to be used for tracking. The default is gray.

**Histogram**

Show a histogram for the images selected.

**Default**

Reset the settings.




## 4.5.2 Specify Tracking Area

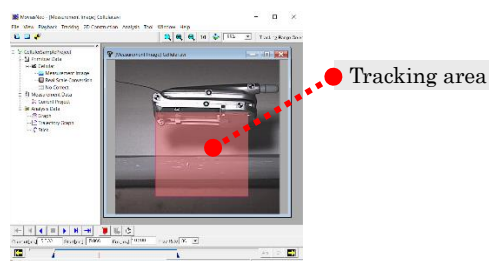
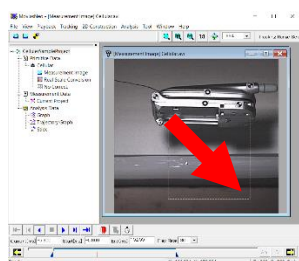
Sets the tracking area. You can only set for 2D analysis projects.

If the tracking area is set, measurement points detected outside the area during auto tracking are treated as tracking failures.

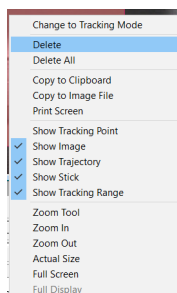
Set in the designate tracking area mode. Perform either of the following to access the specify tracking area mode.

- ✓ Click area settings  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません.
- ✓ Click [Tracking] -> [Specify Tracking Area] on the menu.

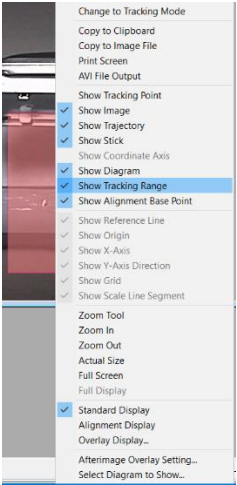
In the specify tracking area mode, drag on the image to add the tracking area. Multiple areas can be added. After creating an area, you can move or resize it.



You can delete the currently selected tracking area or delete the entire area using the right click menu.



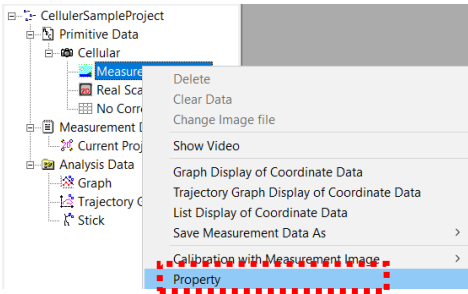
In modes other than the specify tracking area mode, the tracking area can be switched from show to hide with [Show Tracking Range] on the right click menu of the image window.



4.5.3 Batch Settings for Measurement Point Properties

The properties for all the measurement points in a project can be set together or individually.

Click [Properties] on the right click menu of the measurement image node to set the measurement point properties as a batch.



The [Measurement Point Display Settings] dialog appears.

Batch settings

Measurement Point Display Dialog

Name	Show Position	Show Name	Color	Trajectory	Future	Past	Zoom Ratio	Graph(X)	Graph(Y)	List(X)	List(Y)
<input checked="" type="checkbox"/> Batch											
<input checked="" type="checkbox"/> Point 0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Red	<input checked="" type="checkbox"/>	1	5	400%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Point 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Green	<input checked="" type="checkbox"/>	1	5	400%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Qua...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Blue	<input checked="" type="checkbox"/>	1	5	400%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Dark	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Sky	<input checked="" type="checkbox"/>	1	5	800%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Total Measurement4

UPDOWN

Close

[Measurement Point Display Settings] dialog

Total number of measurement points

Sort button

The following measurement point parameters can be set individually or as a batch using this dialog.

Set each item by double clicking each of the cells on the list.

To set as a batch, check the box to the left of the measurement points and set the parameters together. Click on the checkmarks for the batch settings to switch the checkmarks to the left of all the measurement points.

- Name

Set the name of the measurement point.
- Show Location

Switch the measurement point location to show/hide.
- Show Name

Switch the measurement point name to show/hide.
- Color

Set the measurement point color (select color or set custom color).
- Trajectory

Switch the trajectory on the measurement image to show/hide.
- Future Trajectory

Set the number of frames ahead to display the trajectory.
- Past Trajectory

Set the number of frames behind to display the trajectory.
- Zoom Ratio

Set the zoom view rate (100%,200%,400%,800%,1600%).

- Graph (X)** Switch the X coordinates on the coordinates graph for the tracking results to show/hide.
- Graph (Y)** Switch the Y coordinates on the coordinates graph for the tracking results to show/hide.
- List (X)** Switch the X coordinates on the coordinates list for the tracking results to show/hide.
- List (Y)** Switch the Y coordinates on the coordinates list for the tracking results to show/hide.
- The coordinates graph and coordinates list for tracking results can be displayed from the right click menu of the [Measurement Image] node. You can also move with multiple states selected. The same operations can be made from [Top] or [Bottom] on the right click menu on the list.

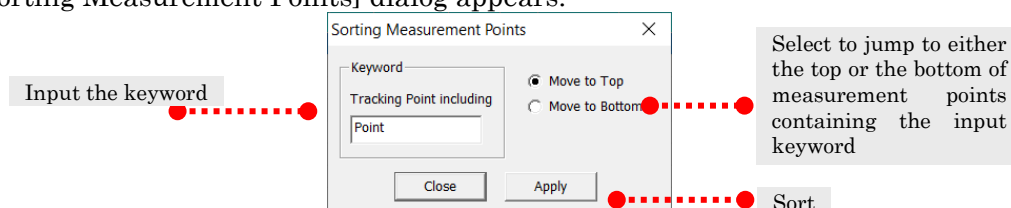
#### 4.5.4 Sort Measurement Point List

The measurement point list can be sorted by keyword or by clicking on the header of the list. Or sort the measurement point list from the [Measurement Point Display Settings] dialog (p. エラー! ブックマークが定義されていません。 ).

##### ● Sort by Keyword

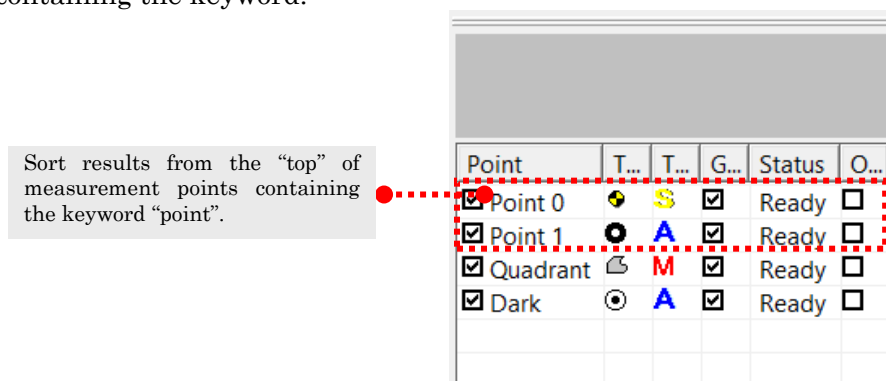
To sort by keyword, click [Sort by Name] on the right click menu in the measurement point list.

The [Sorting Measurement Points] dialog appears.

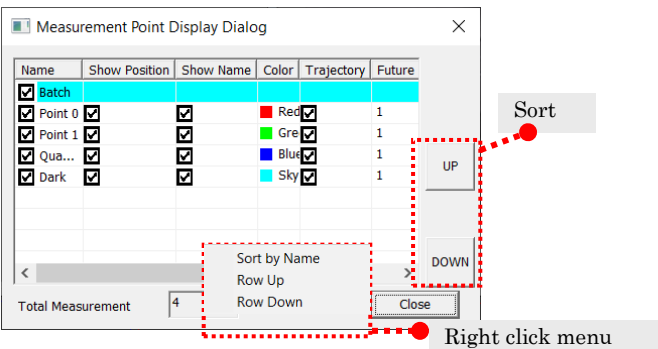


[Sorting Measurement Points] dialog

Input the keyword containing the measurement points to sort and select to go to the top or bottom. Press [Apply] to move to the location designated for the measurement points containing the keyword.



[Sort by Name] can be performed with a right click in the same manner as when sorted from the [Measurement Point Display Settings] dialog. Click [Sort] on the right side to move the selected measurement points [Up] (Down) to the top (bottom).



● Sort by Clicking the Header

Click the header to sort according to the following rules.

Header					
Point	Type	Tracking Method	Graph	Status	Overwrite Tracking
<input checked="" type="checkbox"/> Dark		A	<input checked="" type="checkbox"/>	Ready	<input type="checkbox"/>
<input checked="" type="checkbox"/> Point 0		S	<input checked="" type="checkbox"/>	Ready	<input type="checkbox"/>
<input checked="" type="checkbox"/> Point 1		A	<input checked="" type="checkbox"/>	Ready	<input type="checkbox"/>

Header	Sorting Method
Point	Alphabetical
Type	Quadrant ⇔ White dot ⇔ Black dot ⇔ Feature point ⇔ Fixed point ⇔ User defined point
Tracking Method	Auto ⇔ Semi-automatic ⇔ Manual
Graph	Show ⇔ Hide
Status	Status number
Overwrite Tracking	Overwrite tracking ⇔ Do not overwrite

Click the header of the [Measurement Point Display] dialog and sort according to the following rules.

Header	Sorting Method	Header	Sorting Method
Name	Alphabetical	Zoom Rate	100% ⇔ 200% ⇔ 400% ⇔ 800% ⇔ 1600%
Display Location	Show ⇔ Hide	Graph (X)	Show ⇔ Hide
Display Name	Show ⇔ Hide	Graph (Y)	Show ⇔ Hide
Color	RGB value	List (X)	Show ⇔ Hide
Trajectory	Show ⇔ Hide	List (Y)	Show ⇔ Hide
Forward/Reverse Trajectory	Numerical order		



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## 5. Calibration

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Calibration must be performed to convert from the image coordinate system to the real space coordinate system. MOVIAS Neo performs calibration for 2D analysis (real scale conversion · changing perspectives) as well as calibration and lens distortion correction for 3D analysis. For 2D analysis, measurement data can be created even without calibration. In this case, data is created with 1 mm /pixel and a Z coordinate value of "0".

### 5.1 Using Calibration

Sections エラー! 参照元が見つかりません。～ エラー! 参照元が見つかりません。 describe how to use calibration. Basic standards for use are provided.

Motion of measurement target?

1. Plane (or linear)

Film the plane from the front

⇒ エラー! 参照元が見つかりません。

Corrects optical distortion if the image has confirmed optical distortion.

From the diagonal

⇒ エラー! 参照元が見つかりません。 (Consider 3D analysis if the angle is greater than 45°)

Corrects optical distortion if the image has confirmed optical distortion.

Moving plane

⇒ Use 3D calibration

2. 3D Movement

⇒ Use 3D calibration

Use 3D calibration

To confirm slight optical distortion

⇒ MDLT

Unable to confirm distortion

⇒ 3D - DLT

Visible optical distortion

⇒ エラー! 参照元が見つかりません。 +MDLT

Is there optical distortion?

Visible optical distortion (barrel, pincushion)

⇒ Perform エラー! 参照元が見つかりません。





## 5.2 Real Scale Conversion


Performs depth correction on the tracking results for a 2D analysis project. With real scale conversion, an object moves on the same vertical plane as the camera and the analysis is conducted on that plane.



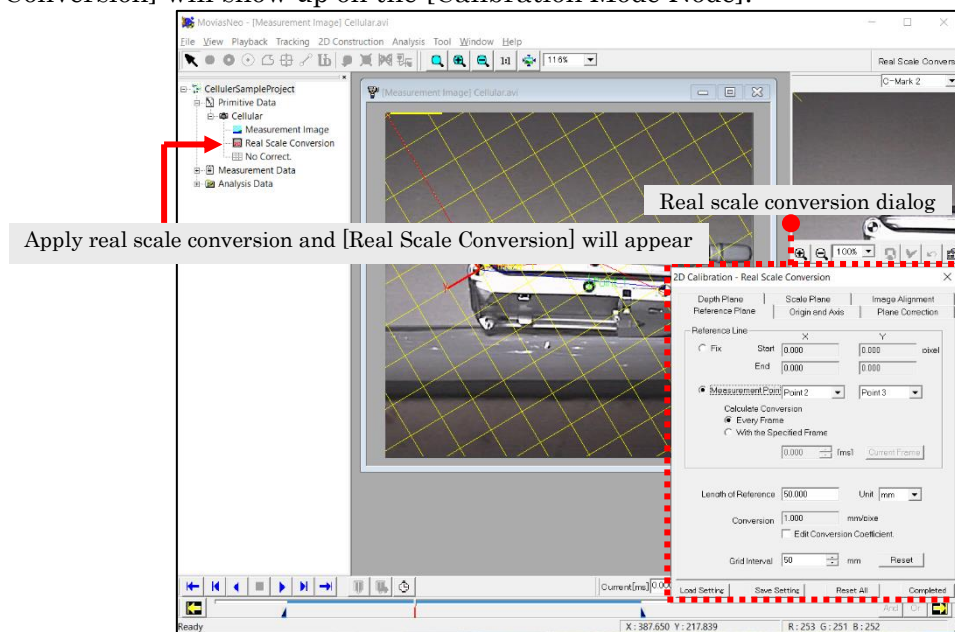
DV-AVI and AVCHD video files may not have a pixel aspect ratio of 1: 1. In this case, use the image resize function from エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) to convert to a square pixel image and then perform measurements • analysis.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) in エラー! 参照元が見つかりません。 for an explanation of the calculations for real scale conversion.

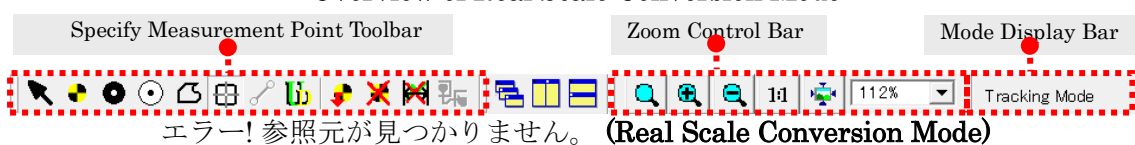
Open the measurement image window and perform either of the following for real scale conversion.

- ✓ Click [2D Construction] ⇒ [Calibration Settings] ⇒ [Real Scale Conversion] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .

The [Real Scale Conversion Dialog] appears and then it switches to the real scale conversion mode. Real scale conversion settings can be made in this mode. If you own a license for the エラー! 参照元が見つかりません。 , you can make the settings for the same functions on the real scale conversion dialog. Apply real scale conversion and [Real Scale Conversion] will show up on the [Calibration Mode Node].



Overview of Real Scale Conversion Mode



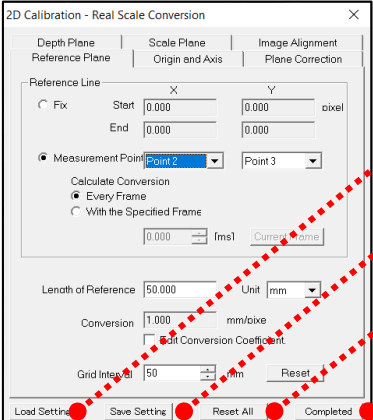


Operation is made with both the measurement image window and the real scale conversion dialog.

The procedure for real scale conversion is as follows.

- ① Create a reference plane.
- ② Set the origin and axis if necessary.
- ③ Create the correction plane (depth plane • scale plane).
- ④ Record each of the measurement points to the plane.
- ⑤ Click Finish.

After closing the dialog, the depth correction parameters are automatically applied.








The screenshot shows the '2D Calibration - Real Scale Conversion' dialog box. It has three tabs: 'Depth Plane', 'Scale Plane', and 'Image Alignment'. The 'Reference Plane' sub-tab is active. It contains fields for 'Reference Line' (Start, End, X, Y), 'Measurement Point' (Point 2, Point 3), 'Calculate Conversion' (Every Frame, With the Specified Frame), 'Length of Reference' (50.000), 'Unit' (mm), 'Conversion' (1.000), 'Grid Interval' (50), and 'Reset' buttons. Red dotted lines with circular endpoints point from text boxes to specific controls in the dialog:


- 'Data settings are loaded from the file (\*.2cs).' points to the 'Load Setting' button.
- 'Current settings are saved to the file (\*.2cs).' points to the 'Save Setting' button.
- 'Restore settings.' points to the 'Reset All' button.
- 'Set the values to finish calibration. Calibration calculations done automatically.' points to the 'Completed' button.

When other windows (graphs and such) are in the active window, or when the close button on the upper right is clicked, the calibration parameters are eliminated and the real scale conversion mode is ended.

Click **Save Setting** to save the current settings to the settings file (\*.2cs).

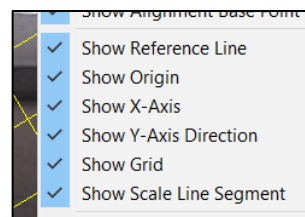
Click **Load Setting** to load the previously saved settings file (\*.2cs).

Quadrant , white dot , black dot , and fixed point  can be used for the control point settings. Also, use select measurement points  to select the tracked measurement points and coordinates can be set for the control points that are the same as those for the measurement points.

Line input  can also be used. It is a method to input fixed points with a single operation. Click the starting point on the image. Drag the mouse to the location of the ending point. In the real scale conversion mode, use the reference line input under the エラー! 参照元が見つかりません。, the X axis input under the エラー! 参照元が見つかりません。 or the line length input under the エラー! 参照元が見つかりません。 . In the change perspective mode, use the X axis input under the エラー! 参照元が見つかりません。 .

In the real scale conversion mode, [Reference Line], [Origin] and [Grid] are displayed on the image window. The grid is shown without taking optical distortion into consideration. If making settings for optical distortion correction, the grid displayed will be out of place from the real space grid. Instead of using for exact positioning, use as a target for the axis direction.

Switch the display ON/OFF using the right click menu.





## 5.2.1 [Reference Plane] Tab

The reference length is set using the [Reference Plane] tab. Input the image coordinates and the actual line length for auto calculation, or you can manually input the real scale conversion coefficients.

If using the real scale conversion coefficients calculated with a different analysis project, or if using the real scale conversion coefficients obtained from different analysis software, manually input the real scale conversion coefficients. In all other cases, use the image coordinates and the actual line length for auto calculation.

Use together with the measurement image window.

Set the reference length with either of the following processes.

- ✓ Specify the image coordinates and actual line length to auto calculate.
- ① Remove the check on [Manually Input Conversion Coefficients] to automatically calculate them.
- ② Select either [Fix] or [Specify Measurement Points] as the reference line input method.
  - (ア) With [Fix], input the starting point and the ending point of a line with a specific length in the measurement image window.
  - (イ) With [Specify Measurement Points], specify two measurement points and select either [Calculate Conversion Coefficients for Each Frame] or [Calculate Conversion Coefficients for Specific Frames] as the method of calculating coefficients.
- ③ Use the dialog to input the length of the real space in [Actual Length of Reference Line].
- ④ Select the units for conversion.
- ✓ Manually input the real scale conversion coefficients
- ① Check [Manually Input Conversion Coefficients] so they can be input.
- ② Manually input the reach scale conversion coefficients in [Conversion Coefficients].
- ③ Select the units for conversion.

### Fix

Displays the coordinates for the starting point and the ending point clicked in the measurement image window.

### Specify Measurement Points

#### Calculate Conversion Coefficients for Each Frame

Calculates the conversion coefficients for each frame from the designated measurement points.

#### Calculate Conversion Coefficients for Specific Frames

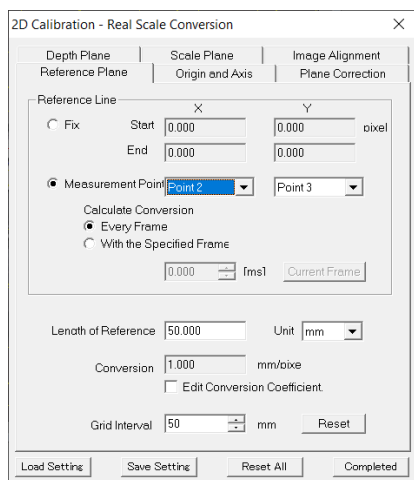
Converts all of the frames with conversion coefficients for designated measurement points and times. Press [Current Frame] to set the time of the frame currently displayed.

### Actual Length of Reference Line

Input the length of the real scale for the line set in the image.

### Conversion Coefficients

Shows the conversion coefficients.



### Manually Input Conversion Coefficients

Select either automatic calculation or manual input of real scale conversion coefficients.

Remove the check to automatically calculate from the [Reference Line] coordinates and [Actual Length of the Reference Line] coordinates.

Check to manually input the real scale conversion coefficients into [Conversion Coefficients]. In this case, you can ignore the settings in [Reference Line] and the values for [Actual Length of the Reference Line].

### Unit

Sets the units after conversion.

### Grid Interval

Sets the grid interval displayed.

### Reset

Resets the settings to when the dialog was open.

## 5.2.2 [Origin and Axis] Tab

Set the origin and X axis and Y axis directions used in conversion under the [Origin and Axis] tab.

### Origin for the Coordinate System

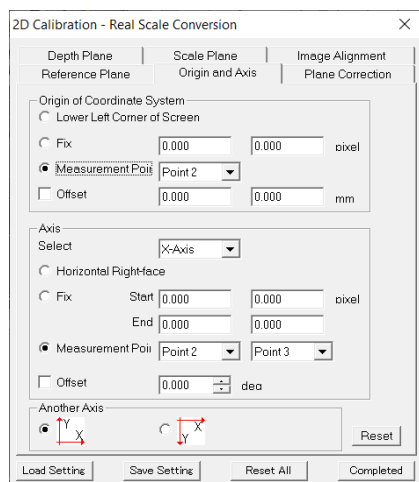
- ✓ **Lower Left Corner of the Screen**  
The lower left of the image is used as the origin.
- ✓ **Fix**  
Manually input coordinates to set the origin. The units are pixels and the upper left of the image is (0, 0).
- ✓ **Each Frame**  
Calculates a specific point as the origin.
- ✓ **Offset**  
Sets offset as the coordinate system origin. Applies the offset input to the coordinates after real scale conversion. Uncheck to cancel the offset application.

### Axis

#### Select Axis

Select the axis to set. Select either the X axis or the Y axis.

- ✓ **Horizontal Right Facing**  
Sets the axis to face right.
- ✓ **Fix**  
Manually input the coordinates for the starting and ending points and set the axis direction. The units are pixels and the upper left of the image is (0,0). Line input is possible.
- ✓ **Each Frame**




- The line connecting specified points is set as the axis.
- ✓


Offset

Sets offset to the axis direction. Applies the offset input to the coordinates for the settings. Values are set as ‘degrees’. Counterclockwise is ‘+’. Uncheck to cancel the offset application.
- ✓

Another Axis




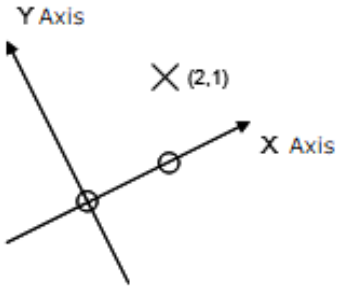
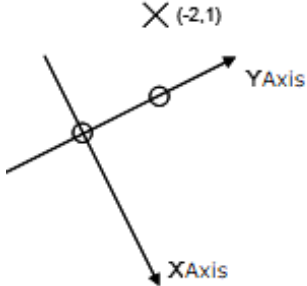

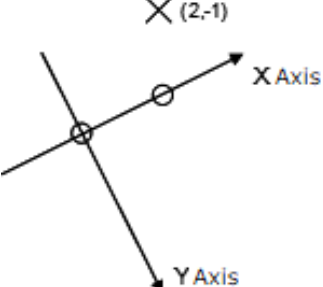
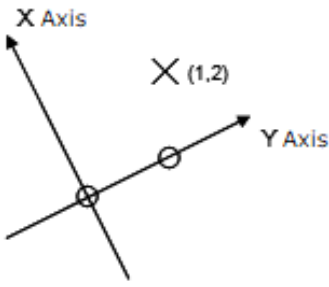
Coordinates where the Y axis is in a position 90° counterclockwise from the X axis.



Coordinates where the Y axis is in a position 90° clockwise from the X axis.

Reset

Resets the settings to when the dialog was open.
- There are various axis settings possible when combining the set axis (X axis, Y axis) with another axis (counterclockwise, clockwise) and offset coordinate origin and offset axis direction.

The chart below shows examples of coordinate converted measurement point coordinates when [Select Axis] and [Additional Axis] are combined.
- |   | Axis Selected: X Axis  | Axis Selected: Y Axis   |
|---|--|---|
| Other Axis: Counterclockwise <div></div> | <div></div> | <div></div> |
| Other Axis: Clockwise <div></div>        | <div></div> | <div></div> |

○: Axis starting and ending points    ×: Coordinate converted measurement point
- Make the following settings for [Origin and Axis] to that before Ver2.22.

  - Delete the coordinate origin offset and axis direction offset.
  - Select [X Axis] from the axis selection combination box.

When using any other settings (settings after Ver2.22), set under the [Origin and Axis] tab.
- (00355)L

5－9

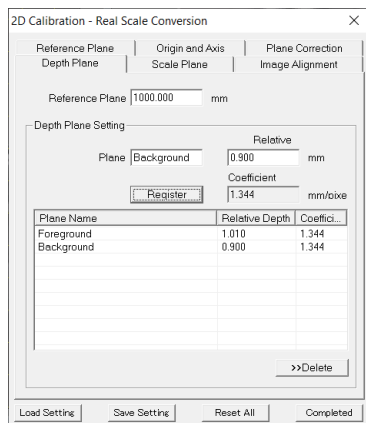
### 5.2.3 [Depth Plane] Tab

Calibration of moving objects along a plane is performed under the [Depth Plane] tab if there is a plane where the relative depth is known from the reference plane.

Specify the relative depth to the reference plane and the name of the depth plane to create a depth plane.

The registered depth plane is used for the [Plane Correction] tab.

After registering the plane, the name of the plane and the relative depth can be edited in the list.



#### Reference Plane Depth

Set the depth of the reference plane.

#### Name of the Plane

Set the name of the depth plane.

#### Relative Depth

Input the depth from the reference plane. Input the depth towards the front as a negative.

#### Register

Register to the depth plane list.

#### Delete

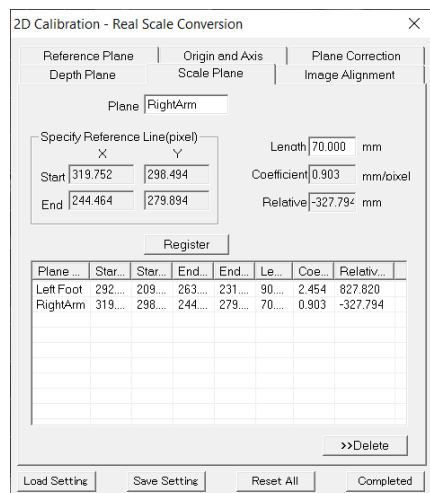
Delete the depth plane selected from the list.

### 5.2.4 [Scale Plane] Tab

Calibration of moving objects along a plane is performed under the [Scale Plane] tab if there is a plane where the length is different from the reference length.

Click on the starting and ending points of a line on the measurement image window with a known length and input the actual length in the dialog.

After registering the plane, the name of the plane and the actual length can be edited in the list.



#### Plane Name

Set the name of the scale plane created.

#### Designate a Line in the Image Window

Shows the coordinates for the starting and ending points of the line with a known length on an image.

The coordinates clicked on the measurement image window are automatically input.

#### Actual Length

The real length for the scale plane. This value is used to calculate the conversion coefficient for the scale plane.

#### Register

Register the current scale plane to the list.

#### Delete

Delete the scale plane selected on the list.

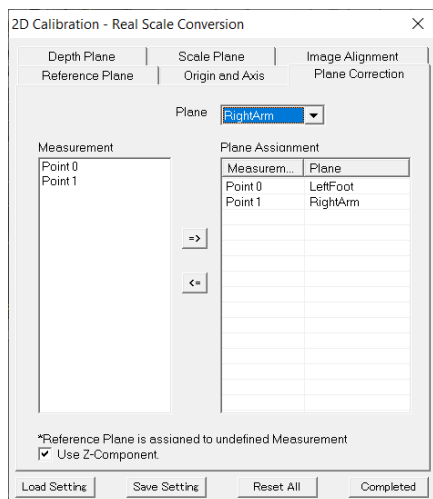


## 5.2.5 [Plane Correction] Tab

Use the [Plane Correction] tab to link the planes and measurement points created under the [Depth Plane] tab and the [Scale Plane] tab.

The measurement points not registered here are calibrated using the conversion coefficients for the reference plane.

Check [Set Z Coordinate during Depth Correction] to set the Z value for the measurement point.



### Select Plane

Select the plane created in the [Depth Plane] tab or the [Scale Plane] tab.

### Measurement Point List

Select the measurement points linked to the plane.

### List of Correction Plane Assignments for the Measurement Points

Display the results of the links between measurement points and planes.

### Add =>

Link the measurement points selected in [Measurement Point List] with the selected plane.

### Delete <=

Delete the measurement point selected from [List of Correction Plane Assignments for the Measurement Points].

### Set Z Coordinate during Depth Correction

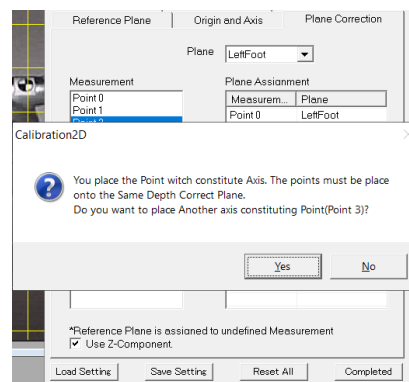
Check to assign measurement points to correction planes and set the relative depth of the correction plane as the depth of the measurement point (Z coordinate). This set value is used with analysis calculations.

Uncheck to perform analysis calculations with the Z coordinate of 0 regardless of the assigned correction planes. Before MOVIAS Neo Ver2.21, this was calculated by checking [Set Z Coordinate during Depth Correction]. Uncheck to calculate in the same manner as MOVIAS Pro.

The correction planes cannot be assigned to measurement points specified on the reference line. If assigning a correction plane to points selected for [Every Frame] in the axis direction settings under the [Origin and Axis] tab, the starting and ending points must also be set on the same correction plane.

If setting a point as an assigned point for [Every Frame] in the axis direction settings under the [Origin and Axis] tab, another point is added.

If assigning improperly corrected planes, a warning message will appear when switching tabs or clicking [Finish], so make sure to assign properly corrected planes.




### 5.3 Changing Perspectives

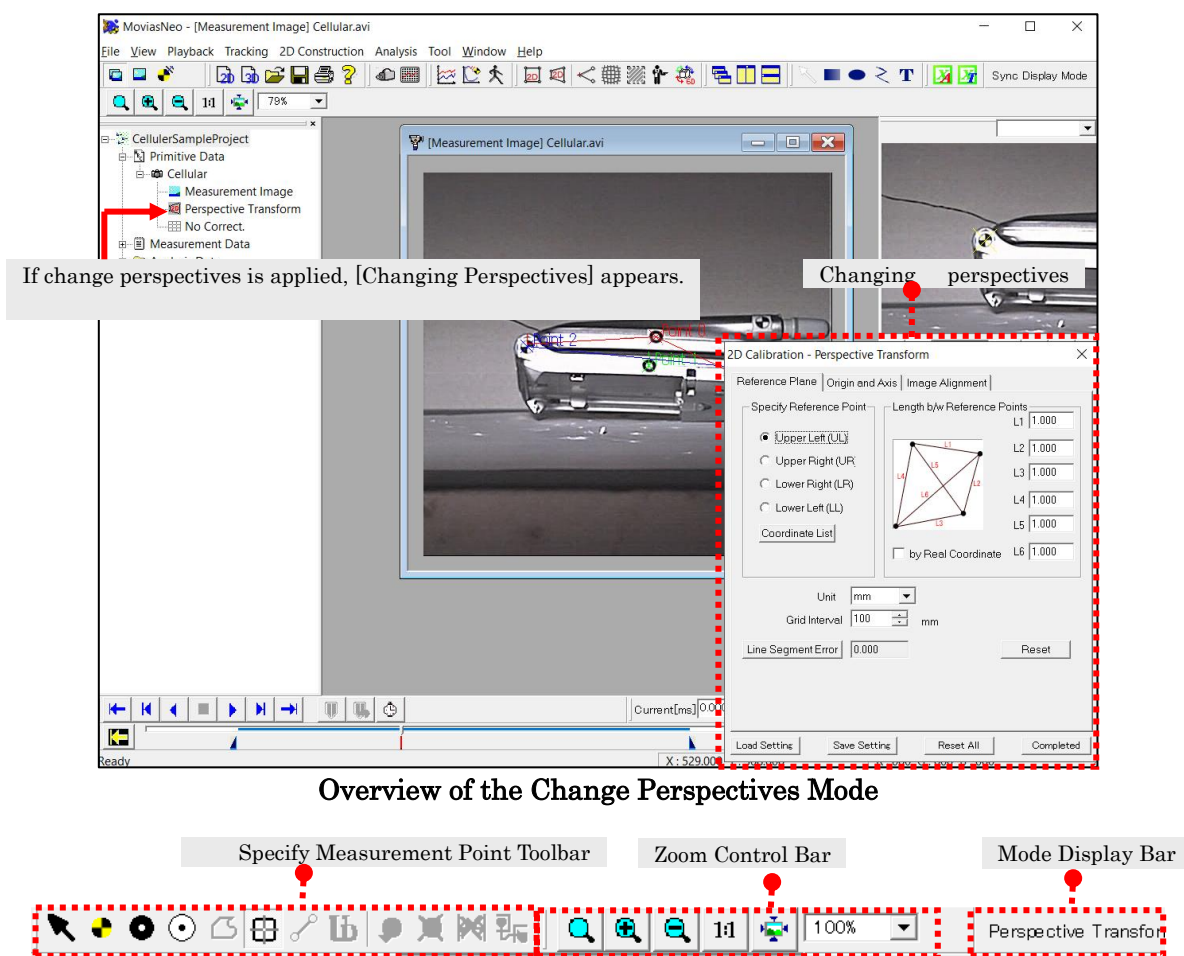
Corrects the tracking results of a 2D analysis project by changing perspective. Unlike real scale conversion, changing perspective does not require the camera and plane to be vertical. Measurements can be made on diagonal scenes. Takes depth elements into consideration when correcting movements that have depth.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 s (p. エラー! ブックマークが定義されていません。) for an explanation of the calculations used for changing perspectives.

Perform either of the following to display the measurement image window and make the settings for changing perspectives.

- ✓ Click [2D Construction] ⇒ [Calibration Status Settings] ⇒ [Changing Perspectives] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .

The [Changing Perspectives] dialog appears and then it switches to the change perspectives mode. Change perspectives settings can be made in this mode. When changing perspectives, [Changing Perspectives] appears in the [Calibration Mode Node].



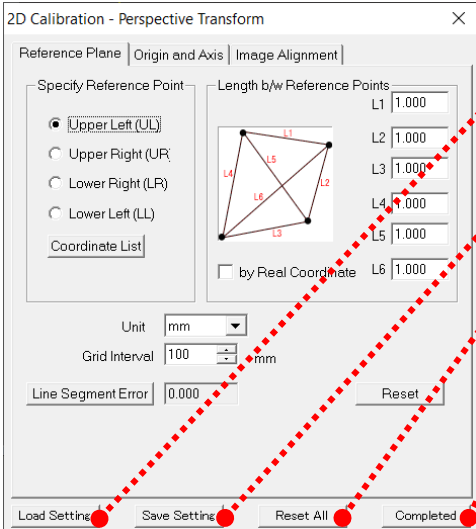
エラー! 参照元が見つかりません。 (**Change Perspectives Mode**)

Operation is performed both with the measurement image window and the changing perspective dialog.

The procedure for changing perspectives is as follows.

- ① Click on 4 points in the measurement image window.
- ② Input the length for the real space between the 4 points (6 lengths) or the coordinates between the real space (4 points) using the dialog.
- ③ Set the origin and axis if necessary.
- ④ Click Finish.

After closing the message, the change perspective parameters are automatically applied.



Data settings loaded from the file (\*.2cd).

Current settings saved to the file (\*.2cd).

Restores the values.






Sets the value to complete the calibration.

Calibration calculations are done automatically.

When other windows (graphs and such) are in the active window, or when the close button at the upper right is clicked, the calibration parameters are cancelled and the changing perspectives mode is ended.

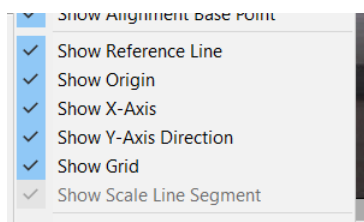
Click **Save Setting** to save the current settings to the settings file (\*.2cd).

Click **Load Setting** to load from the previously saved settings file (\*.2cd).

Quadrant  • White Dot  • Black Dot  • Fixed Point  can be used for the control point settings. Also, you can use Select Measurement Points  to select the tracked measurement points and set the control points with the same coordinates as the measurement points.

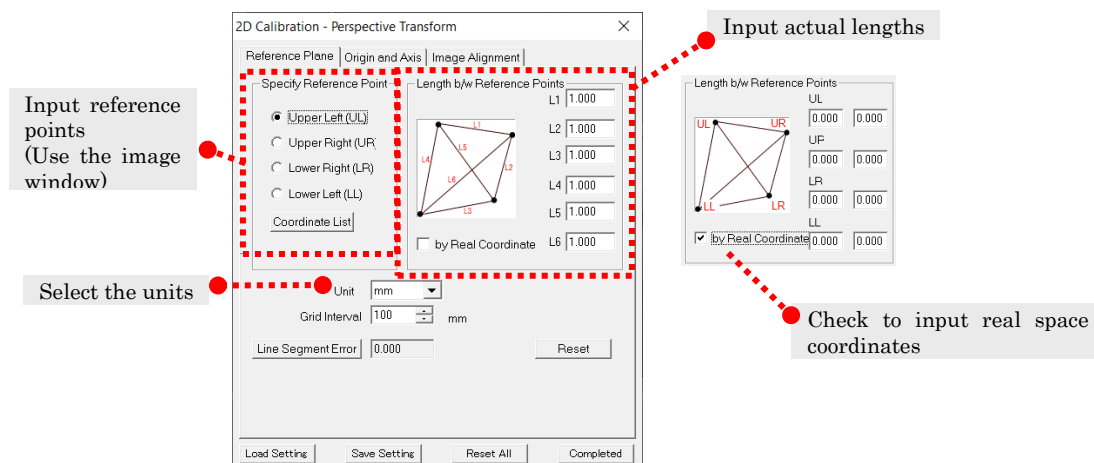
When in the changing perspectives mode, [Reference Line], [Origin] and [Grid] may appear in the image window, depending on the current change perspectives settings. The grid appears without taking optical distortion into consideration. If making settings for optical distortion correction, the grid displayed will be out of place from the real space grid. Instead of using for the exact location, use as a target for the axis.

Switch the display from Show • Hide from the right click menu.



### 5.3.1 [Reference Plane] Tab

Sets the parameters for changing perspectives using the [Reference Plane] tab. Designate 4 points with the coordinates for reference points and input the actual length between the four points using 6 lengths. The coordinates for the 4 reference points are input by clicking a point on the measurement image window. Input the actual lengths · real space coordinates using the dialog.



#### ● Input Reference Points

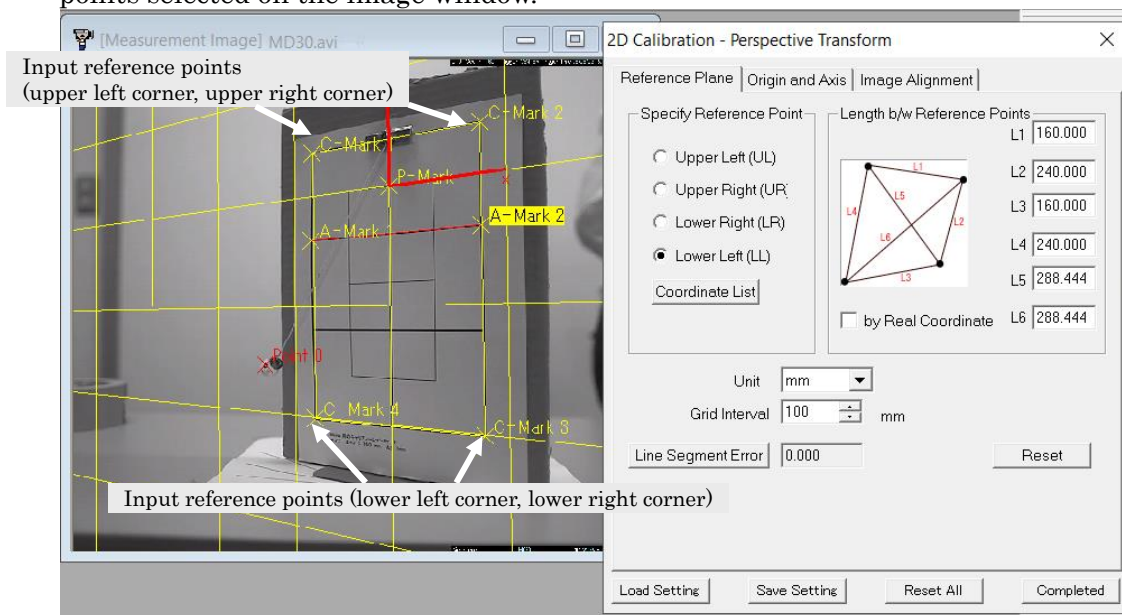
Click four points (upper left corner, upper right corner, lower right corner, lower left corner) in the measurement image window to set the coordinates. The operation for making the settings for the 4 points is different from when making the initial settings.

#### Initial Settings

Input the four points according to the following sequence. [Upper Left Corner] ⇒ [Upper Right Corner] ⇒ [Lower Right Corner] ⇒ [Lower Left Corner]

#### Reset after Setting 4 Points

Select the reference points using the dialog and adjust the location of the reference points selected on the image window.



### ● Input Actual Length

If [Input Coordinates] is not checked, input the 6 actual lengths between the four points of the reference points.

L1: Actual length between the upper left corner (UL) ⇔ upper right corner (UR)

L2: Actual length between the upper right corner (UR) ⇔ lower right corner (LR)

L3: Actual length between the lower right corner (LR) ⇔ lower left corner (LL)

L4: Actual length between the lower left corner (LL) ⇔ upper left corner (UL)

L5: Actual length between the upper left corner (UL) ⇔ lower right corner (LR)

L6: Actual length between the upper right corner (UR) ⇔ lower left corner (LL)

### ● Input Coordinate Values

If [Input Coordinates] is checked, input the real space coordinates for the four points of the reference points.

Here, the coordinates input have been subject to depth element correction. To define the coordinate system, make the settings in the [Origin and Axis] tab along with the coordinates input here.

UL: Real space coordinates for the upper left corner

UR: Real space coordinates for the upper right corner

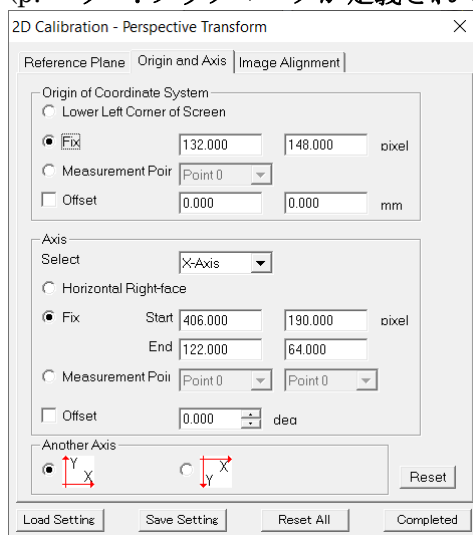
LR: Real space coordinates for the lower right corner

LL: Real space coordinates for the lower left corner

When input for the reference points and actual lengths is complete, the grid appears on the measurement image window.

### 5.3.2 [Origin and Axis] Tab

Set the origin and axis under the [Origin and Axis] tab. If setting [Fixed] in Origin and Axis, the input value is the same as the image coordinates shown at the right side of the status bar under the playback bar and does not correspond with the real space coordinates. The operation is the same as that in [エラー! 参照元が見つかりません。] of the [Origin and Axis] tab (p. エラー! ブックマークが定義されていません。).



When changing perspectives, make sure to use the appropriate settings since the origin and axis selected greatly impact the measurement results.

## 5.4 3D Calibration


To construct 3D data, multiple measurement images and the geometric relationship of the filming camera must be obtained.

Since the same relationship is required for each camera, 3D calibration must be conducted multiple times.

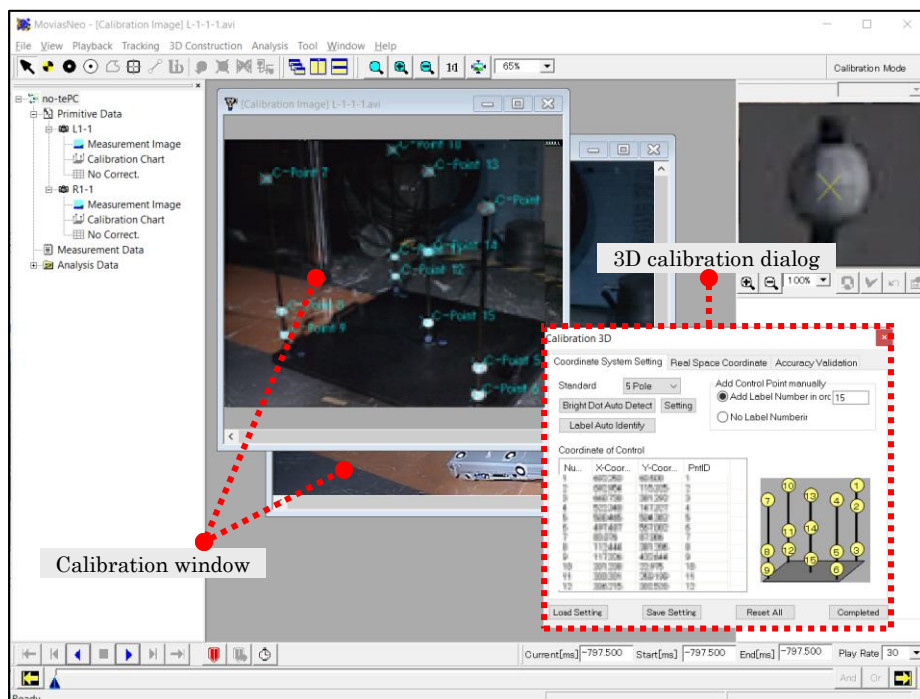
Perform [Control Point Real Space Coordinate Input] and [Image Coordinate Input on the Calibration Chart for Each Camera] for 3D calibration.

Designate the fixed measurement points on the calibration chart for the control points.

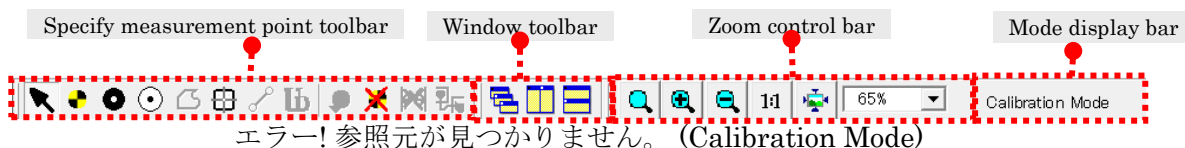
Perform any of the following to display the calibration image and start constructing 3D data.

- ✓ Click [Construct 3D Data] ⇒ [Calibration] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Switch to Calibration Mode] on the right click menu on the calibration window.

The [3D Calibration Dialog] appears, and it switches to the calibration mode. 3D calibration settings are made in this mode.



Overview of the Calibration Mode



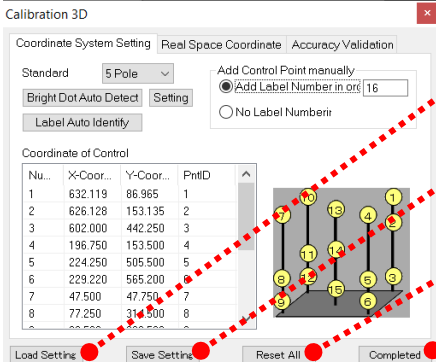


Operation is performed both with the calibration image window and the 3D calibration dialog.

The 3D calibration procedure is as follows.

- ① Input the real space coordinates for the control points.
- ② Click the control points on the calibration image.
- ③ Perform the operation in ② multiple times for the cameras for the measurement targets.
- ④ Perform the 3D data construction calculations.

When creating a project, the setting is automatically loaded when there is a setting file with the same name (extension of \*.3cd) in the same folder as the calibration image.



The screenshot shows the 'Calibration 3D' dialog box with three tabs: 'Coordinate System Setting', 'Real Space Coordinate', and 'Accuracy Validation'. The 'Coordinate System Setting' tab is active, showing a table of control points and a 3D visualization of a camera setup. Red dotted lines with circular endpoints point from text boxes to specific UI elements.

- Data settings loaded from the file (\*.3cd). Also loads the settings for the real space coordinates. Current settings saved to the file (\*.3cd). Settings for the real space coordinates are also saved.** (Points to the 'Load Setting' button)
- Restores values.** (Points to the 'Reset All' button)
- Make the settings to complete the calibration.** (Points to the 'Save Setting' button)

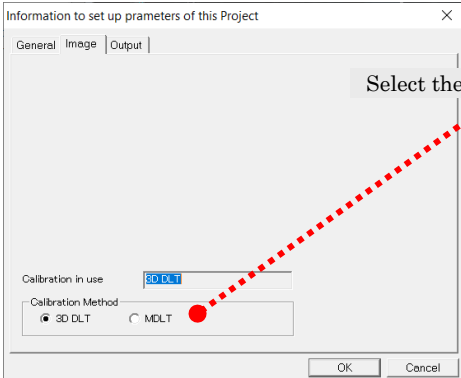
During calibration, click on other calibration windows to confirm the values set on the current window, and it switches to the active window operation and continues calibration. Click on something other than the calibration image to process in the same manner as that when clicking to finish.

In エラー! 参照元が見つかりません。 , if [Automatically Construct Measurement Data during 3D Analysis] is enabled, 3D data construction is performed automatically when the dialog is completed. Refer to the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) in Environmental Settings for details.

### 5.4.1 3D Calibration Parameter Calculation Method

The two methods of calculating 3D calibration in MOVIAS Neo include [3D DLT] and [MDLT].

To set the calculation method, click [File] → [Project Information] in the menu and select the calibration calculation method under the [Image] tab in the [Project Information] dialog.



The screenshot shows the 'Information to set up parameters of this Project' dialog box with three tabs: 'General', 'Image', and 'Output'. The 'Image' tab is active, showing options for 'Calibration in use' and 'Calibration Method'. A red dotted line with a circular endpoint points from a text box to the 'Calibration Method' section.

**Select the calibration calculation method.** (Points to the 'Calibration Method' section)

### 3D DLT

The basic method that calculates the parameters for 3D data construction. Input of a minimum of 6 points is required.

### MDLT

Calculates parameters for 3D data construction taking optical distortion into consideration. Input of a minimum of 8 points is required.

If there is optical distortion visible to the eye, consider using Optical Distortion Correction (p. エラー! ブックマークが定義されていません。).



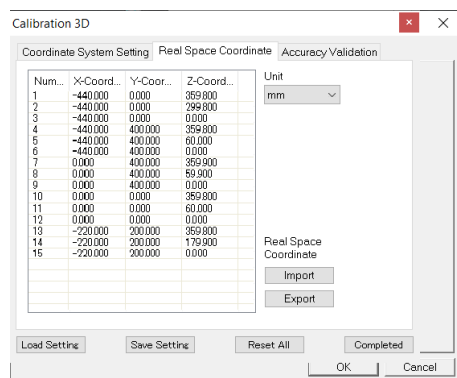
Both calculation methods require a minimum number of points but the accuracy cannot be guaranteed. We recommend calibrating using more points (10~15 points).

## 5.4.2 [Real Space Coordinates] Tab

[Control Point Real Space Coordinate Input] is performed under the [Real Space Coordinates] tab. 6 or more points with precise space coordinates are required for calibration (8 or more points for MDLT). Perform the either of the following to input the real space coordinates.

- ✓ Load from the real space coordinates file.
- ✓ Manually input on the real space coordinate list.

These real space coordinates are shared between cameras. Input is not necessary for calibration from the second and subsequent cameras.



### Real Space Coordinate List

Shows the real space coordinates. Can be manually input.

### Unit

Units for real space coordinates. Select from m, cm, mm, um. These units are applied to 3D data construction.

### Import • Export

Loads • saves coordinates. The file format is CSV (\*.csv).

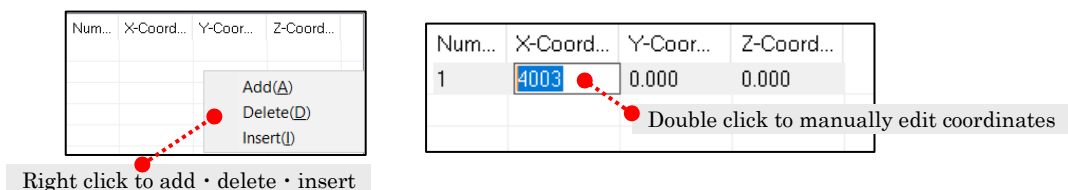
### ● Edit the Real Space Coordinate List

You can edit the number and coordinates on the list. Double click to edit.

Right click to • delete • insert.

Double click on the row under the last input to add a new row.

The point can be switched when inputting previously saved points to change the number.



### ● Real Space Coordinate File Format

Real space coordinates can be imported and exported. The file format is the comma separated value (CSV) format. An example is shown below.

#Point No	X	Y	Z
1,	0.4,	360.7,	2.6
2,	0.5,	360.9,	58.3
3,	0.4,	361.5,	435.7
4,	0.0,	0.0,	0.0
5,	-0.1,	0.9,	-376.5
6,	0.2,	-0.1,	-438.4
7,	400.1,	3.4,	0.9
#	(Unit: mm)		
Unit=mm			

Set the coordinates, number and units.

The 1<sup>st</sup> column indicates the number. The 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> columns show the XYZ coordinates.

They are loaded as:

Number1, X coordinate, Y coordinate, Z coordinate

Number2, X coordinate, Y coordinate, Z coordinate

Number3, X coordinate, Y coordinate, Z coordinate

If starting with "Unit=", the following unit is set. If there are multiple, the unit for the last row is set. If not set, mm are set. Available units include mm, cm, um, m. In the example above, it is written in the last row but it can be written in the first row instead. Ignore rows starting with letters, empty rows or duplicate numbers.

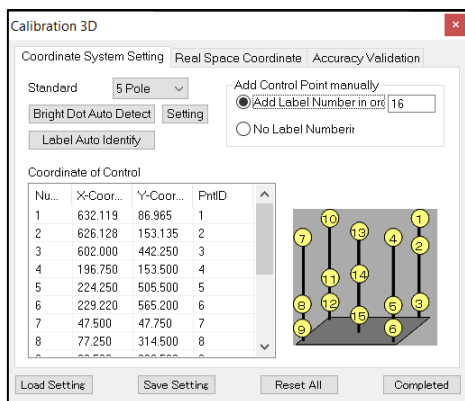
In the example below, two points (Point 1, Point 2) are loaded and the units are set to "cm".

"Point 1" loads the coordinates for "Point 1" in the second row.

#Point No	X	Y	Z
1,	0.4,	360.7,	2.6
1,	0.5,	360.9,	58.3
Ignore this row.			
(new row)			
(new row)			
2,	400.1,	3.4,	0.9
#	(Unit: mm)		
Unit=mm			
Unit=m			
Unit=cm			

### 5.4.3 [Image Coordinate Settings] Tab

In the [Image Coordinate Settings] tab, the image coordinates for the control points are verified on the calibration image and the real space coordinates assigned



#### Control Point List

Shows the currently added control points.

#### Standard Chart

Select from [4 Pole], [5 Pole], [AMASS] and [Custom] for the calibration chart to be used for [Auto Identify Label].

#### Manually Add Control Points

Set the method of adding control point numbers.

#### Auto Detect White Dot

Auto detect white dots from calibration images based on the settings.

#### Auto Identify Labels

Automatically identify the control point numbers for the real space coordinates of the standard chart.

Perform the following operations.

- ① Select the method for adding numbers in [Manually Add Control Points].
- ② Click the control point on the calibration image to add. Adjust the position in zoom view.
- ③ Use the エラー! 参照元が見つかりません。 (refer to p. エラー! ブックマークが定義されていません。 ) and auto identify labels to assign the numbers set in the [Real Space Coordinates] tab.

Use the procedures above to perform calibration on a single camera. Perform this operation for each calibration image.

If the control point is a white dot, the [エラー! 参照元が見つかりません。 ] function can be used to add control points

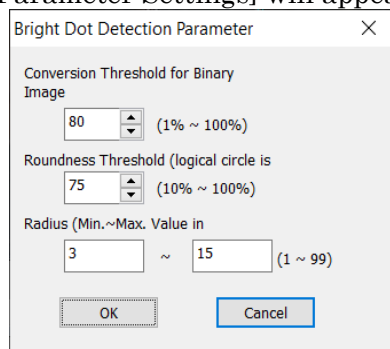
If using a standard chart (4 Pole, 5 Pole, AMASS), you can use the [エラー! 参照元が見つかりません。 ] function (p. エラー! ブックマークが定義されていません。 ).

## ● Auto Detect White Dot

Detects white dot control points from the calibration image as a batch. Consider using the [Specify Detection Area] function for scenes with bright backgrounds and scenes with unrelated white dots. The procedure is as follows. If necessary, specify the detection area. Auto detection is performed on the entire image if there is no detection area specified.

### (a) Detection Parameter Settings

Click **Setting** under the [Image Coordinate Settings] tab and the [White Dot Detection Parameter Settings] will appear. Use the dialog to set the white dots to be detected.



#### Conversion Threshold for Binary Image

Sets the brightness threshold for white dot detection.

#### Roundness Threshold

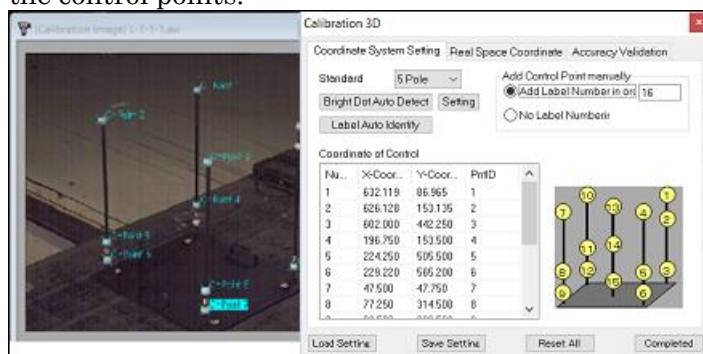
Sets the roundness.

#### White Dot Radius

Sets the range for the size of the point detected.

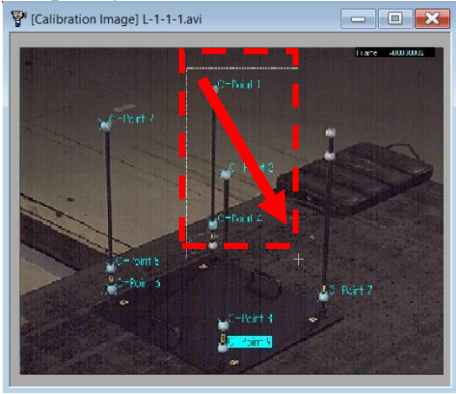
### (b) Detect

Click **Bright Dot Auto Detect** under the [Image Coordinate Settings] tab to sequentially detect the control points.

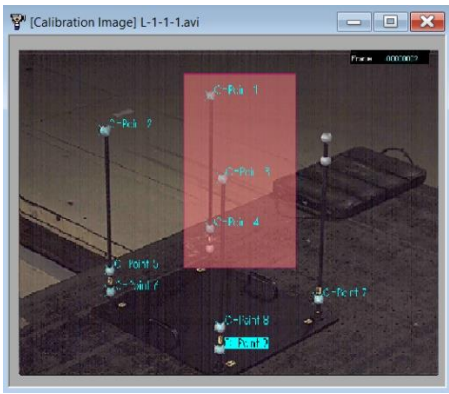


(c) Specify Detection Area

Specifies the detection area for white dots with [Auto Detect White Dots]. If an area is specified, white dot detection is performed only on dots within that area. Detection can be performed only on areas required, such as scenes with unrelated white dots. Click [Detection Range] on the right click menu and drag on the calibration image window to specify the detection area.



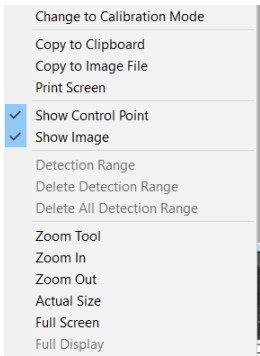
Drag over the area to specify



Detection area set where dragged

Multiple detection areas can be added. Areas created can be moved or resized. The detection area can be automatically deleted when the 3D calibration mode is finished.

Use the right click menu to add or remove detection areas.



**Detection Area**

Check to add or delete detection areas.

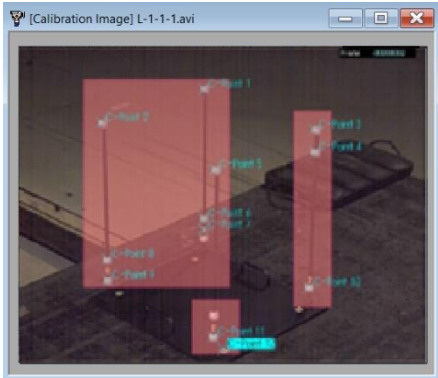
**Delete Detection Area**

Deletes the selected detection area.

**Delete All Detection Areas**

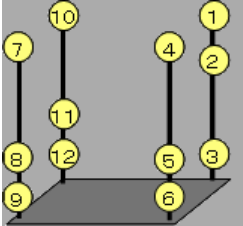
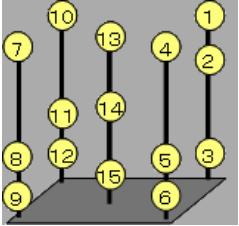
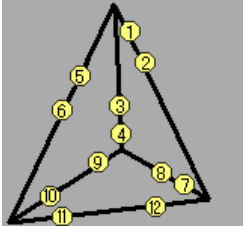
Deletes all of the detection areas in the window.

After setting the areas, click **Bright Dot Auto Detect** under the [Image Coordinate Settings] to sequentially detect the control points within the [Detection Area].



● Auto Identify Labels

Identifies the control points and the real space coordinates on the calibration image. Valid with charts designated as the standard chart. Supports the following types of charts.

		
4 Pole Chart (12 Points)	5 Pole Chart (15 Points)	AMASS Chart (12 Points)

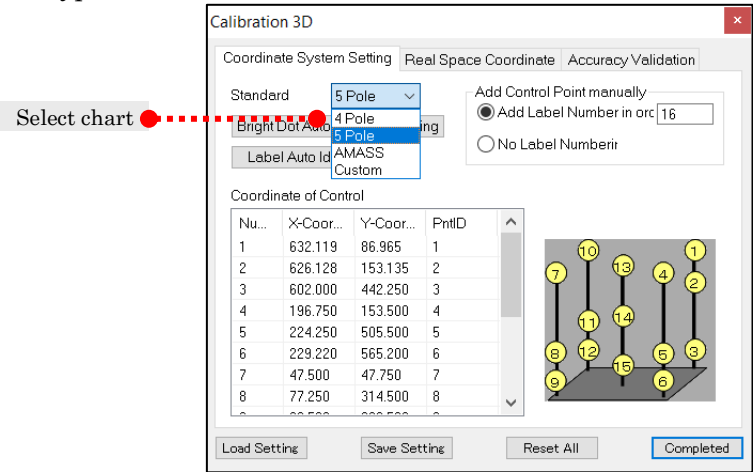
The control points must be grouped, the numbers for the control points deleted and new positions established.

If the number of control points are designated under the [Real Space Coordinates] tab for something other than the charts given above, [Custom] is automatically selected in the chart selection combination box. Do not use the auto identify label function when [Custom] is selected

The procedure for the auto identify label function is found in エラー! 参照元が見つかりません。 below.

(a) Select the Type of Chart for the Real Space Coordinates

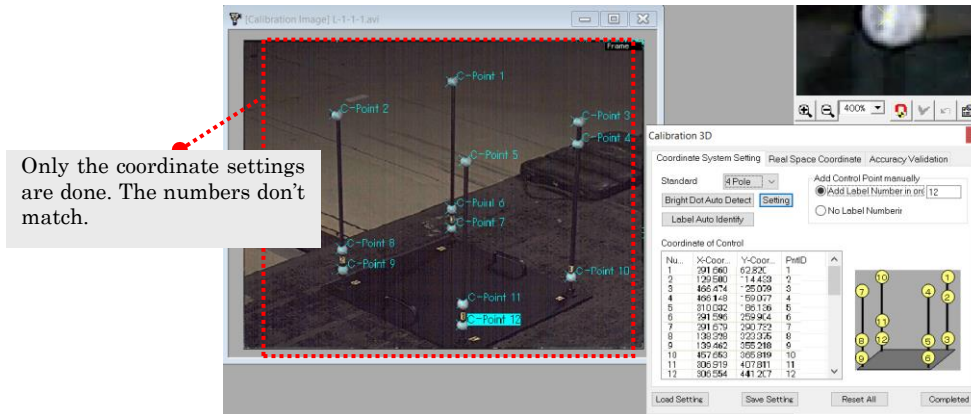
Select the type of chart to be used.





### (b) Add Control Points

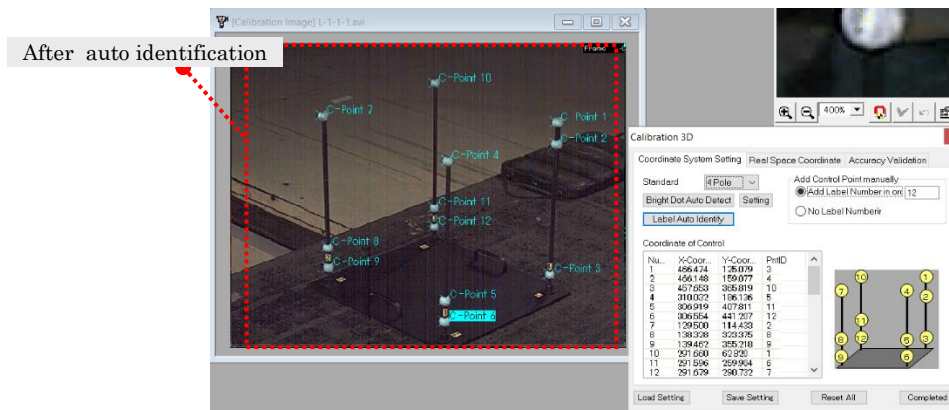
Add control points to the calibration image. The position and number must match. The figure below shows an example before auto identification of labels. The positions match but the control point numbers don't match.



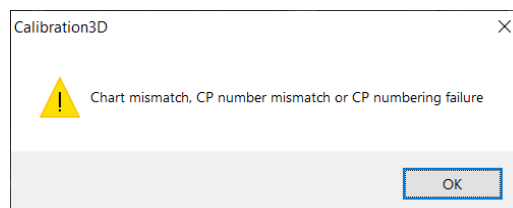
### (c) Click on Auto Identify Labels

Click [Auto Identify Labels]. If the auto identification of labels is successful, the identified numbers will appear.

The figure below shows an example after auto identification of labels. The control point numbers are corrected according to the chart sequence.



If auto identification of labels fails, the following message appears. Check to make sure the number of control points matches, the control points haven't shifted and the type of chart is accurate.



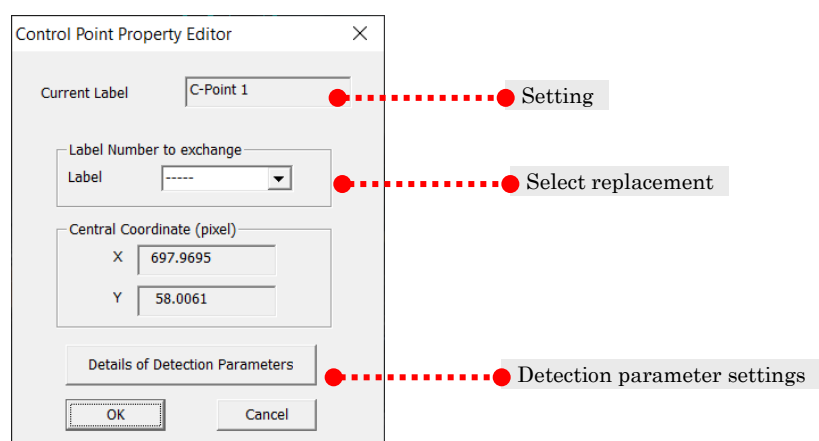


### ● Control Points Properties Editor

The 3D calibration measurement point properties are shown in the [Control Point Properties Editor]. Replaces detection points and sets detection parameters.

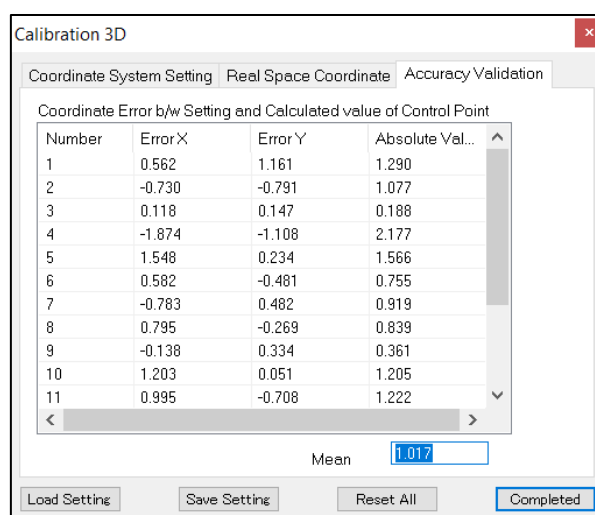
Replacement of detection points cannot be done when the selection for replacement is “---”. If another number is selected, that point is replaced with the current point number.

Detailed detection parameter settings are the same as the detailed tracking parameters. s (p. 4–11) for details.



### 5.4.4 [Precision Verification] Tab

Under the [Precisions Verification] tab, calibration data calculated for one camera is used to calculate and display the reprojection error. The units for this error are pixels.



## 5.5 Optical Distortion Correction

If performing analysis with MOVIAS Neo, we recommend filming with a “lens without optical distortion”. However, you may want to perform measurements with a “lens with optical distortion” such as with wide angle photography using a single camera. With “videos with optical distortion” filmed in this manner, analysis is not possible due to the fluctuations in the length between two points according to their positions in the image. To perform analysis, you need to perform “optical distortion correction”.

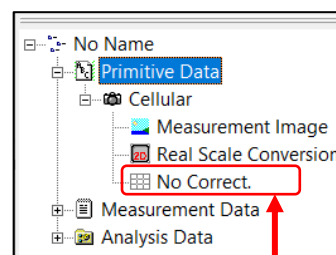
MOVIAS Neo has an [Optical Distortion Correction] function and an [Extended Optical Distortion Correction] function.

With the [Optical Distortion Correction] function (p. エラー! ブックマークが定義されていません。), basic optical distortion correction is performed using a grid chart image.

The [Extended Optical Distortion Correction] function (p. エラー! ブックマークが定義されていません。 ) is a revised version of the [Optical Distortion Correction] function. Optical distortion correction is performed using a grid line chart or a chessboard chart. Qualitative optical distortion correction can be performed without a specialty chart (p. 5 – 35).

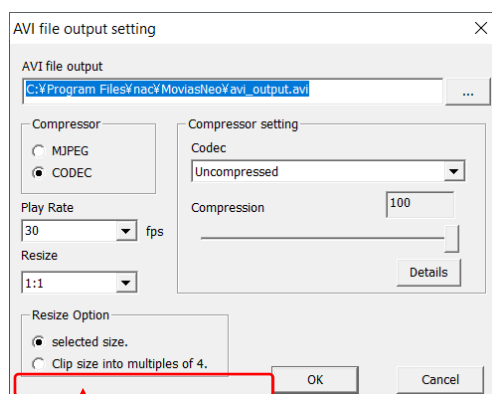
If there are multiple cameras, add and correct each optical distortion correction chart.

In the [Optical Distortion Correction Chart] node, the currently applied optical distortion correction method is shown. After creating a project, [No Distortion Correction] appears and the real coordinates are calculated without performing optical distortion correction. If the [Optical Distortion Correction] function is applied and the [Optical Distortion Correction Chart] and the [Extended Optical Distortion Correction] functions are applied, [Extended Optical Distortion Correction (Radial/Polynomial)] appears and each type of optical distortion correction is performed.



“No distortion correction” shows after creating a project

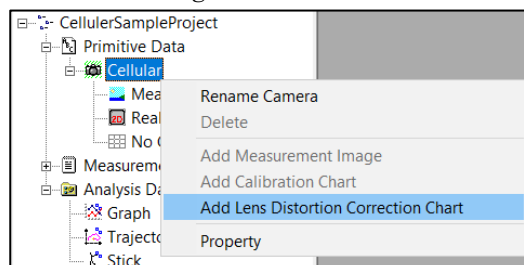
If you perform AVI export on the measurement image with distortion correction activated, you will be able to export the image after being corrected for distortion.



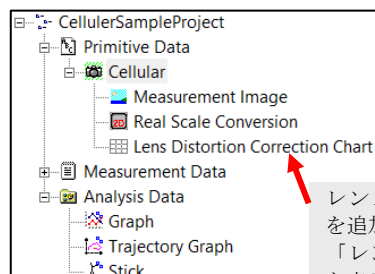
Check for AVI output of images subject to distortion correction.

### 5.5.1 Add Optical Distortion Correction Chart

First, add an optical distortion correction chart to use the [Optical Distortion Correction] function. Select the camera node to be added and click [Add Optical Distortion Correction Chart] in the right click menu.

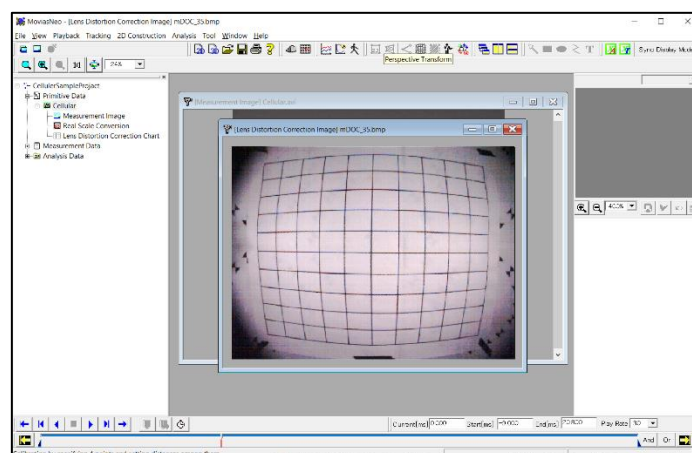


Select [Add Optical Distortion Correction Chart] from the right click menu on the camera node



The [Optical Distortion Correction Chart] is added


レンズ歪み補正チャートを追加すると、「レンズ歪み補正チャート」と表示されます。



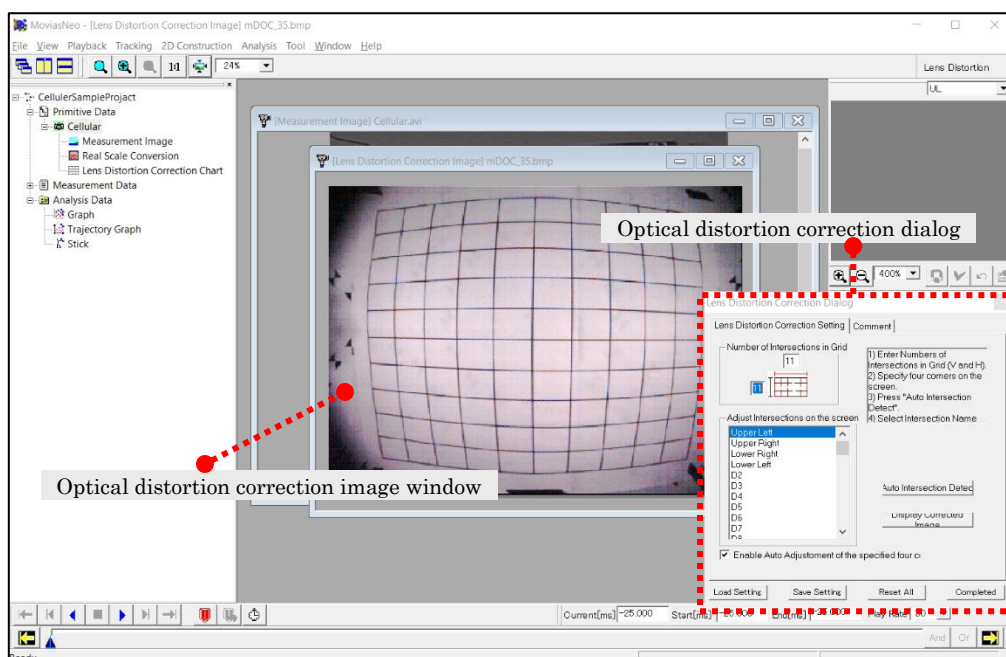
If an optical distortion correction chart is added, the optical distortion correction image automatically appears.

## 5.5.2 Optical Distortion Correction Mode

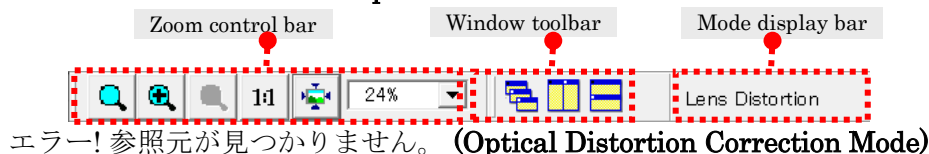
Access the optical distortion image window and perform either of the following to switch to the optical distortion correction mode.

- ✓ Click on [Switch to the Optical Distortion Correction Mode] in the right click menu in the optical distortion correction image window.
- ✓ Click  from the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .

The [Optical Distortion Correction Dialog] appears and it switches to the optical distortion correction mode. The optical distortion correction settings are made in this mode.



### Overview of the Optical Distortion Correction Mode



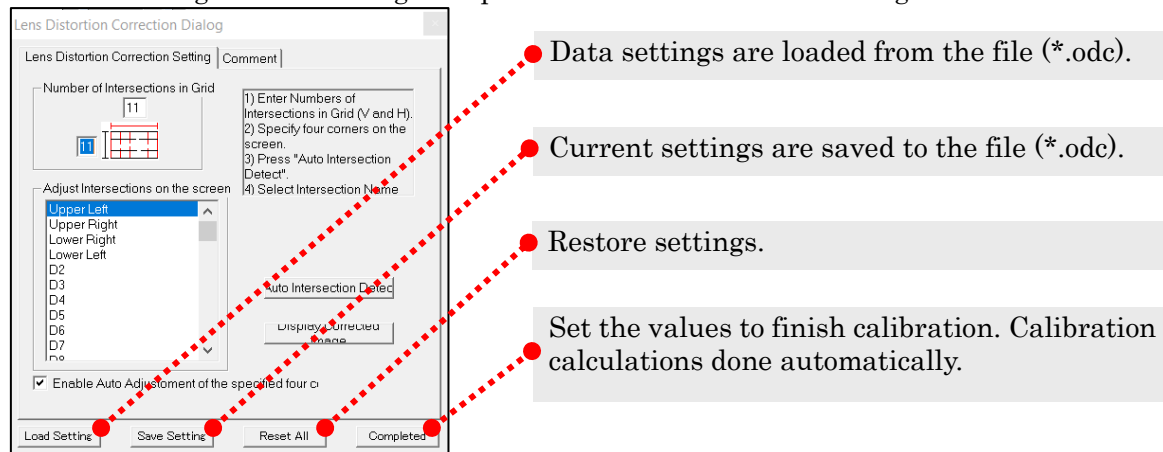
Operations can be carried out in the optical distortion correction image window and the optical distortion correction dialog. Perform the following for optical distortion correction.

- ① Set the size of the grid.
- ② Use the dialog to select the four corners and input each on the optical distortion correction image.
- ③ Click [Auto Detect Intersection]. Or manually input all of the points.
- ④ After setting all of the grid points, click [Show Corrected Image] to confirm the corrected image.
- ⑤ Click [Finish] to complete the processing and save the parameters. The distortion correction parameters are automatically applied when building measurement data.



### 5.5.3 Optical Distortion Correction Dialog

The optical distortion correction operation is performed in the optical distortion correction image window using the optical distortion correction dialog.



#### ● [Optical Distortion Correction Settings] Tab

##### Number of Grid Intersections

Set the vertical and horizontal grid lines in a range from 5~25.

##### Adjust the Location of the Intersections Detected on the Image Window

Shows a list of the intersections. The unique names of "Upper Left", "Upper Right", "Lower Right", "Lower Left" are assigned to the four corners.

##### Enable the Function to Auto Adjust the Locations of the Four Corners Designated

If the corners are clicked on the optical distortion correction image when this is checked, the locations of the four corners are automatically set to estimated locations.

If unchecked, the clicked coordinates are manually set.

##### Auto Detect Intersections

After inputting the four corners, press auto detect intersection to auto detect the grid.

Auto detection failure may occur with distorted images. Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on auto detection of intersections.

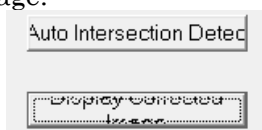
##### Show Corrected Image

Display Corrected Image

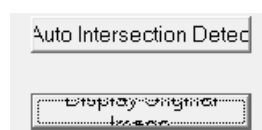
##### Show Original Image

Display Original Image

After setting all of the intersections, click show corrected image to show the image after optical distortion correction. During display of the corrected image, the button to show the original image will appear. Click show original image to display the original image.



Show Original Image



Show Corrected Image

#### ● [Comments] Tab

You can enter comments relating to optical distortion correction.

### 5.5.4 Extended Optical Distortion Correction

Extended optical distortion correction performs the following.

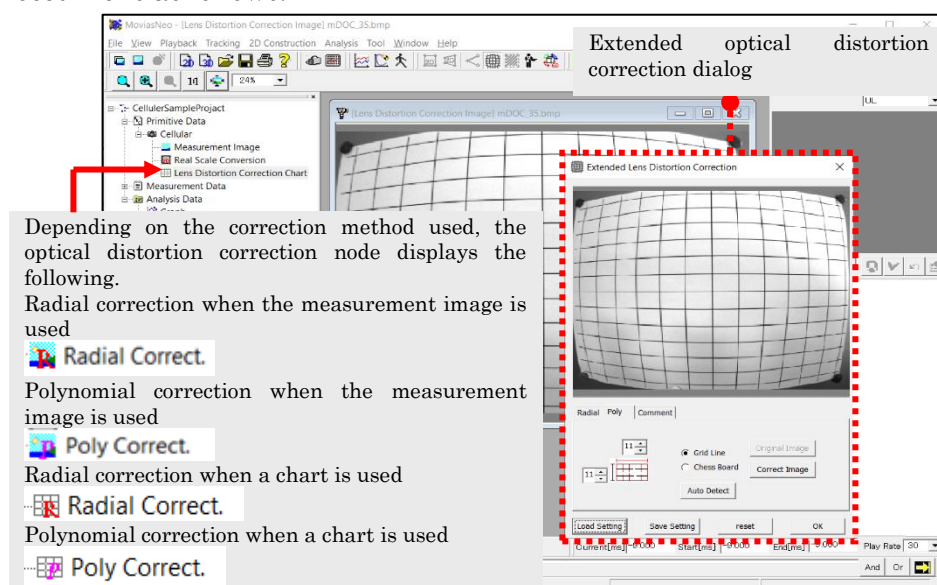
- Qualitative distortion correction without an optical distortion correction chart
- Auto detection of intersections from a grid or chessboard
- Revised optical distortion correction

To perform optical distortion correction, perform the following operations with the measurement image or optical distortion correction image shown. The optical distortion correction image is preferentially used. After adding an optical distortion correction image, you must delete the optical distortion correction image from the project tree to perform manual distortion correction on the measurement image.

- ✓ Click [2D Construction] ⇒ [Extended Optical Distortion Correction] (for 2D analysis) on the menu.
- ✓ Click [3D Construction] ⇒ [Extended Optical Distortion Correction] (for 3D analysis) on the menu.

The [Extended Optical Distortion Correction] dialog appears. Once extended optical distortion correction is applied, the display of the [Optical Distortion Correction Node] is updated according to the method applied.

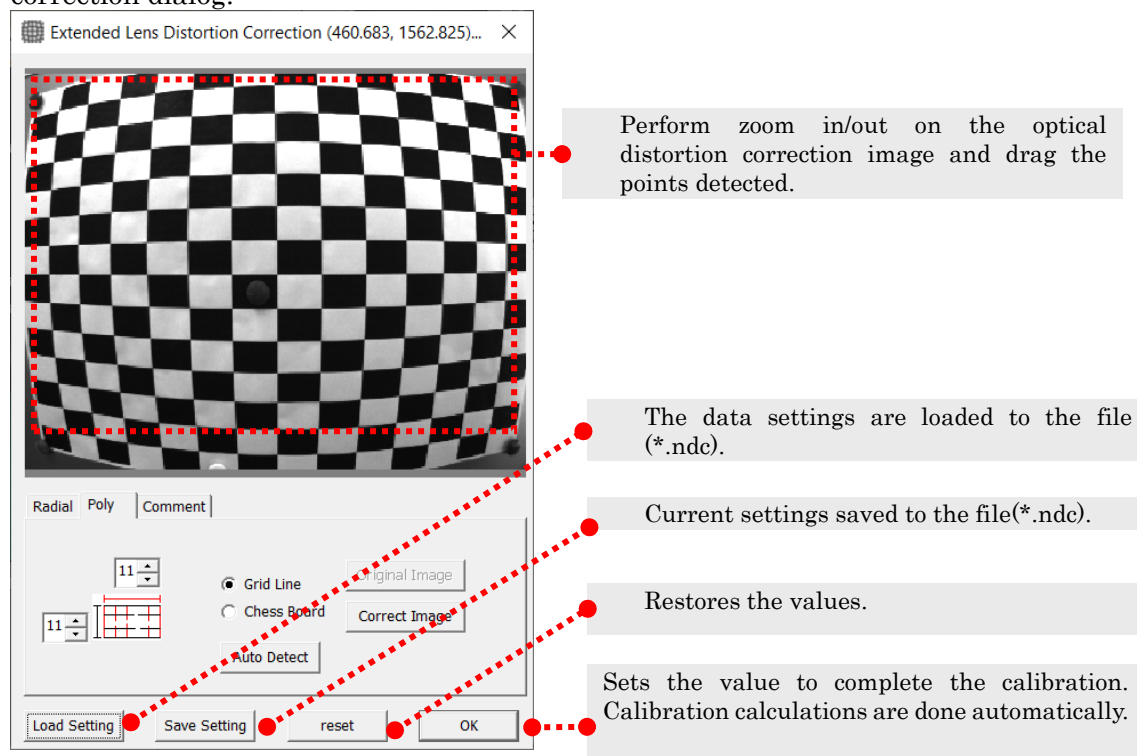
The operation is performed in the [Extended Optical Distortion Correction] dialog. The procedure is as follows.



- ① Select either radial or the polynomial tab.
- ② Set according to each tab. Refer to Radial (p. 5-35) or エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for the detailed settings.
- ③ Check the corrected image and confirm that the distortion has been corrected.
- ④ Click [OK] to finish the process and save the parameters. The distortion correction parameters are automatically applied when building measurement data. When clicking [OK], correction for the tab shown ([Radial] or [Polynomial]) is enabled. To set the hidden tab, reset and disable.

### 5.5.5 Extended Optical Distortion Correction Dialog

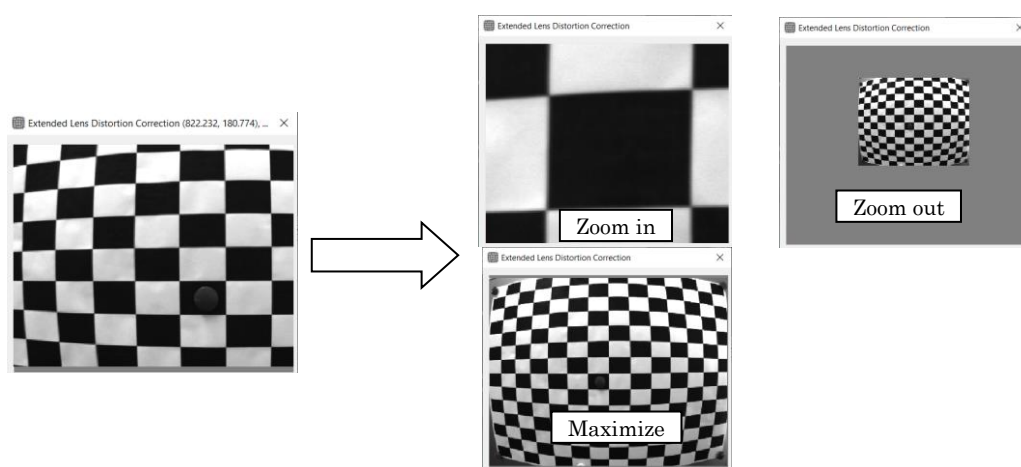
Extended optical distortion correction is performed with the extended optical distortion correction dialog.



#### [Extended Optical Distortion Correction]

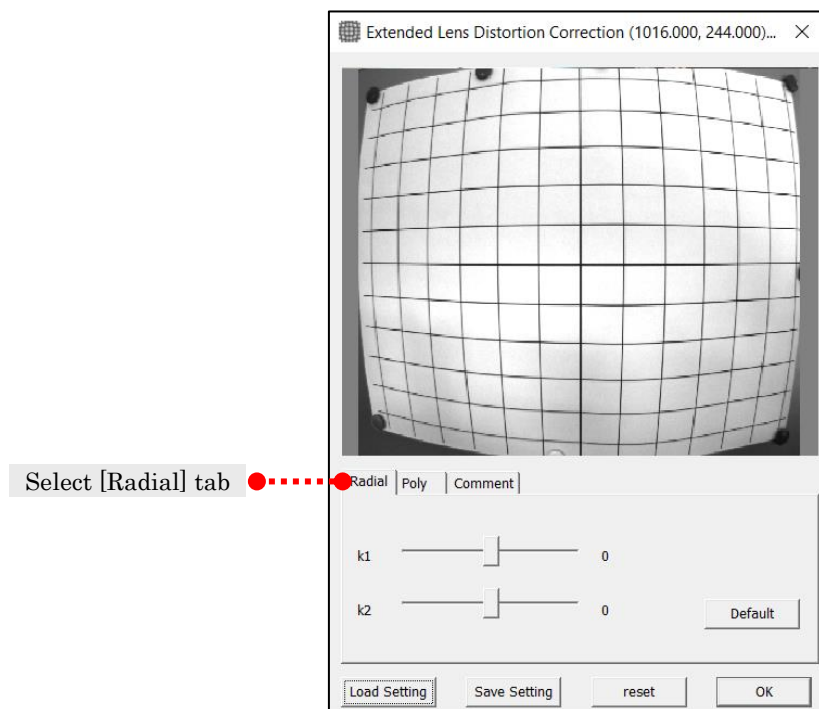
Use the radial tab or the polynomial tab to set the optical distortion correction. Include comments under the [Comments] tab.

You can move the image in the image window with [Maximize], [Zoom In], [Zoom Out] or by using the mouse wheel.





## ● Radial Tab



Select the [Radial] tab in the extended optical distortion correction dialog to perform radial correction.

Radial correction performs distortion correction without using specialty charts.

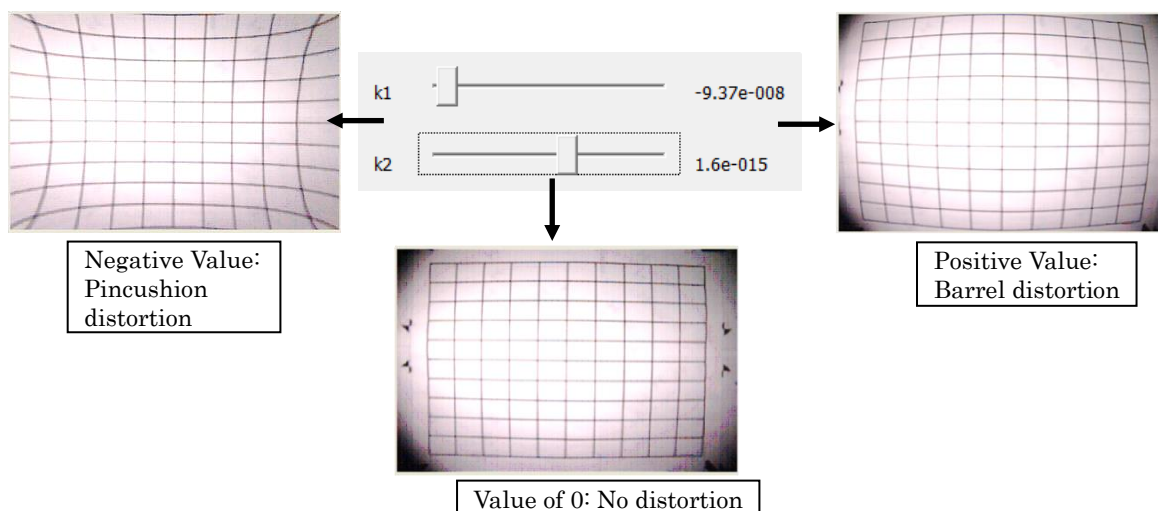
Precise correction is not performed since it is qualitative correction. To perform precision correction, please refer to the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) .

Details of radial correction settings are shown in the figure below.

Use the k1, k2 slider to apply distortion correction to the image.

k1 is the parameter to correct the distortion mostly in the middle of the image while k2 is the parameter to correct the distortion mostly on the edges of the image.

Click [Default] to disable distortion correction.

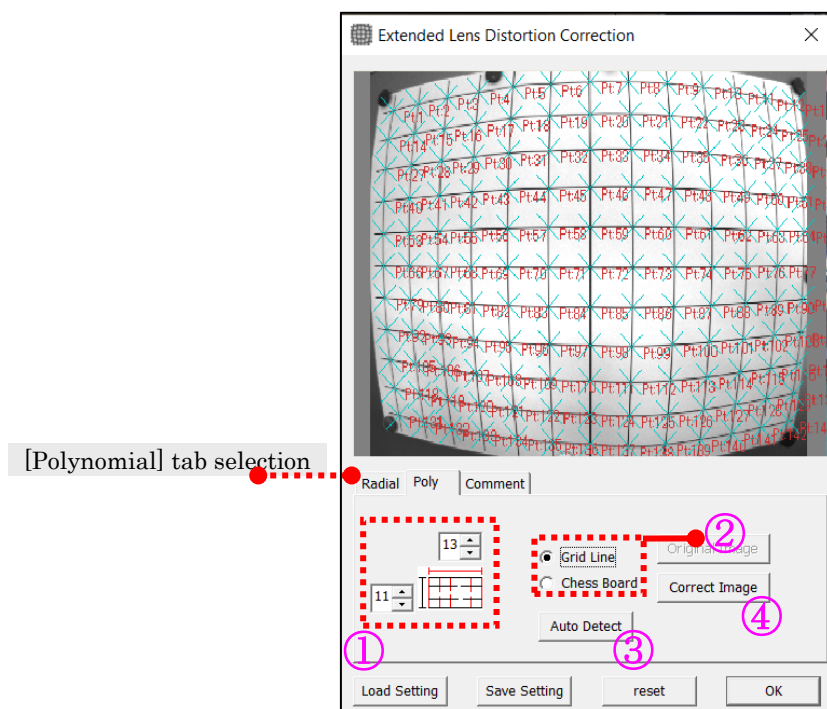


**Radial Correction Settings**

## ● Polynomial Tab

Select the [Polynomial] tab in the extended optical distortion correction dialog to perform polynomial correction.

Optical distortion correction settings are made from the image of the optical distortion correction chart filmed.

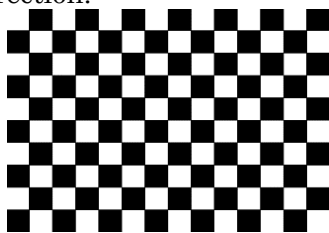


The procedure is as follows.

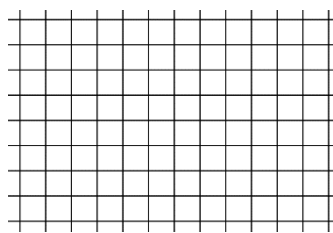
- ① Set the number of vertical and horizontal detection points in a range from 5~50.
- ② Select either grid or chessboard as the type of auto detection chart.
- ③ Click [Auto Detect] to search.  
If auto detection is successful, the detection points are shown on the image. If auto detection fails, refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).
- ④ After auto detection, click [Corrected Image] to confirm the corrected image.

### (a) Chart Types

The following charts can be used for auto detection with the polynomial method of correction.



Chessboard (Detection of the corners)



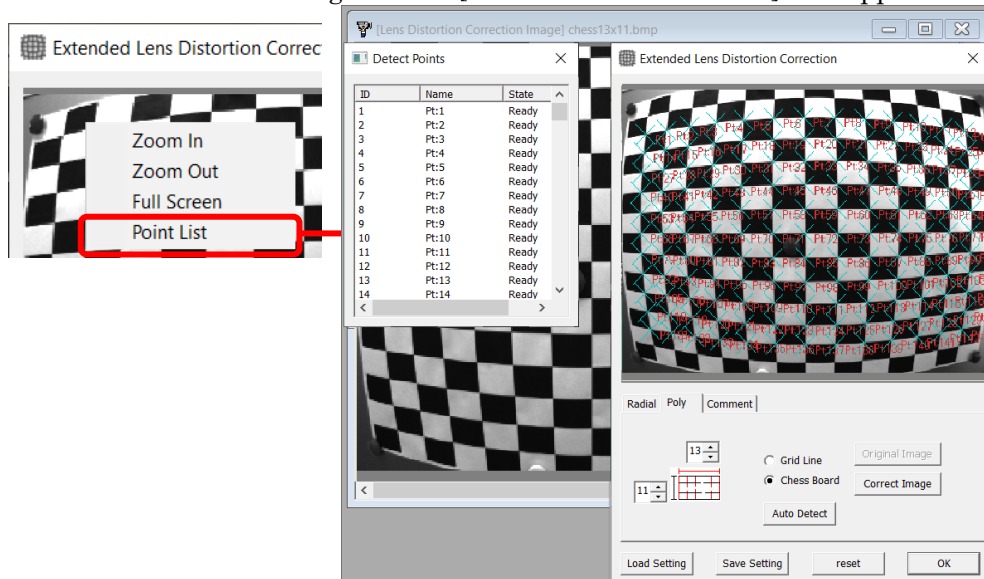
Grid (Detection of the intersections)

### (b) Manual Input of Intersections

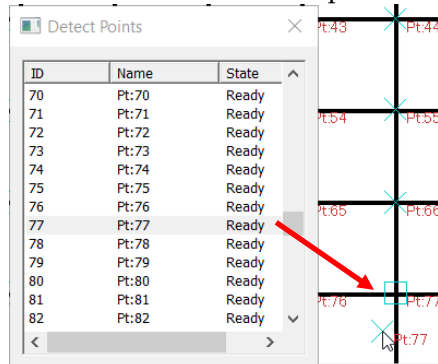
Manual input of intersections on the optical distortion correction image.

If using something other than the standard optical distortion correction charts and if auto detection is not possible, you can manually input the intersections for correction.

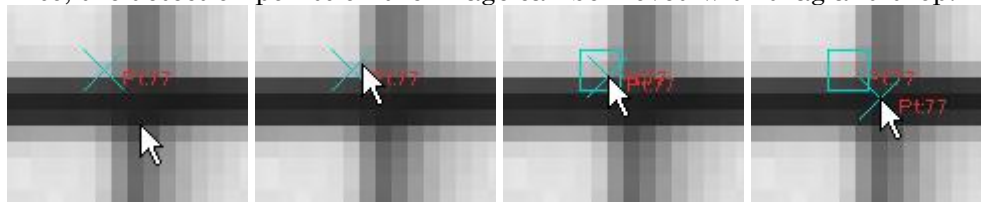
Select [List of Detection Points] from the right click menu of the extended optical distortion correction dialog and the [List of Detection Points] will appear.



Select the points to set manually from the list of detection points and click the image to set these as detection points.



Also, the detection points on the image can be moved with drag and drop.



### 5.5.6 Enable • Disable Optical Distortion Correction

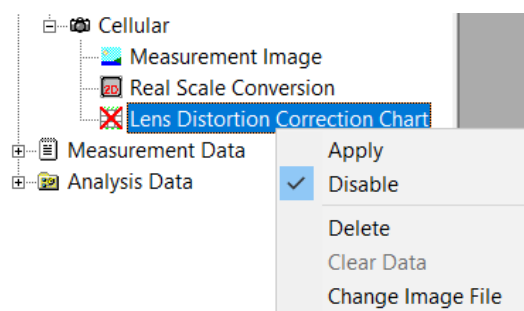
After setting the optical distortion correction, you can switch between enable • disable correction.

To disable optical distortion correction, select the optical distortion correction node on the project tree and select [Disable] on the right click menu. If [Disable] is selected, the measurement data is updated without performing optical distortion correction.

To enable optical distortion correction, select the optical distortion correction node on the project tree and select [Enable] in the right click menu.

The [Enable] and [Disable] settings can be set while in the synchronized display mode or the display mode.

To delete all of the optical distortion correction parameters select [Delete] from the right click menu of the optical distortion correction node.



**Right click menu on the optical distortion correction node**

5.5.7 Auto Detect Function for Optical Distortion Correction

Functions for optical distortion correction include the auto adjust function for the four corners and the function to auto detect intersections from an optical distortion correction chart. These functions have the following limitations. Images where auto detection failed can still use auto detect by reversing the colors or removing the chart part from the image.

1. Intervals in the vertical • horizontal directions are equidistant. But the vertical • horizontal intervals do not have to be the same.
2. The following limitations apply to grids.

① Chart must be created with black lines on a white background

② Black lines other than those on the chart are not included

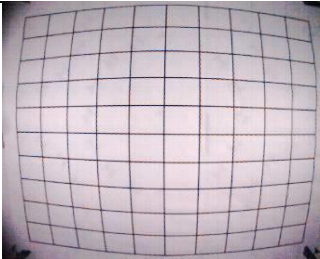
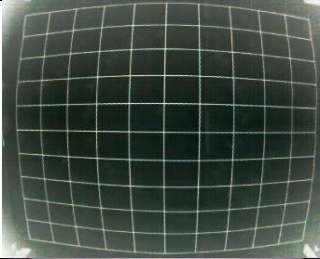
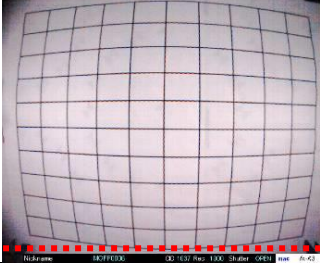
③ For optical distortion correction, a square chart where the lines do not extend from the outside of the chart

④ For extended optical distortion correction, a chart with a grid where the lines extend from the outside of the chart

We recommend filming optical distortion correction charts as follows.

1. There should be more intersections and corners in the horizontal direction than the intersections and corners in the vertical direction.
2. Marker arrangement in chessboards and grids should have at least 17 columns and 13 rows.
3. The number of intersections and corners in the horizontal and vertical directions should be an odd number, and you should film by aiming at one intersection centered on the camera image.

These limitations do not apply if manually inputting the intersections.  
The chart below shows image examples of successful and failed auto detection of intersections.

Auto Detection Possible		Example of an image for auto detection of intersections. However, auto detection of intersections may fail if the image has severe distortion.
Auto Detection Not Possible		The chart image must have black lines on a white background to perform auto detection. Auto detection fails in the figure to the left because the chart image has white lines on a black background.
Auto Detection Not Possible		Detection fails due to the presence of an unrelated black line at the bottom of the chart. <div>Black line unrelated to the chart</div>



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## 6. Create Measurement Data

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### 6.1 Create Measurement Data

Measurement data refers to the values from calibration of tracking data and the application of parameters such as coordinate conversion and distortion correction. Tracking data and calibration parameters are used to create measurement data.

#### 6.1.1 Create Measurement Data for a 2D Analysis Project

Measurement data is automatically calculated for 2D analysis projects when switching to that mode. If no calibration was performed, the measurement data is created using 1 mm /pixel and a Z coordinate of "0".

The calculation results can be confirmed on a measurement graph • measurement list • measurement Trajectory Figure. For details, refer to 6.1.3 Measurement Graphs, Measurement Lists (p. 6–2).

#### 6.1.2 Create Measurement Data for a 3D Analysis Project

Perform any of the following to create measurement data for 3D analysis projects. You must conduct calibration in advance.

- ✓ Click [3D Construction] ⇒ [Create 3D Measurement Data] on the menu.
- ✓ Check [Automatically Construct Measurement Data during 3D Analysis] under the [Reconstruction Settings] in the [Environmental Settings] dialog to automatically create measurement data in this mode.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for details on measurement data construction failures.

Calculation results can be confirmed with a measurement graph, measurement list, measurement Trajectory Figure. For details, refer to 6.1.3 Measurement Graphs, Measurement Lists (p. 6–2).

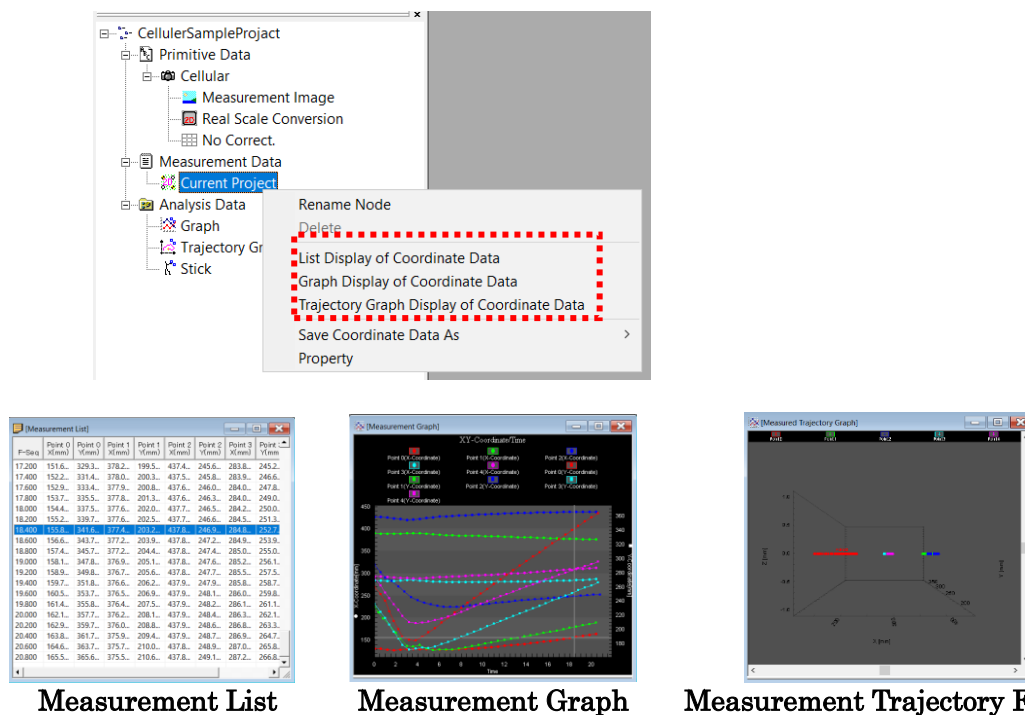
### 6.1.3 Measurement Graphs, Measurement Lists, Measurement Trajectory Figures

If the measurement data is created, the current project node is added to the measurement data node.

Measurement graphs, measurement lists and measurement trajectory figures can be displayed from the right click menu of the current project.

(Double click on the current project node to show the measurement list.)

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) to check the tracking data.



### 6.1.4 Automatic Updates of Measurement Data

If repositioning or deleting measurement points that make up virtual points (p. エラー! ブックマークが定義されていません。) or calculate partial gravity (p. エラー! ブックマークが定義されていません。) or if updating measurement data by performing calibration, the virtual points and calculate partial gravity are recalculated.

If updating measurement data by performing calibration, the virtual points and center of gravity points are recalculated.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) to automatically update graphs.



### 6.1.5 Evaluate 3D Data Construction Errors

Shows the data errors made during creation of the 3D measurement data.

Click [3D Construction] ⇒ [Evaluate 3D Construction Errors] on the menu to display the data errors.

**Construction Error of 3D Calibration Chart (Error Tab)**

Number	Error X	Error Y	Error Z	Absolute Error
1	19.602	391.497	2.097	391.993
2	-3.827	-75.175	-0.563	75.274
3	-8.532	-112.477	-0.689	112.802
4	-2.261	13.897	-0.133	14.081
5	3.030	34.857	-0.245	34.990
6	1.754	35.304	-0.038	35.348
7	1.639	-2.518	0.146	3.008

**Construction Error of 3D Calibration Chart (Calculated Value Tab)**

Number	Coordinate X	Coordinate Y	Coordinate Z
1	82.398	-369.497	-1.097
2	107.827	175.175	1.563
3	116.532	312.477	2.689
4	112.261	286.103	2.133
5	116.970	298.143	3.245
6	120.246	309.696	4.038
7	142.361	457.518	4.854

The coordinates calculated from the image coordinates, the calculated coordinates and their differences are shown in the [Construction Errors in 3D Calibration Charts] dialog. The units and mean errors are also shown.

The calculated values are the 3D coordinates calculated from the image coordinates input during 3D calibration. The units for the coordinates are the units from the real space coordinates on the calibration chart.

This is different from the errors shown under the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) in the [3D Calibration] dialog.

### 6.1.6 Show Measurement Data Construction Status

Displays information on measurement points that failed during construction of measurement data.

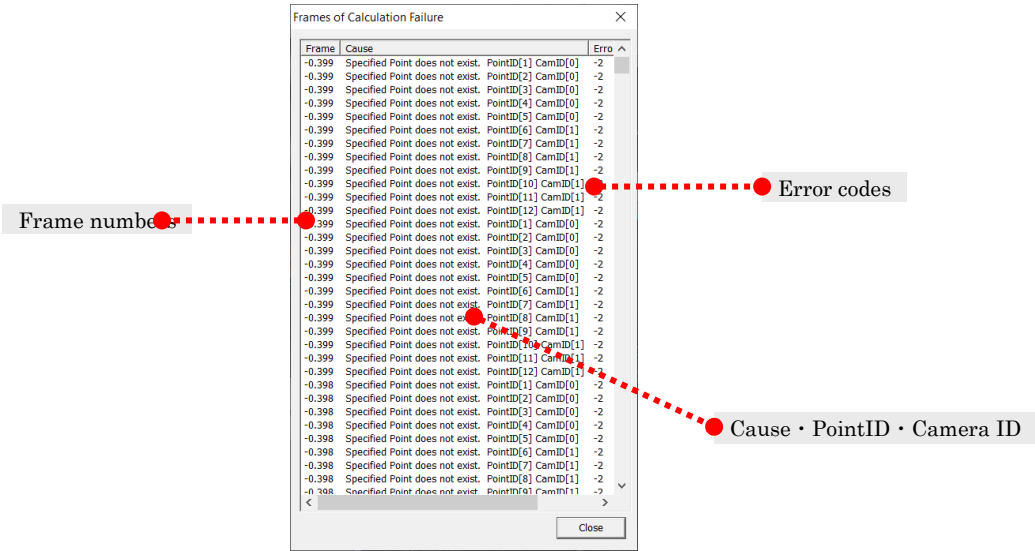
Identifies the restore status when only a certain camera does not track.

Perform any of the following to show information on failures during measurement data construction.

- ✓ Click [2D Construction] ⇒ [Show Measurement Data Construction Status] (for 2D measurement) on the menu.
- ✓ Click [3D Construction] ⇒ [Show Measurement Data Construction Status] (for 3D measurement) on the menu.

Shows information for the point in the [Frames with Calculation Failure] dialog. If the measurement data construction is successful, [Show Measurement Data Construction Status] on the menu is not used.

If there is a failure during construction when [Show Restore Results During Data Construction] is checked under the [Restore Settings] tab in [Environment Settings], the [Frames with Calculation Failure] dialog will automatically appear.



The figure above shows an example of when one point is not tracked during 3D analysis.

**Frame**

Frames with issues.

**Cause**

PointID for the point where there was a failure or an issue, and the camera ID affiliated with that point.

**Error Code**

Shows the internal error codes.

## ● List of Error Codes

### During Real Scale Conversion

- 1 The specified dynamic markers do not exist in this frame.  
If setting with measurement points as the origin or axis, these measurement points are not tracked in the specified frame so construction failed
- 2 Two points superimposed on the designated X axis  
Since the coordinates match the axis settings, calculations in the axial direction could not be performed.
- Other Undetermined error code 2D Scale Calibration Failed  
Any other failures.

### When Changing Perspective

- 1 The specified dynamic markers do not exist in this frame  
If setting with measurement points as the origin or axis, these measurement points are not tracked in the specified frame so construction failed.
- 2 Two points superimposed on the designated X axis  
Since the coordinates match the axis settings, calculations in the axial direction could not be performed.
- 3 Input value error for the actual length of the reference point  
The actual length for the reference plane setting is incorrect. Check the input value.
- 4 DLT parameter error (designated reference point error, Ex: common line)  
The coordinates input for the reference plane setting are incorrect. Check that the coordinates input are correct.
- Other Undetermined error code 2D-DLT Calibration Failed  
Any other failures.

### During 3D Calibration

- 1 Void point PointID[number] state[number] CamID[number]  
PointID point within the CamID camera was in a state other than [Ready], construction could not be performed.  
If the state is not 1, tracking cannot be conducted properly. Check the tracking state of the frame.
- 2 The specified point does not exist PointID[number] CamID[number]  
The measurement point for the PointID on the camera with this CamID does not exist on this camera.
- 3 The specified frame does not exist CamID [number]  
Data for the specified frame on the camera with this CamID does not exist.

The CamID is the number from the top of the camera node on the project tree. It starts with 0.

## 6.2 Virtual Points


New measurement points are added from the measurement data using calculations. These points are called virtual points.

Includes MOVIAS Neo standard feature virtual points (common virtual points) and future extension virtual points (custom virtual points).

### 6.2.1 Common Virtual Points

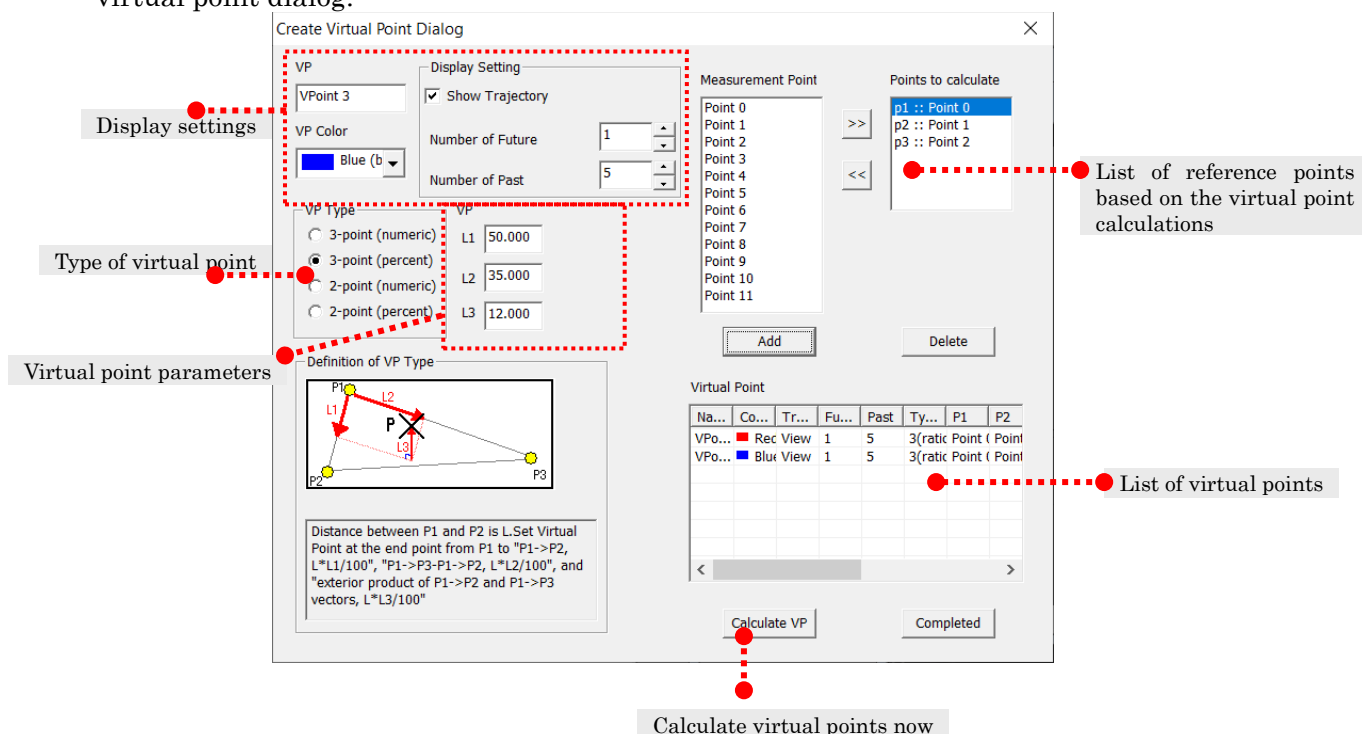
Common virtual points are a kind of measurement point created from 2 or 3 measurement points and their coefficients.

Perform any of the following to add common virtual points.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Analysis] ⇒ [Add Common Virtual Point] on the menu.
- ✓ The measurement trajectory figure appears. Click [Add Common Virtual Point] on the right click menu.

The common virtual point settings dialog and the current project trajectory figure appears.

Perform the operations in the current project trajectory figure window and the create virtual point dialog.



#### Virtual Point Name

Set the name of the virtual point.

#### Virtual Point Color

Set the color of the virtual point.

**Show Trajectory**

Check to show the trajectory of the virtual points.

**Number of Frames Behind • Number of Frames Ahead**

Set the number of frames in the forward and reverse directions to show the trajectory.

**Type of Virtual Point**



Select from 3 point and 2 point, numeral and percentage.

**Virtual Point Parameters**

Parameters used for calculations. The effect and number changes according to the type of virtual point.

**List of Points for Virtual Point Calculations**

The measurement points specified for virtual point calculations.

To add, select the measurement points on the list of measurement points and click . To delete, select the measurement points on the list of points for virtual point calculations and click .

**List of Virtual Points**

Displays the virtual points currently created. Manual editing of the name, color, show/hide display, and length of trajectory on the image can be performed.

**Virtual Point Calculations**

Calculate the currently set virtual point now. Press calculates virtual points and the currently set virtual point is added to the measurement point list and is also shown on the trajectory figure.

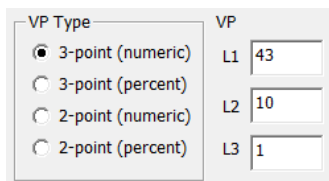
(Virtual point calculations are automatically performed, even when [Finish] is pressed)

## 6.2.2 Calculation Method for Common Virtual Points

---

This describes the calculations for common virtual points.

The virtual points are called P1, P2, and P3, and the virtual point parameters are called L1, L2, and L3.

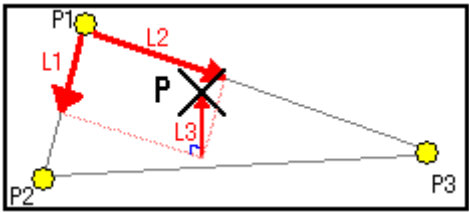


- **3 Points (Percentage) • (Numeral)**

Calculates the virtual points on a 3D space from 3 measurement points. The points of movement from P1 with a length of L1 in the direction of “P1 → P2”, the movement with a length of L2 in the “direction from the direction of P1 → P3 minus the components in the P1→ P2 direction” and the movement L3 in the “direction of the two previous vectors” constitute the virtual points.

With [Numeral], input the coefficient as the calibration unit.

With [Percentage], input the coefficient as a proportion (%) of the length “P1→ P2”.

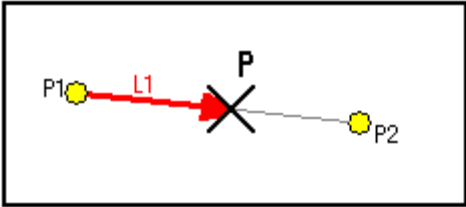


<b>Input</b>	
L1, L2, L3:	Values input for the virtual point parameters on the dialog
P1, P2, P3:	Points based on the virtual point calculations
<b>Output</b>	
P:	Virtual points calculated
Vector Calculations	
$\vec{u}' = (\vec{P2} - \vec{P1}), \vec{u} = \frac{\vec{u}'}{\ \vec{u}'\ }$	
$\vec{v}' = (\vec{P3} - \vec{P1}) - ((\vec{P3} - \vec{P1}) \cdot \vec{u}) \vec{u}, \vec{v} = \frac{\vec{v}'}{\ \vec{v}'\ }$	
$\vec{w} = \vec{u} \times \vec{v}$	
Coefficient Calculations (Numeral)	Coefficient Calculations (Percentage)
$M_1 = L_1$	$M_1 = L_1 / 100 * \ \vec{P2} - \vec{P1}\ $
$M_2 = L_2$	$M_2 = L_2 / 100 * \ \vec{P2} - \vec{P1}\ $
$M_3 = L_3$	$M_3 = L_3 / 100 * \ \vec{P2} - \vec{P1}\ $
Final Calculation of Virtual Points	
$\vec{P} = M_1 \vec{u} + M_2 \vec{v} + M_3 \vec{w} + \vec{P1}$	

where  $\vec{a} \cdot \vec{b}$  is the scalar product of vectors a and b,  $\|\vec{a}\|$  is length of vector a, and  $\vec{a} \times \vec{b}$  is the product of vectors a and b.

● 2 Points (Percentage) • (Numeral)

Virtual points are calculated along a line from two measurement points. Points from P1 and those L1 from P1 towards P2 are new virtual points.  
With [Numeral], input the coefficient as the calibration unit.  
With [Percentage], input the coefficient as a proportion (%) of the length “P1→ P2”.  
With percentage, if L1 is 0 , it matches P1, and if L1 is 100, it matches P2.



**Input**  
L1: Values input for the virtual point parameters on the dialog  
P1, P2: Points based on the virtual point calculations  
**Output**  
P: Virtual points calculated

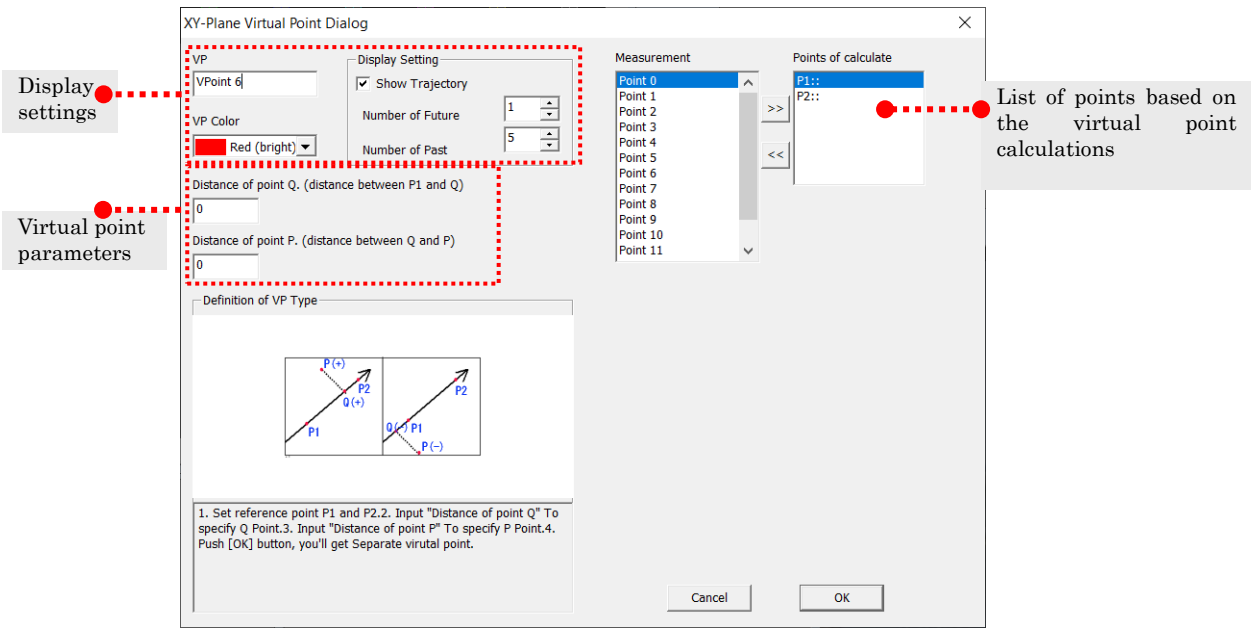
Vector Calculations	
$\vec{u}' = (\vec{P2} - \vec{P1}), \vec{u} = \frac{\vec{u}'}{\ \vec{u}'\ }$	
Coefficient Calculations (Numeral) $M_1 = L_1$	Coefficient Calculations (Percentage) $M_1 = L_1/100 * \ \vec{P2} - \vec{P1}\ $
Final Calculation of Virtual Points $\vec{P} = M_1 \vec{u} + \vec{P1}$	

6.2.3 Custom Virtual Points

Custom virtual points are virtual points with an add-in function. After MOVIAS Neo Ver1.01, “virtual points away from line segments” can be used as custom virtual points. Other virtual points can have the add-in function.

● Virtual Points Away from Line Segments

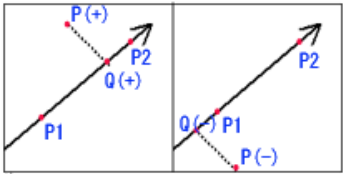
One point is created from the two points of P1, P2, by moving from P1 along the plane parallel to XY.  
  
To add virtual points away from line segments, click [Analysis] → [Add Custom Virtual Points] → [Virtual Point Away from Line Segments] on the menu.  
  
The [Create Virtual Point on the XY-Plane] dialog appears.



Using P1 and P2 as the original virtual points, the [Length from P1 on the Horizontal Axis] for [Virtual Point Parameters] is Q and the [Distance from the Vector] is P.

Create the vector in the direction from P1 to P2 and proceed only Q from P1. The virtual point is the point from Q only in the amount of P in the direction perpendicular to the vector.

(Q is positive in the direction from P1 to P2, and negative in the direction from P2 to P1. P is positive to the left of the vector and negative to the right of the vector.)  
Input the virtual point parameters in calibrated units.



**Input**

Q set value: Length from P1 on the horizontal axis (dialog input value)  
P set value: Distance from the vector (dialog input value)  
P1, P2: Points based on virtual point calculations

**Output**


P:	Calculated virtual points
Vector Calculations	
$\vec{u}' = (\vec{P2} - \vec{P1}), \vec{u} = \frac{\vec{u}'}{\ \vec{u}'\ }$	
Vector rotated counterclockwise 90° $\vec{v} = \vec{u}'$	
Coefficient Calculations	
$L_1 = Q$ set value	
$L_2 = P$ set value	
Final Calculation	
$\vec{P} = L_2 \vec{u} + L_1 \vec{v} + \vec{P1}$	



## 6.3 3D Coordinate Conversion

Converts from the calibration coordinate system to a different coordinate system.  
Enabled only during 3D measurement

Perform either of the following for 3D coordinate conversion.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Tool] → [3D Coordinate Conversion] on the menu.

The [3D Coordinate Conversion Settings] dialog appears.

Select [Calibration Coordinate System], [3-2-1 Conversion], [Parallel Transport] or [Best Fit for Reference Points] from [Select a Conversion Method] as the conversion method.

### Calibration Coordinate System

Use the calibration coordinate system.

### 3-2-1 Conversion

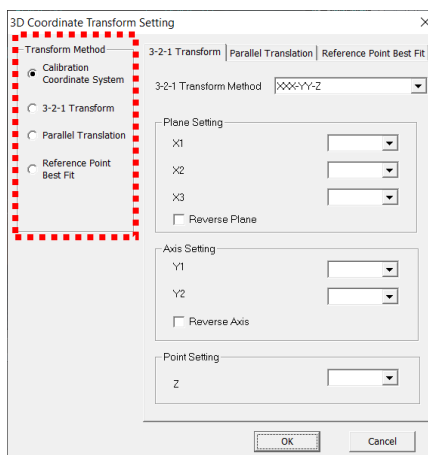
Conversion defined as a plane with 3 points, axis with 2 points and 1 point.

### Parallel Transport

Move parallel using the input coordinates as the starting point.

### Best Fit for Reference Points

Conversion defined as 3 points with real coordinates from the desired coordinate system.



[3D Coordinate Conversion Settings] Dialog

Click OK to save the coordinate conversion settings selected with [Select Conversion Method].

If the [Automatically Construct Measurement Data during 3D Analysis] setting under the エラー! 参照元が見つかりません。 in エラー! 参照元が見つかりません。 is enabled, click OK to automatically apply coordinate conversion to the measurement data. If the [Automatically Construct Measurement Data during 3D Analysis] setting is disabled, click [3D Construction] → [Create 3D Measurement Data] on the menu and manually construct the measurement data.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details.

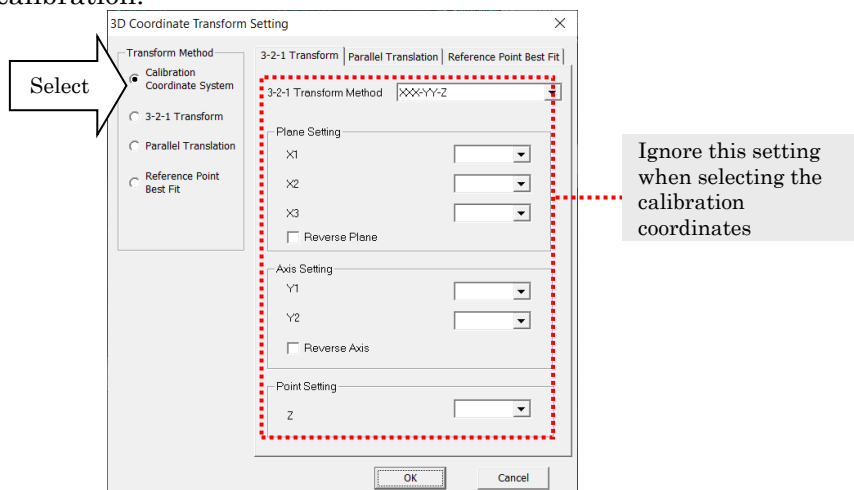
After coordinate conversion, analysis is performed using coordinate converted data for virtual points, analysis graph creation, trajectory figure creation and stick display. If Auto Update Graphs (p. エラー! ブックマークが定義されていません。 ) is enabled, the graph created is recalculated with the new coordinate system and then displayed.

The calibration coordinate system can be saved even after coordinate conversion. You can repeatedly switch to a 3D coordinate system calibration based on the coordinate system.

If you delete measurement points used with the coordinate conversion settings (such as the plane settings), the coordinate conversion settings are deleted, and the calibration coordinate system is applied to the measurement data.

### 6.3.1 Calibration Coordinates

Cancels the coordinate conversion currently set and employs the coordinates used during calibration.



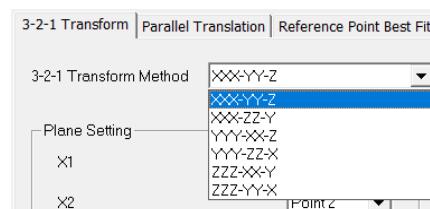
### 6.3.2 3-2-1 Conversion

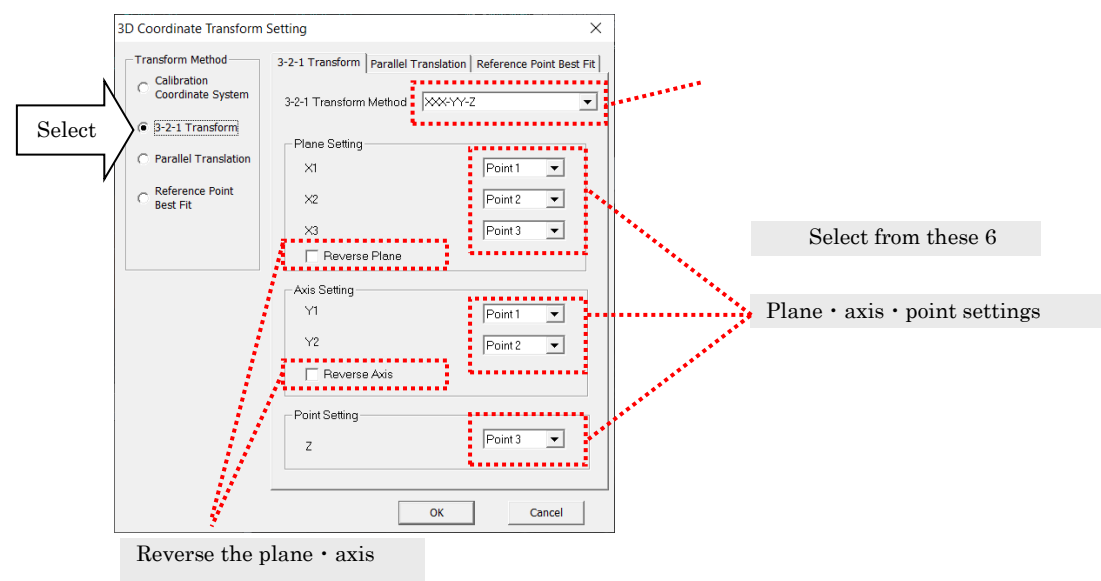
Defined as a plane forming two coordinate axes with 3 points, 2 points in the direction of one coordinate axis and the coordinate axis where 1 point intersects that plane (the intersection is the starting point).

In the following figure, the 3 points are the X-Y plane, the 2 points are the Y axis and the 1 point is the Z axis passing through the starting point.

The order of point input changes according to the axis direction so adjust by checking [Reverse the Plane] or [Reverse the Axis] and apply to the left and right coordinate systems.

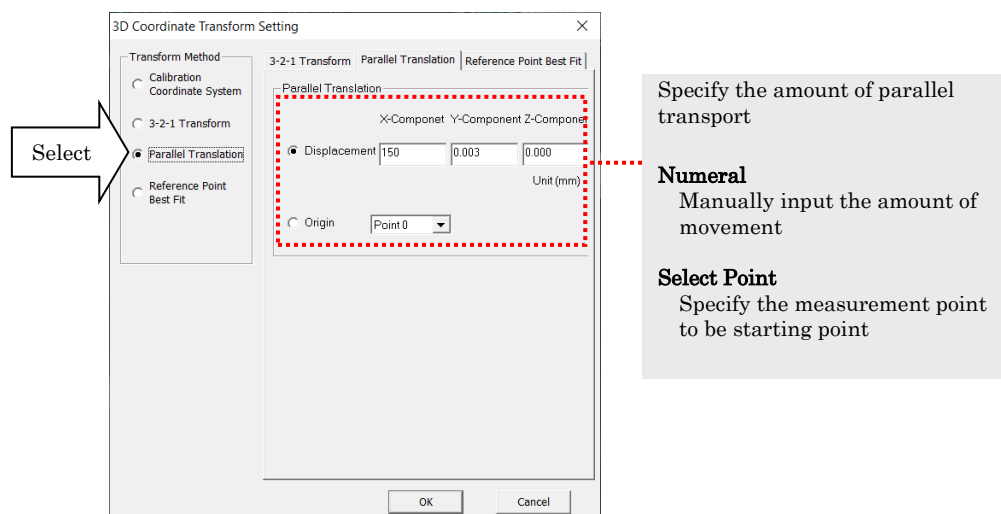
Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for detailed calculations.





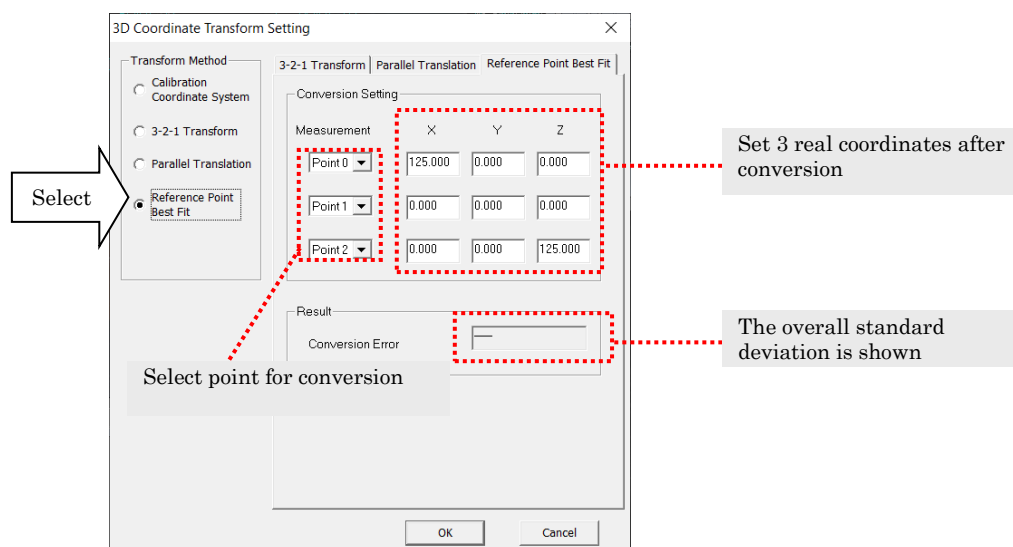
### 6.3.3 Parallel Transport

Input the movement amount from the calibration coordinate starting point using numbers (mm units), or specify the measurement point as the origin point. Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for the detailed calculations.



### 6.3.4 Best Fit for Reference Points

Defines 3 points as the real coordinates after conversion and conduct coordinate conversion. The standard deviation for errors after conversion is shown to determine the optimal conversion. Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for detailed calculations.



## 6.4 Mass Settings

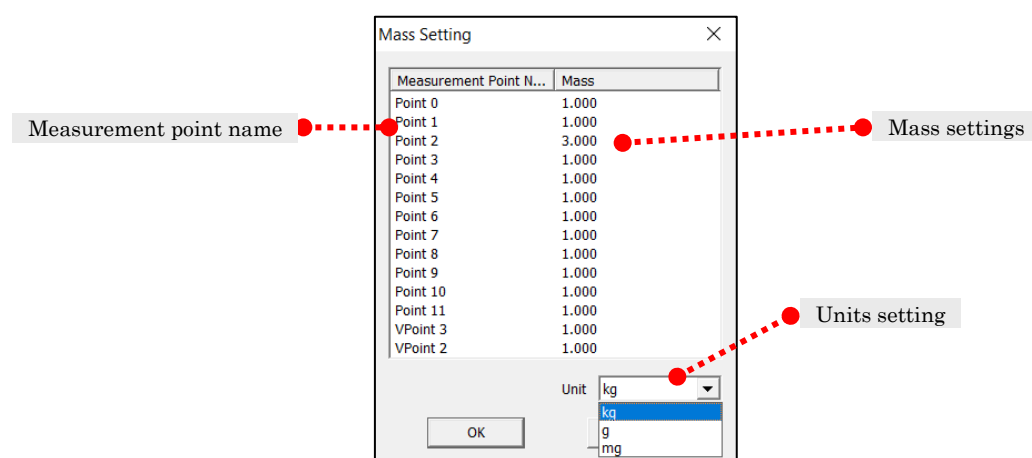
By assigning mass to the measurement points, an analysis of momentum, force, power, energy and center of gravity can be conducted.

### 6.4.1 Mass Settings

Sets the mass to the measurement points.  
Perform the following for the mass settings.

- ✓ Click [Analysis] ⇒ [Mass Settings] on the menu.

The mass setting dialog appears.



#### Measurement Point Name

Shows the name of the measurement point.

#### Mass

Sets the mass. Double click to manually input numerals.

#### Units

Select from kg, g or mg.

Click OK to set the mass to the measurement points.

The momentum, force, power, and energy can be calculated using the mass set. Refer to the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details of analysis.

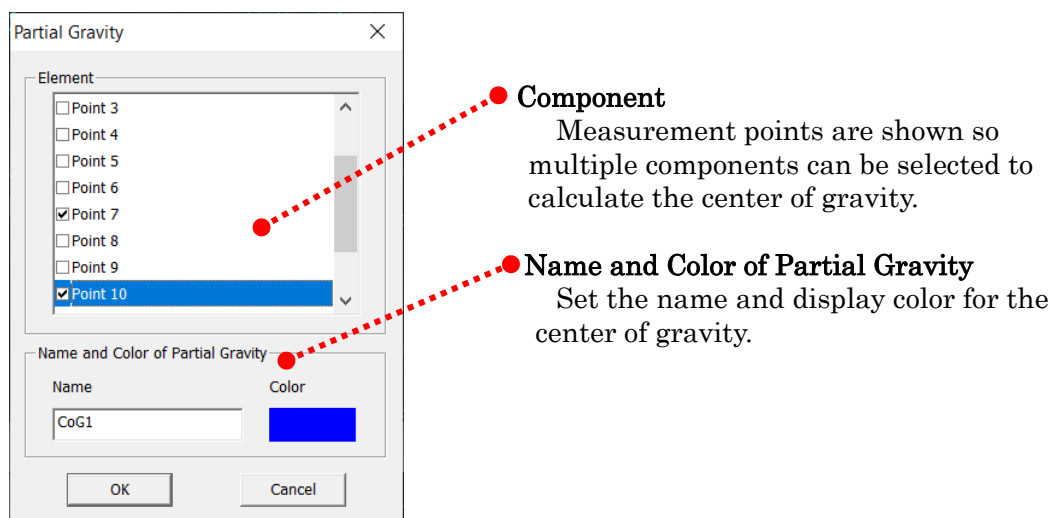
## 6.4.2 Calculate Partial Gravity

Calculates the center of gravity and adds it to the current measurement data. Perform the following for the center of gravity.

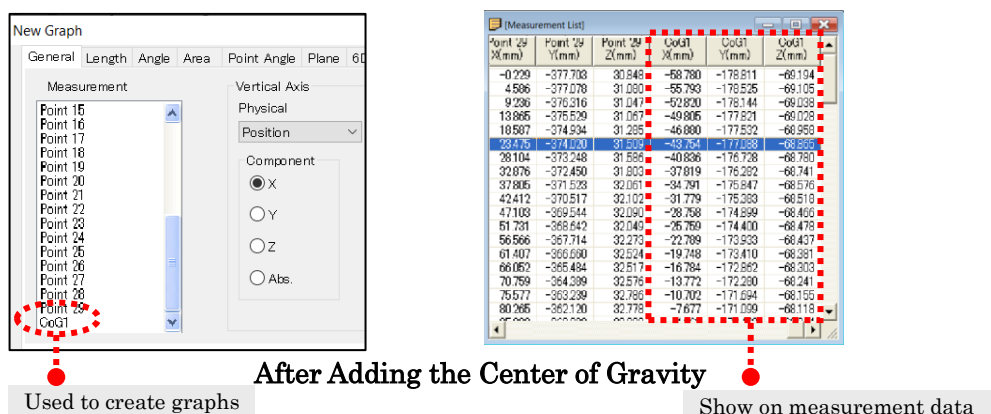
- ✓ Click [Analysis] ⇒ [Calculate Partial Gravity] on the menu.

The center of gravity dialog appears.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on calculating the center of gravity.



Click OK to add the center of gravity point to the measurement data. Just as with other measurement points, select from the measurement data list or the measurement point list in the graph creation dialog.




## 7. Analysis of Measurement Data

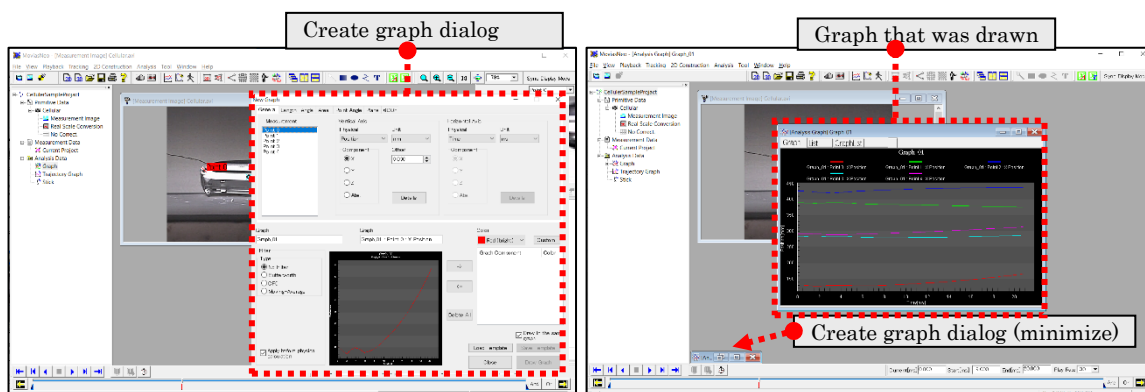
### 7.1 Analysis Graph

#### 7.1.1 Create a Graph

Various physical amounts can be calculated from the measurement data to create graphs. Perform either of the following to create a graph.

- ✓ Click [Analysis] ⇒ [Create Graph] on the menu.
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .

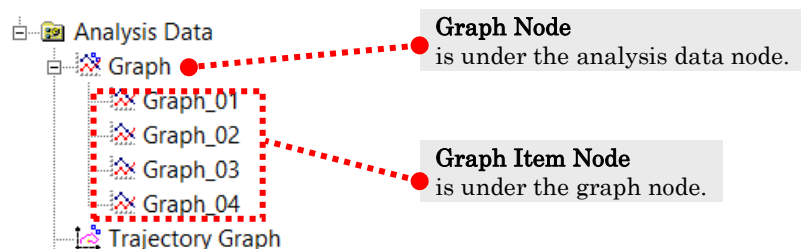
The [Create New Graph] dialog appears.



#### Overview of Create Graph Dialog

#### After Graph is Drawn

After creating a graph in the [Create New Graph] dialog (p. エラー! ブックマークが定義されていません。), the graph created appears in the window. Also, a graph item node is created under the graph node on the project tree. The graph title set is shown on the graph item node.



The physical amounts that can be created are as follows. For details, refer to the descriptions for each tab.

エラー! 参照元が見つかりません。: “エラー! 参照元が見つかりません。”, “エラー! 参照元が見つかりません。”, “エラー! 参照元が見つかりません。”, “Velocity”, “Acceleration”, “Displacement”, “エラー! 参照元が見つかりません。”

りません。”，“Momentum”，“Force”，“エラー! 参照元が見つかりません。”，“Energy”。

エラー! 参照元が見つかりません。：“エラー! 参照元が見つかりません。”，“エラー! 参照元が見つかりません。”，“エラー! 参照元が見つかりません。”。



エラー! 参照元が見つかりません。：“エラー! 参照元が見つかりません。”，“エラー! 参照元が見つかりません。”，“エラー! 参照元が見つかりません。”。

エラー! 参照元が見つかりません。：“エラー! 参照元が見つかりません。”，“エラー! 参照元が見つかりません。”，“エラー! 参照元が見つかりません。”。

Measurement Point Angle Tab [Measurement Point Angle (quadrant angle, group angle for group tracking)]

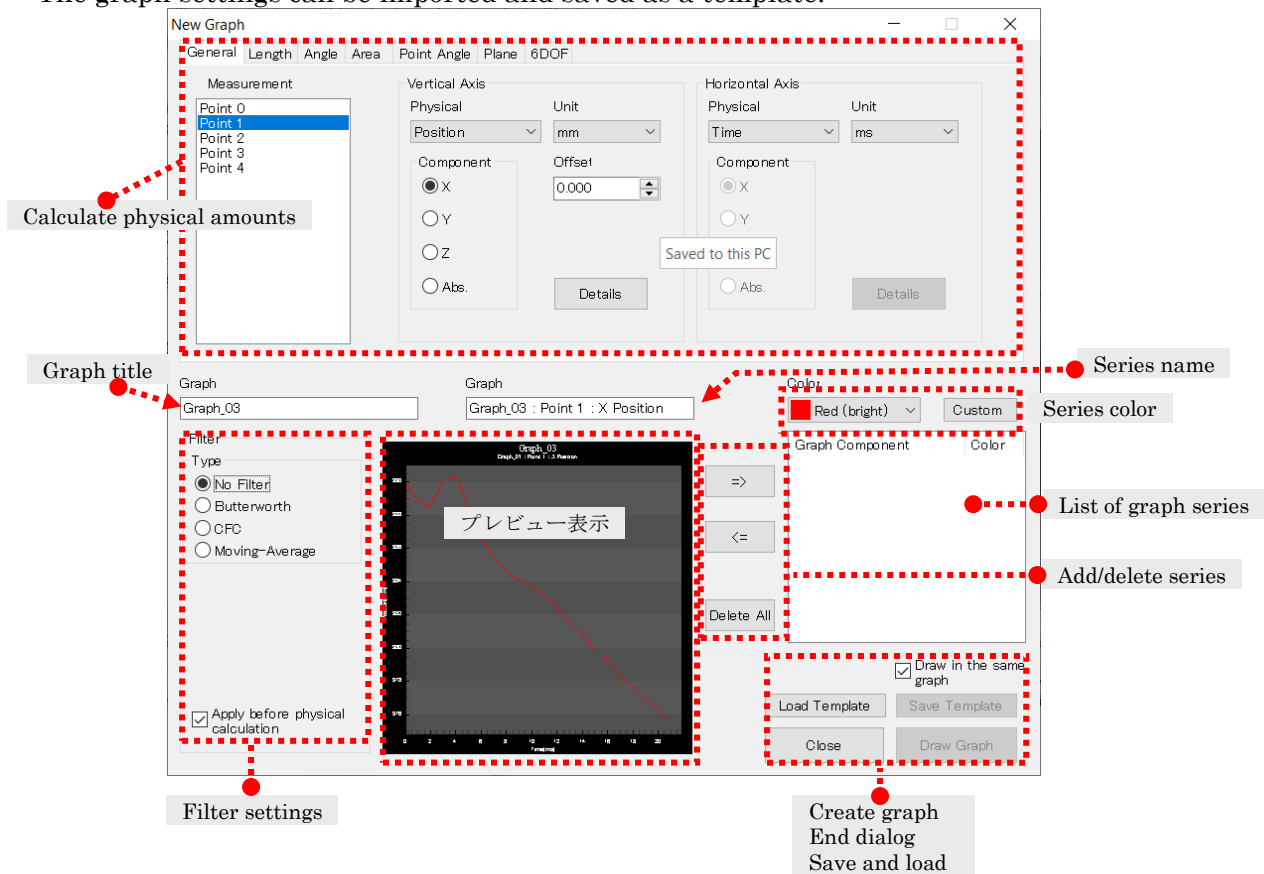
## 7.1.2 [Create a New Graph] Dialog

The procedure for creating graphs is as follows.

- ① Set the physical amounts.
- ② Set the filter, if necessary.
- ③ Set the title, series name and series color. Use a different title for each graph.
- ④ Check the graph preview and use  to add to the [List of Graph Display Points].
- ⑤ Select whether or not to draw on the same graph and click .
- ⑥ The [Create New Graph] dialog is minimized and the graph is drawn in the graph window.

Click  to close the [Create New Graph] dialog.

The graph settings can be imported and saved as a template.



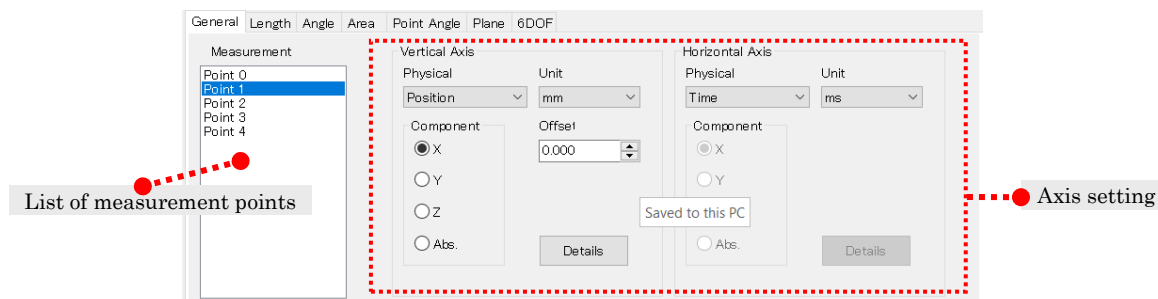


### **Create Graph Dialog**

Next are descriptions of the items set with each tab for calculating the physical amounts.

## ● [General] Tab

### (a) Basic Operation



**List of Measurement Points:** Select the measurement points to be used for calculation.

**Axis Settings:** Set the horizontal and vertical axis.  
Sets the details for physical amounts, units and components.

Calculate the basic physical amounts and create graphs.

Physical amounts that can be used for horizontal and vertical axes include “エラー! 参照元が見つかりません。”, “エラー! 参照元が見つかりません。”, “エラー! 参照元が見つかりません。”, “Velocity”, “Acceleration”, “Displacement”, “エラー! 参照元が見つかりません。”, “Momentum”, “Force”, “エラー! 参照元が見つかりません。”, “Energy”.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for a description of the physical quantities.

Specify the points to be calculated in the measurement point list and specify the physical quantities, units and components for both the horizontal and vertical axis. If necessary, make detailed settings to the selected physical amounts.

When registering multiple axes, the physical quantities must be identical to the horizontal axis.

### (b) Physical Quantities

#### (i) Time

Plots the time for the measurement data.

Physical Quantities	Time
Units	sec, msec, $\mu$ sec
Components	(None)

#### (ii) Frame Number

Plots the frame numbers for the measurement data.

Physical Quantities	Frame Number
Units	(None)
Components	(None)

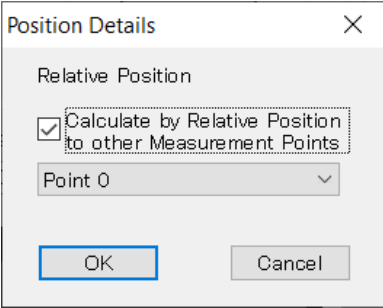
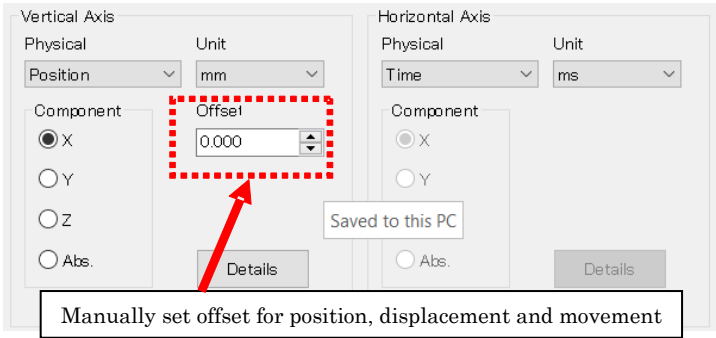
(iii) Position

Plots the coordinates for the measurement data.  
Calculations for the relative position to other points can be made in the detailed settings.

Physical Quantities	Position
Units	m, cm, mm, $\mu$ m
Components	x, y, z, Abs (absolute value)

Offset Settings (Position • Displacement • Movement)

Sets the offset values for position, displacement, and movement. These can be changed after creating a graph. Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).



Detailed Settings Dialog (Position)

Calculate the Relative Position to Other Points

Check to calculate the relative position with measurement points selected with the following combo box.

Select the reference point to calculate the relative position.

**(iv) Velocity**

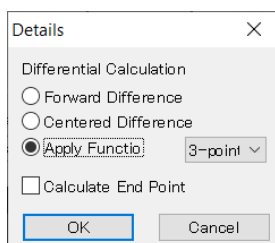
Calculates the velocity of the selected point.  
Select the differential method under detailed settings.

Physical Quantities	Velocity
Units	m/sec, cm/sec, mm/sec, $\mu$ m/sec, km/h
Components	x, y, z, Abs (absolute value)

**Detailed Settings Dialog (Velocity, Acceleration, Momentum, Force, Power, Energy)**

Select the method of calculating the differential.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) and エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on the calculations.

**Forward Difference**

Differential calculations using forward differences.

**Centered Difference**

Differential calculations using central differences.

**Apply Function (3 points, 5 points, 7 points, 9 points)**

Differential calculations made with quadratic functions using a specified number of points.

**Calculate End Point**

Switches between enable and disable the differential calculations for the start and end frames. The operations differ according to the differential method selected.

**(v) Acceleration**

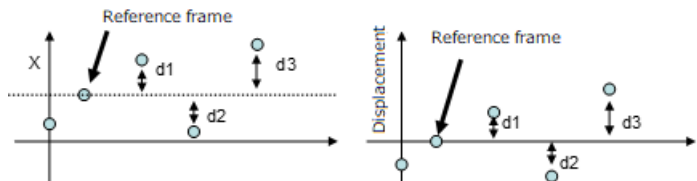
Calculates the acceleration for selected points. Select the differential method under detailed settings.

Physical Quantities	Acceleration
Units	m/sec <sup>2</sup> , cm/sec <sup>2</sup> , mm/sec <sup>2</sup> , um/sec <sup>2</sup> , g (gravity acceleration)
Components	x, y, z, Abs (absolute value)

(vi) Displacement

Calculates the displacement from the reference frame for a specified measurement point. Reference frames are set under detailed settings.

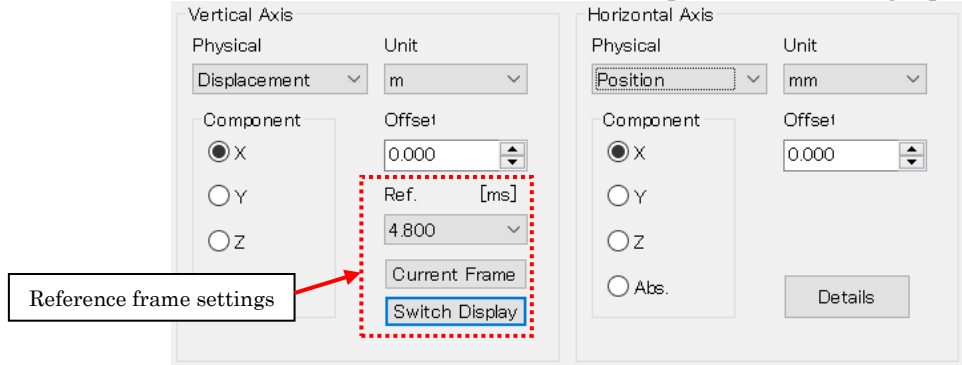
Physical Quantities	Displacement
Units	m, cm, mm, $\mu$ m
Component	x, y, z, Abs (absolute value)



Example calculating the amount of displacement (Component X) : The original coordinate graph is on the left and the graph of displacement is on the right. The figures show the X coordinates but other components are calculated in the same manner. Displacement for the reference frame is 0.

Reference Frame Settings (Displacement • Movement)

Sets the reference frame using the calculations from the physical quantities. Sets the reference frame corresponding to the number when a graph of displacement or movement was added. The reference frame can be specified for each graph series.



Reference Frame

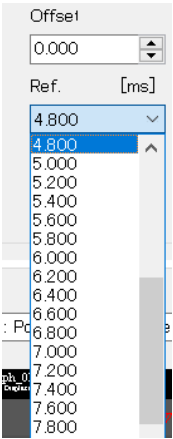
Selects the frame to use as a reference from the reference frame combo box (right).

Current Frame

Click to set the time for the image displayed in the current window as the reference frame.

Switch Display

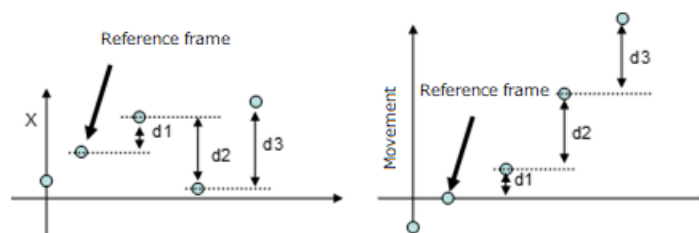
Switches the frame number or time display in the reference frame combo box.



**(vii) Movement**

Calculates the accumulated value from the coordinate of the reference frame. Set the reference frame in detailed settings. The detailed settings are identical to that for [(vi) Displacement].

Physical Quantities	Movement
Units	m, cm, mm, $\mu$ m
Components	x, y, z, Abs (absolute value)



Example calculating the amount of movement (Component X) : The original coordinate graph is on the left and the graph of movement is on the right. The figures show the X coordinates but other components are calculated in the same manner. Movement for the reference frame is 0. Negatives are before the reference frame and positives are after.

**(viii) Momentum**

Calculates the momentum of the selected points. Select the differential method in detailed settings.

Calculates with the mass set in エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).

Physical Quantities	Momentum
Units	kgm/s
Components	x, y, z, Abs (absolute value)

**(ix) Force**

Calculates the force of the selected points. Select the differential method under detailed settings.

Calculates with the mass set in エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).

Physical Quantities	Force
Units	N, mN, $\mu$ N, kN
Components	x, y, z, Abs (absolute value)

**(x) Power**

Calculates the power of the selected points. Select the differential method under detailed settings.

Calculates with the mass set in エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).

Physical Quantities	Power
Units	W, mW, $\mu$ W, kW
Components	x, y, z, Abs (absolute value)

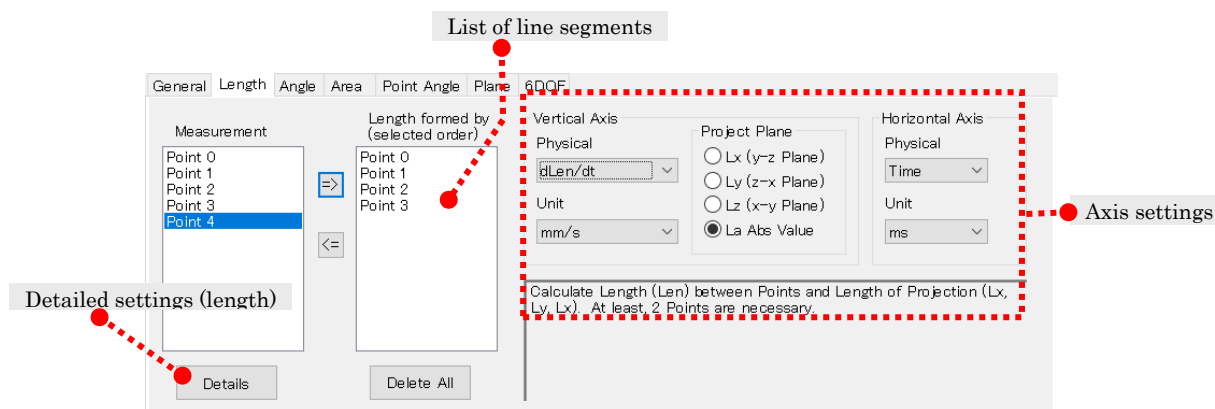
(xi) Energy

Calculates the energy of the selected points. Select the differential method under detailed settings  
Calculates with the mass set in エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).

Physical Quantities	Energy
Units	J, mJ, $\mu$ J, kJ
Components	x, y, z, Abs (absolute value)

## ● [Length] Tab

### (a) Basic Operation



**List of Line Segments:** Shows the measurement points used for calculating lengths.

**Axis Settings:** Sets the physical quantities, components and units to be calculated

**Detailed Settings:** Sets the details for calculating lengths.

Calculates the length and its first and second derivatives, and creates a graph.  
Measurement results for at least two points are required.

Physical quantities used for the vertical axis include “Length”, “First Derivative for Length” and “Second Derivative for Length”.

Physical quantities used for the horizontal axis include “Time” and “Frame Number”.  
Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for a description of the physical quantities.

Designate the components from Lx (length filmed towards the y-z plane), Ly (length filmed towards the z-x plane), Lz (length filmed towards the x-y plane), La (absolute value for length).

Use => (Add) and <= (Delete) to create the list of line segments to create. Calculations are performed in the order found on the list of line segments.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on using the list of line segments.

Calculation of lengths is performed in the order registered to the line segment list. For example, if registered in an order of “Point1”, “Point2”, “Point5”, “Point3”, “Point4”, the sum of the lengths in the path is calculated according to “Point1” => “Point2” => “Point5” => “Point3” => “Point4”.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on how to calculate length.

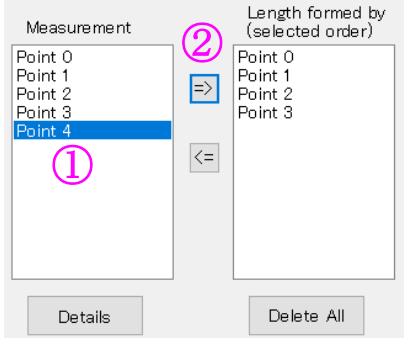


(b) Using the List of Line Segments (Line Segment Points)

(i) Adding to the List of Line Segments

① Select the measurement points on the list of measurement points (multiple selections allowed).

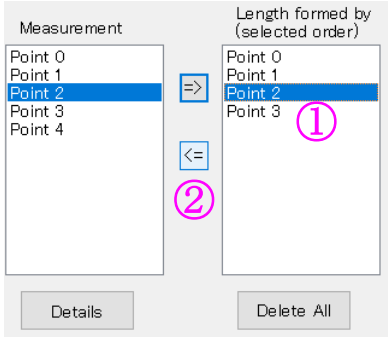
② Click **=>** (Add). Multiple selections are added from the top of the list.



(ii) Delete from the List of Line Segments

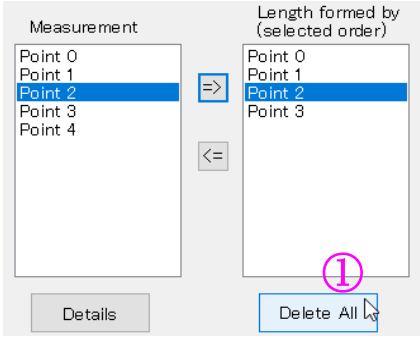
① Select the points to be deleted from the list of measurement points (multiple selections allowed).

② Click **<=** (Delete).



(iii) Delete All from the List of Line Segments

① Click **Delete All** (Delete All).



## (c) Physical Quantities

**(i) Length**

Calculates the lengths. Calculates the sum on the path of points on the list of line segments.

For example, if registered in the order of Point1, Point2, Point4, the lengths will be calculated in the order of Point1⇒Point2⇒Point4.

Physical Quantities	Length
Units	m, cm, mm, $\mu$ m
Components	Lx(y-z plane), Ly(z-x plane), Lz(x-y plane), La(absolute value)

**(ii) First Derivative for Length**

Calculates the rate of change in the lengths. Calculates the sum of derivatives for the path of points on the list of line segments. Select the differential method in detailed settings.

Physical Quantities	Rate of Change in Length
Units	m/sec, cm/sec, mm/sec, $\mu$ m/sec
Components	Lx(y-z plane), Ly(z-x plane), Lz(x-y plane), La(absolute value)

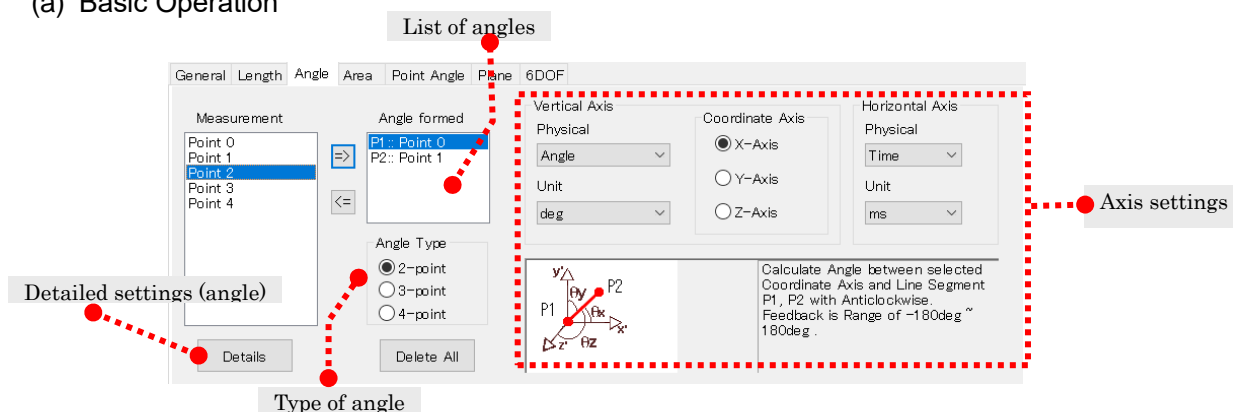
**(iii) Second Derivative for Length**

Calculates the acceleration of the lengths. Calculates the sum of the second derivative for the path of points on the list of line segments. Select the differential method for detailed settings.

Physical Quantities	Acceleration of the Lengths
Units	m/sec <sup>2</sup> , cm/sec <sup>2</sup> , mm/sec <sup>2</sup> , $\mu$ m/sec <sup>2</sup> , g (Acceleration of gravity)
Components	Lx(y-z plane), Ly(z-x plane), Lz(x-y plane), La(absolute value)

## ● [Angle] Tab

### (a) Basic Operation



**List of Angles:** Shows the measurement points used for calculating angles.

**Type of Angle:** Specifies the type of angle to calculate.

**Axis Settings:** Sets the physical quantities, units, coordinate axis or plane of projection to be calculated.

**Detailed Settings:** Sets the details of the angles.

Calculates the angle, angle velocity and angle acceleration, and creates a graph. Measurement results for at least two points are required.

Physical quantities used for the vertical axis include “エラー! 参照元が見つかりません。”, “エラー! 参照元が見つかりません。”, “エラー! 参照元が見つかりません。”.

Physical quantities used for the horizontal axis include “Time” and “Frame Number”.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for a description of the physical quantities.

Various types of angles can be calculated by specifying the type of angle and axis/plane of projection.

Angles that can be calculated are shown in the following table.

		Type of Angle		
		2 Points	3 Points	4 Points
Angle	Vector angle	None	(2D) Standard (3D) Standard, absolute value	(2D) Standard (3D) Standard, absolute value
	Angle with axis	(2D) vs. X,Y,Z axis (3D) vs. X,Y,Z axis	None	None
	Angle on plane of projection	None	(2D) None (3D) vs. X,Y,Z plane	(2D) None (3D) vs. X,Y,Z plane

Select from 2, 3 and 4 point angles to specify the points making angles.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for the types of angles.

After setting the type of angle, create a list of angles and specify the desired angle.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) for details on using the list of angles.

Use the detailed settings if necessary.

## (b) Types of Angles

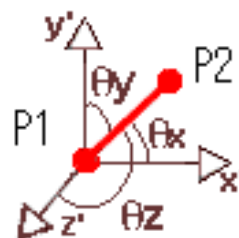
## (i) 2 Points

Angle type where two measurement points are specified. Calculates the angle between the coordinate axis and the specified line segment.

Set two points to calculate the angle from the same vector to the coordinate axis.

Select the coordinate axis from the X axis, Y axis or Z axis.

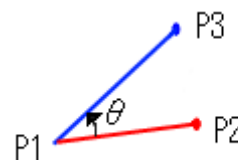
Set P1, P2 on the list of angles.



## (ii) 3 Points

Angle type where three measurement points are specified. Calculates the angle between vector **t** extending from P1 to P2 and vector **u** extending from P1 to P3. The direction of the angle is the angle of rotation from **t** to **u**. For 3D analysis, the photographic angle and the absolute value of the angle can be calculated.

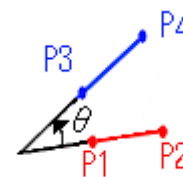
Set the three points of P1~P3 on the list of angles.



## (iii) 4 Points

Angle type where four measurement points are specified. Calculates the angle between vector **t** extending from P1 to P2 and vector **u** extending from P3 to P4. The direction of the angle is the angle of rotation from **t** to **u**. For 3D analysis, the photographic angle and the absolute value of the angle can be calculated.

Set the four points of P1~P4 on the list of angles.



## (c) Axis Setting or Plane of Projection

## (i) Coordinate Axis

Shows when the type of angle is one that has 2 points.

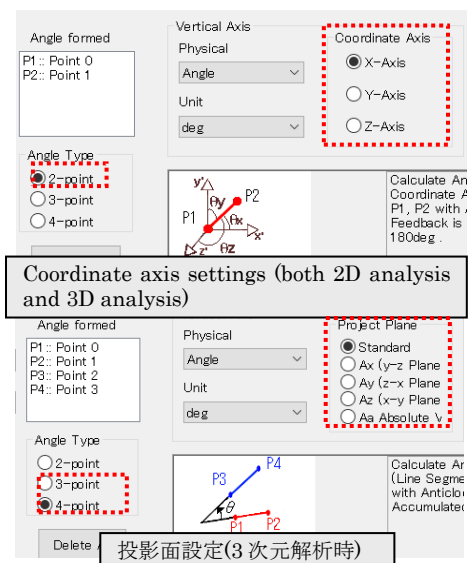
Select from "X Axis", "Y Axis" and "Z Axis".

## (ii) Plane of Projection

Shows a 3 point and 4 point angle during 3D analysis.

Select from "Standard", "Ax (y-z plane)", "Ay (z-x plane)", "Az (x-y plane)", "Aa (absolute value)".

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 Angles (p. エラー! ブックマークが定義されていません。 ) for details on each



calculation.

(d) Using the List of Angles (Points that Create Angles)


Builds a list of selection points in the same manner as that for length and area. However, an operation ((i)-(2)) to select points to create angles on the list of angles (list on the right side) is required.

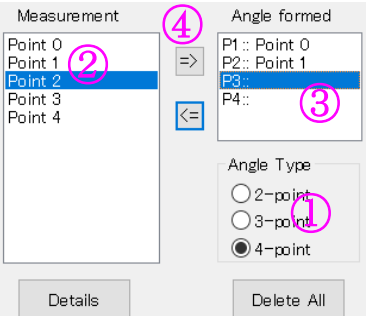
(i) Adding to the List of Angles

① Select the type of angle.

② Select the measurement points to add to the list of angles.


③ Select the setting.

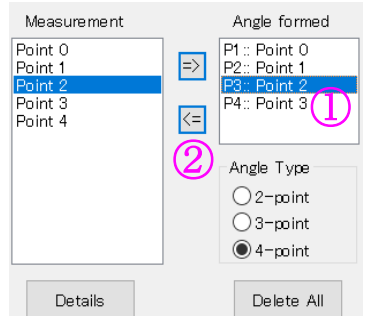
④ Click  (Add).




(ii) Delete from the List of Angles

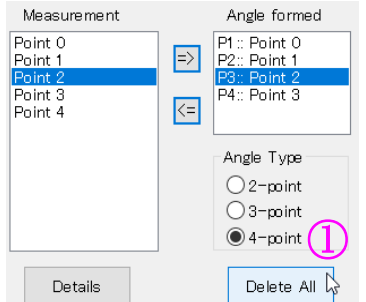
Select the points to be deleted.

Click  (Delete).



(iii) Delete All from the List of Angles

Click  (Delete All).



(e) Physical Quantities

(i) Angle

Calculates the angle based on the type of angle set.

Physical Quantities	Angle
Units	deg, rad “deg” refers to degree, “rad” refers to radian.
Components	Coordinate axis or plane of projection

**(ii) Angle Velocity**

Calculates the angle velocity.

Refer to p. エラー! ブックマークが定義されていません。 for detailed settings.

Physical Quantities	Angle Velocity
Units	deg/sec, rad/sec, rpm
Components	Coordinate axis or plane of projection

**(iii) Angle Acceleration**

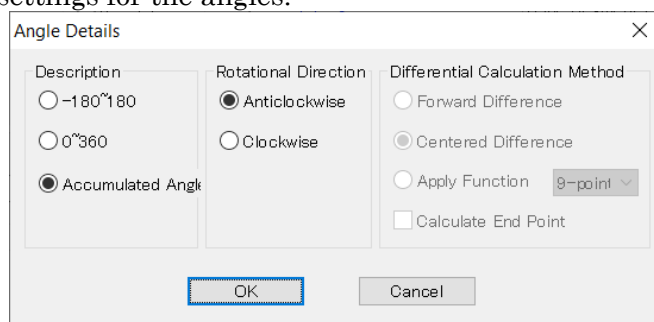
Calculates the angle acceleration.

Refer to p. エラー! ブックマークが定義されていません。 for detailed settings.

Physical Quantities	Angle Acceleration
Units	deg/sec <sup>2</sup> , rad/sec <sup>2</sup>
Components	Coordinate axis or plane of projection

**(f) Detailed Settings for Angles**

Sets the detailed settings for the angles.



[Detailed Settings for Angles] dialog

**Description of the Angles**

$-\pi \sim \pi$ ( $-180^\circ \sim 180^\circ$ )	Shows angles in a range of $(-\pi: \pi]$ . If the angle is around $\pi$ , $-\pi$ , the graph may not be continuous.
$0 \sim 2\pi$ ( $0^\circ \sim 360^\circ$ )	Shows angles in a range of $[0: 2\pi)$ . If the angle is around $0$ , $2\pi$ , the graph may not be continuous.
Accumulated angle	Angles are not rounded and are added to the value of the previous frame.

**Rotational Direction**

Counterclockwise: Angle calculations performed on the screen counterclockwise in the + direction.

Clockwise: Angle calculations performed on the screen clockwise in the + direction

**Differential Calculation Method**

Set the differential calculation method using the angle velocity and angle acceleration.

This is the same as the method used to calculate velocity.

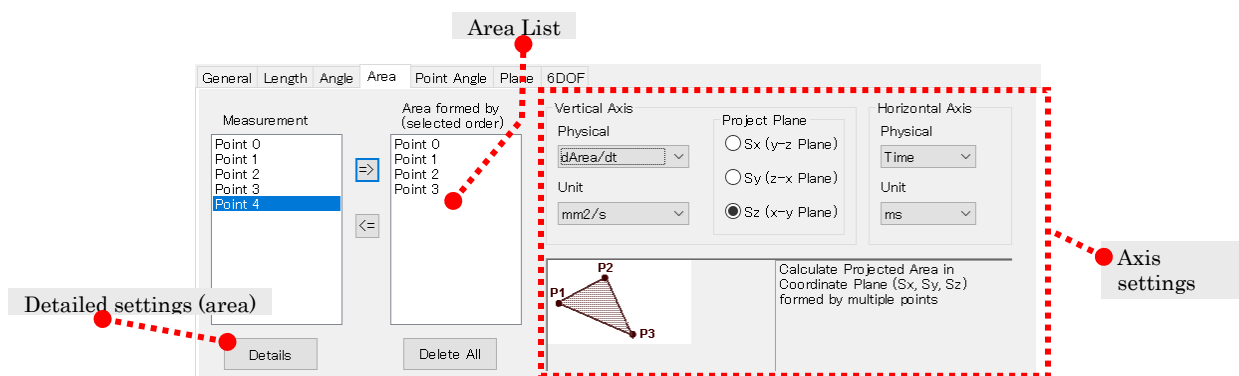
Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。  
(p. エラー! ブックマークが定義されていません。) and エラー! 参照元が見つかり

ません。エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for details on the calculations.



## ● [Area] Tab

### (a) Basic Operation



**Area List:** Displays the measurement points used for calculating area.

**Axis Settings:** Specifies the physical amounts, units and plane of projection to calculate.

**Detailed Settings:** Sets the differential method for the area.

Calculates the area and its first and second derivatives, and creates a graph. Measurement results for at least three points are required.

Physical quantities used for the vertical axis include [Area], [First Derivative for Area], [Second Derivative for Area].

Physical quantities used for the horizontal axis include [Time] and [Frame Number].

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for a description of the physical quantities.

Designate the components from Sx (area projected to the y-z plane), Sy (area projected to the z-x plane) and Sz (area projected to the x-y plane).

Use  (Add) and  (Delete) to create the area list.

The operation for the area list is the same as that for the line segment list. Refer to the エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ).

Calculation of area is performed in the order registered to the area list. For example, if registered in an order of “Point1”, “Point2”, “Point5”, “Point3”, “Point4” on the area list, the area of the region surrounded by “Point1”→“Point2”→“Point5”→“Point3”→“Point4”→“Point1” is calculated.

Area calculations cannot be properly made with intersecting lines. Do not intersect.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on the calculations.

## (b) Physical Quantities

## (i) Area

Calculates the area.

Calculates the triangle in the area list.

For example, if registered in the order of Point1, Point2, Point4, Point5, Point7, the area projected on the plane designated to be the area surrounded by P1→P2→P4→P5→P7→P1 will be calculated.

Physical Quantities	Area
Units	m <sup>2</sup> , cm <sup>2</sup> , mm <sup>2</sup> , μ m <sup>2</sup>
Components	Sx (y-z plane), Sy (z-x plane), Sz (x-y plane)

## (ii) First Derivative for Area

Calculates the rate of change in the area.

Calculates the derivative after calculating the area.

Select the differential method in detailed settings.

Physical Quantities	Rate of Change in Area
Units	m <sup>2</sup> /sec, cm <sup>2</sup> /sec, mm <sup>2</sup> /sec, μ m <sup>2</sup> /sec
Components	Sx (y-z plane), Sy (z-x plane), Sz (x-y plane)

## (iii) Second Derivative for Area

Calculates the acceleration of the area.

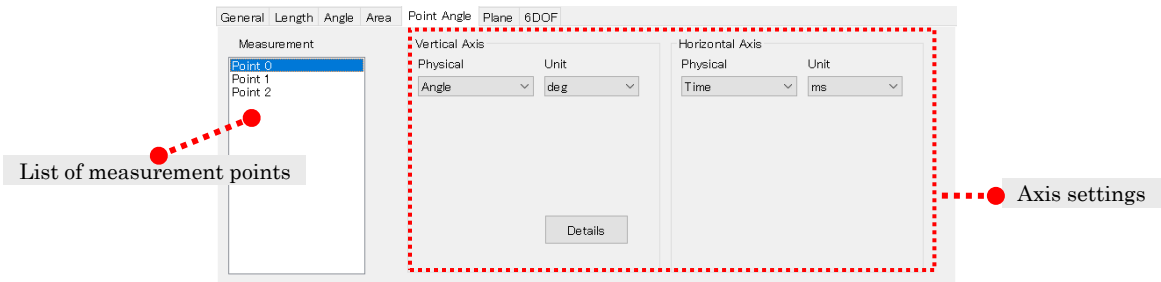
Calculates the derivative after calculating the area.

Select the differential method in detailed settings.

Physical Quantities	Acceleration of the Area
Units	m <sup>2</sup> /sec <sup>2</sup> , cm <sup>2</sup> /sec <sup>2</sup> , mm <sup>2</sup> /sec <sup>2</sup> , μ m <sup>2</sup> /sec <sup>2</sup>
Components	Sx (y-z plane), Sy (z-x plane), Sz (x-y plane)

● [Angle of Measurement Points] Tab

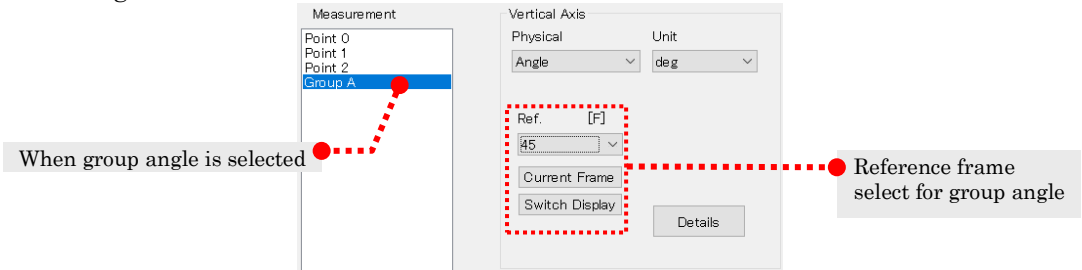
(a) Basic Operation



**List of Measurement Points:** Selects the angles for the measurement points or the angles for the group points used in the calculations.

**Axis Settings:** Performs the settings for the vertical axis • horizontal axis. Physical quantities, units and detailed settings can be made for each.

Creates a graph of the angles from the quadrant tracking results and the group tracking results. Can only be created in a 2D analysis project. A group angle reference frame can be selected for group angles. With the group angle of the frame selected here at 0°, the relative angle of each frame is calculated.



(b) Physical Quantities

(i) Angle

Outputs the measurement point angle or the group angle. During group angle selection, you can set the reference frame for the group angle.

Physical Quantities	Angle
Units	deg, rad
Components	(None)

**Reference Frame**

Selects the frame to use as a reference from the reference frame combo box.

**Current Frame**

Click to set the time for the image displayed in the current window as the reference frame.

**Switch Display**

Switches the frame number or time display in the reference frame combo box.

**(ii) Angle Velocity**  
Calculates the angle velocity for the measurement point angle or the group angle.

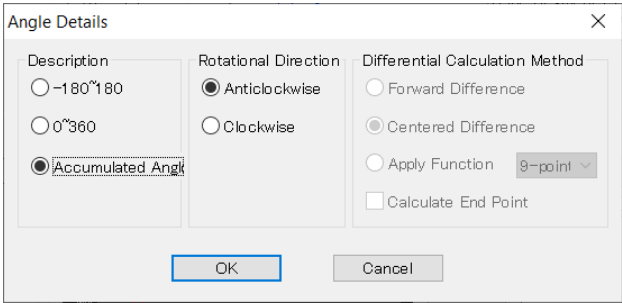
Physical Quantities	Angle Velocity
Units	deg/sec, rad/sec, rpm
Components	(None)

**(iii) Angle Acceleration**  
Calculates the angle acceleration for the measurement point angle or the group angle.

Physical Quantities	Angle Acceleration
Units	deg/sec <sup>2</sup> , rad/sec <sup>2</sup>
Components	(None)

**(c) Detailed Settings for Measurement Point Angles**

Set in the same manner as for エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ).



**Rotational Direction**

Counterclockwise: Angle calculations performed on the screen counterclockwise in the + direction.  
Clockwise: Angle calculations performed on the screen clockwise in the + direction.

(d) Calculation for Quadrants and Group Angles

Angles for quadrant and group tracking are calculated as follows.

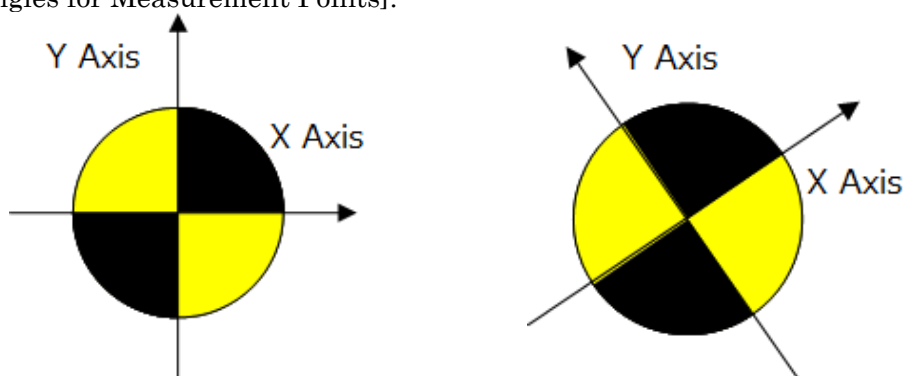
(i) Quadrants

The quadrant angles are calculated for each frame at  $\pm 180^\circ$ .

If using the default settings for [Origin and Axis] for calibration, it is calculated as  $0^\circ$  with the arrangement in the left diagram below.

If the axis direction is set as shown in the following diagram on the right, and the angle of the quadrant matches the angle of the axial direction, it is calculated as  $0^\circ$ .

Positive and negative angles can be set for the rotational direction in [Detailed Settings] under [Angles for Measurement Points].

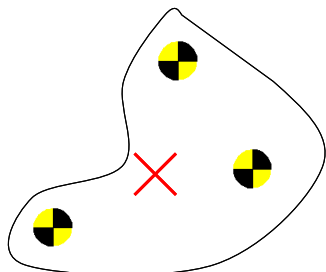


Left Figure: Quadrant angle of  $0^\circ$  when the calibration settings are the defaults.

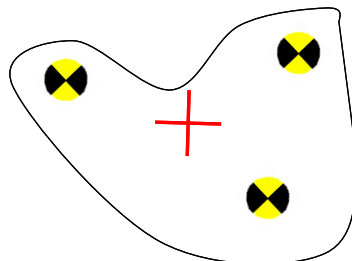
Right Figure: Quadrant angle of  $0^\circ$  when the calibration is set in the axial direction.

**(ii) Group**

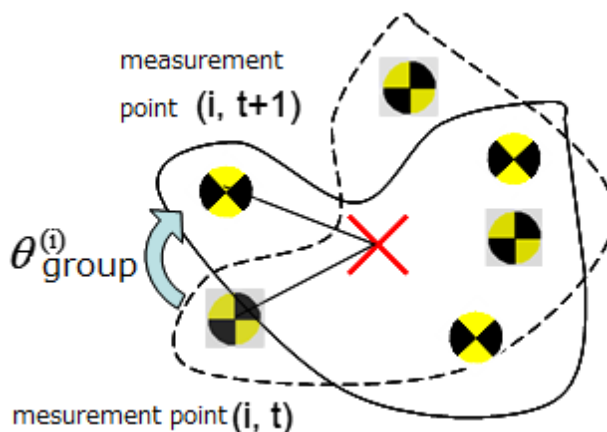
Calculates the differential between the angle of the current frame ( $-180^{\circ} - 180^{\circ}$ ) and the angle of the frame before it. Also adds the offset so the reference frame of the group angle set in the dialog becomes  $0^{\circ}$ . The method of calculating the group is as follows.



**Example of a group with a time of t: Group created with quadrants. The red X is the center of gravity for the quadrant.**



**Example of a group with a time of t+1: the time t group rotates.**

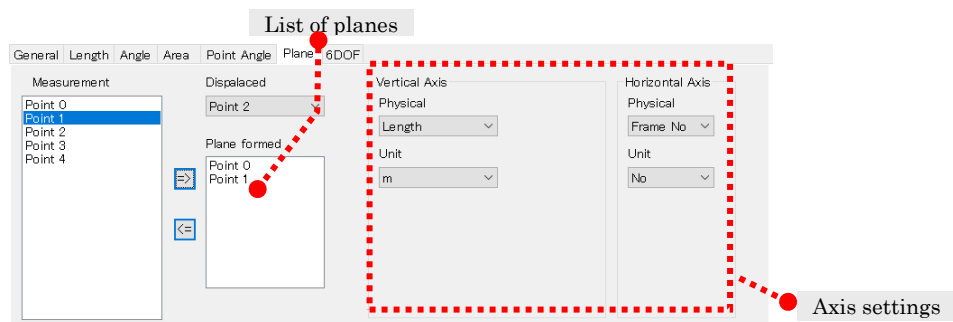


1. Parallel transport so the centers of gravity for the t+1 group and the t group overlap.
2. Calculates the angle of rotation ( $\theta_{group}^{(i)}$ ) between the time t and the time t+1 for the measurement point  $i$  for each point in the group as the rotational center of gravity.
3. Calculates the mean for the  $\theta_{group}^{(i)}$  as the rotational angle  $\theta_{group}$  for this group.
4. Angle calculations are performed in the rotational direction from the [Detailed Settings] so they become + from the set direction.

Also adds the offset so the angle of the time set by the reference frame of the group angle becomes  $0^{\circ}$  and calculates the group angle.

- [Plane Distance] Tab

- (a) Basic Operation



Points subject to Measurement: Shows the measurement points used for calculating distance.

List of Planes: Shows the plane construction points used for calculating distance.



Axis Settings: Sets the physical quantities, components, and units to be calculated.

Calculates the points subject to measurement and the plane distance, and creates a graph.

Measurement results for at least three points are required.

Physical quantities used for the vertical axis include “Length”.

Physical quantities used for the horizontal axis include “Time” and “Frame Number”.

Use  (Add) and  (Delete) to create a list of planes. The calculations are performed according to the order in the list of planes.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。) to use the list of planes.

The methods for specifying planes differ between 2D measurement and 3D measurement.

Real Scale Conversion: Plane passing through the vertical direction between 2 points and the screen

Changing Perspectives: Plane passing through the vertical direction on the perspective plane and 2 points

3D: Plane passing through the 3D points


(b) Points Subject to Measurement

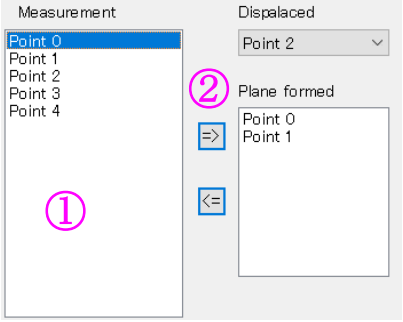
Determines the distance between the points selected for measurement here and the plane selected on the list of planes.

(c) Using the List of Planes

(i) Adding to the List of Planes


1. Select a measurement point on the list of measurement points. (multiple selections allowed.)

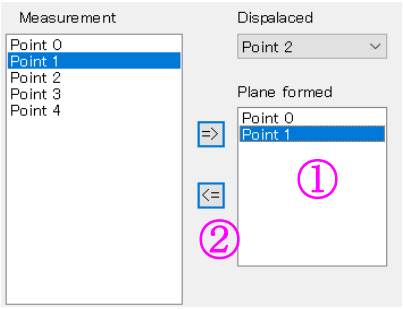
2. Click  (Add). With multiple selections, they are added according to the order on the list.



(ii) Deleting from the List of Planes

1. Select a point on the list of planes to be deleted. (multiple selections allowed.)

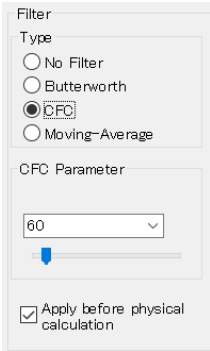
2. Click  (Delete) .





● **Filter**

Smoothing out the graph.

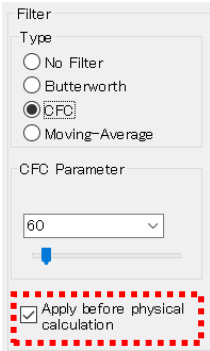


Filters that can be selected include [Butterworth], [CFC] and [Moving Average]. The default is [No Filter]  
If the horizontal axis of the graph is time/frame number, a filter is not used.

Butterworth Filter Specify the cutoff frequency.	CFC Specify the frequency class. Select from 60, 180, 600, 1000.	Moving Average Input the parameters for the moving average. Specify the type (3 point average, 5 point average) and the application frequency.

(a) Order of Filter Application

MOVIAS Neo can select the order of filter application for the physical quantity calculations.

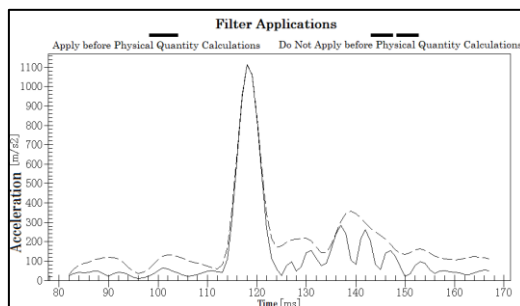


Check [Apply before physical calculation] to apply the filter to the XYZ coordinates before

calculating physical amounts.

Handling the absolute values of multiple components impacts the calculations for the physical quantities. On the other hand, there is almost no difference when calculating only particular components. When calculating absolute values, a version 1.01 or earlier filter has a better smoothing effect.

Uncheck [Apply before physical calculation] to apply the filter after calculating physical quantities. This setting is not available on MOVIAS Neo versions 1.01 or earlier.



#### Comparison of Filter Applications

**Solid Line:** Applied before calculating physical quantities (if checked)

**Dotted Line:** Applied after calculating physical quantities (if not checked)

#### ● Title, Series Names

Sets the graph title and the names of each series. The title is also set to the name of the graph node. Use a title that is different for each graph.

#### ● Series Colors

Designates the series color. Can be set to a custom color.

#### ● Using Series (Add, Delete, Delete All)

Add  Adds the series shown in the current dialog to the graph list.

Delete  Deletes the series selected in the graph list.

Delete All  Deletes all the series registered in the graph list.

#### ● List of Graph Points Shown

Displays the graph series currently created. Select a series to load the data for the series selected and set in the dialog

#### ● Load or Save Template

Loads set data from the saved template file. Also saves data currently registered to the [List of Graph Points Displayed] to a file.

#### ● Draw Graph

Adds data created to a project and displays the graph window. After drawing a graph, the [Create New Graph] dialog is minimized.

Check [Draw in the Same Graph] to display the graph for the series registered in the list in the first window. Uncheck to create a graph item node for each series and display in their own graph window. For example, if three series are registered to the list, three

graph item nodes are created, which are displayed in their own graph window.

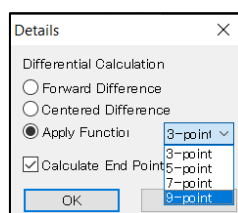
- **Close**

Closes the [Create New Graph] dialog.

### 7.1.3 Differential Calculations

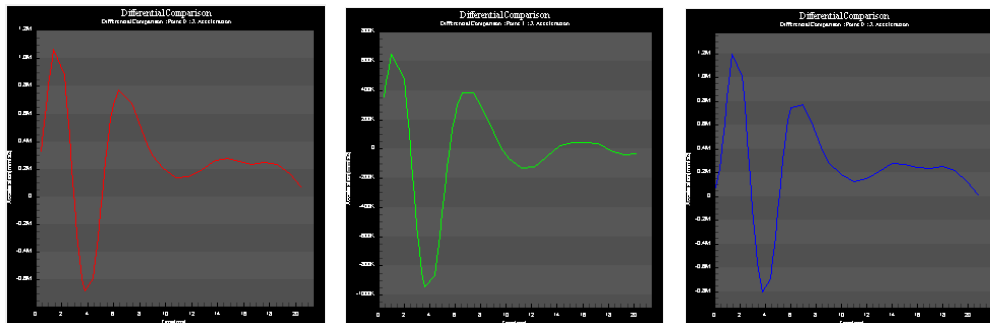
- **Function Fitting Differentials**

With function fitting (3 points, 5 points, 7 points, 9 points) in [Detailed Settings Dialog] for velocity and acceleration, differential calculations are performed with quadratic functions using a specific number of points. Since differentials have a bit of a smoothing effect, there is an effect if there is significant noise from “forward differences” and “central differences”.



Settings Dialog for [Function Fitting]

Next is a comparison with “central differences”.



Comparisons between [Function Fitting] and [Central Differences]

(Left) 7 point [Function Fitting] (Center) 5 point [Function Fitting]  
(Right) [Central Differences]

With [Central Differences], noise is evident while [Function Fitting] shows the graphs smoothed out. The more points, the smoother the differential effect

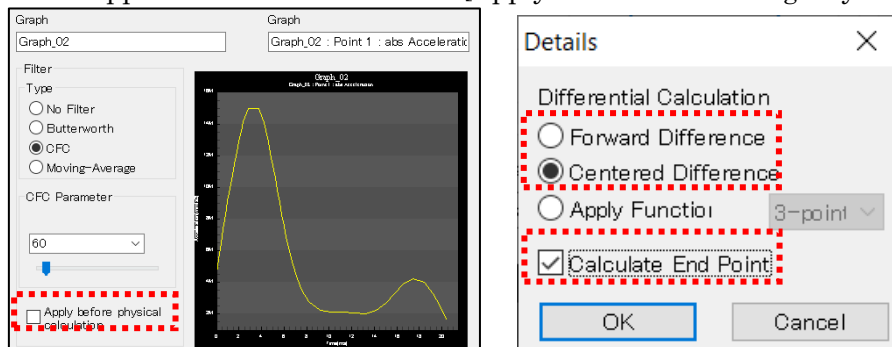
- **Example Reproducing the Effect of the MOVIAS Pro Calculations with MOVIAS Neo Ver1.01 or earlier**

**(i) Reproducing the Calculation Effect with MOVIAS Neo Ver1.01 or Earlier**

Method of Calculating Differentials: Select either [Central Differences] or [Forward Differences].

Calculating End Points: Check [Calculate End Points].

Filter Application: Uncheck [Apply Before Calculating Physical Quantities].

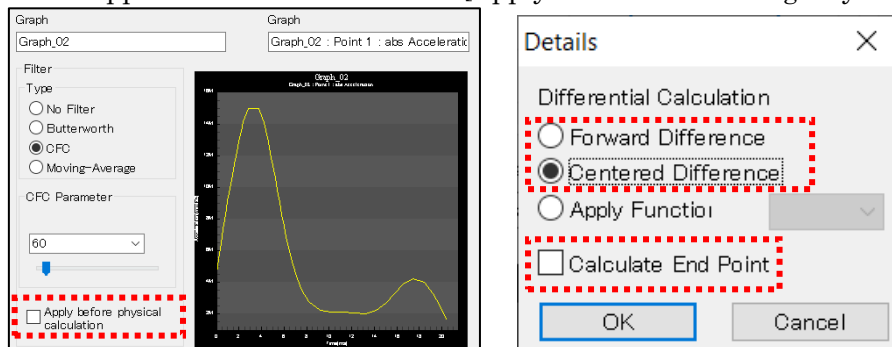


**(ii) Reproducing the Calculation Effect with Movias Pro**

Method of Calculating Differentials: Select either [Central Differences] or [Forward Differences].

Calculating End Points: Check [Calculate End Points].

Filter Application: Uncheck [Apply Before Calculating Physical Quantities].



- Handling End Frames during Differential Calculations

Check [Calculate End Points] to calculate differentials with MOVIAS Neo version 1.02 or later and switch between calculations for end points (starting frame · ending frame).

End point calculations are as follows, according to the differential method selected

**(i) [Forward Differences] or [Central Differences]**

**Check [Calculate End Points]**

Performs differential calculations on all frames. At this point, differential calculations are performed with linear approximation of the base data in the ending frame.

**Uncheck [Calculate End Points]**

Performs differential calculations only on frames that can be calculated with the differential method specified.

**(ii) [Function Fitting]**

**Check [Calculate End Points]**

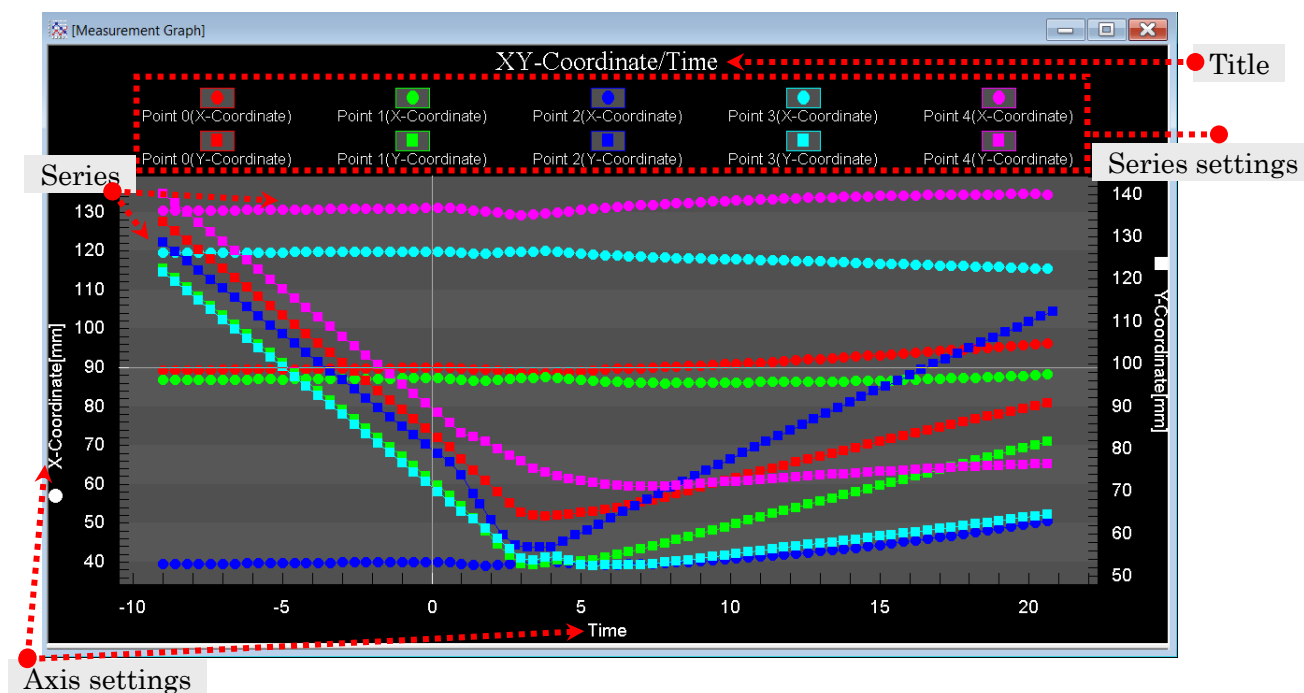
- 3 Points: Performs differential calculations starting with two frames from the beginning and ending with two frames from the end.
- 5 Points: Calculates with five points starting with three frames from the beginning and ending with three frames from the end, and three points starting with two frames from the beginning and ending with two frames from the end
- 7 Points: Calculates with 7 points starting with 4 frames from the beginning and ending with 4 frames from the end, 5 points starting with 3 frames from the beginning and ending with 3 frames from the end, and 3 points starting with 2 frames from the beginning and ending with 2 frames from the end.
- 9 Points: Calculates with 9 points starting with 5 frames from the beginning and ending with 5 frames from the end, 7 points starting with 4 frames from the beginning and ending with 4 frames from the end, 5 points starting with 3 frames from the beginning and ending with 3 frames from the end, and 3 points starting with 2 frames from the beginning and ending with 2 frames from the end.

**Uncheck [Calculate End Points]**

- 3 Points: Performs function fitting differential calculations using 3 points, starting with 2 frames from the beginning and ending with 2 frames from the end
- 5 Points: Performs function fitting differential calculations using 5 points, starting with 3 frames from the beginning and ending with 3 frames from the end.
- 7 Points: Performs function fitting differential calculations using 7 points only starting with 4 frames from the beginning and ending with 4 frames from the end.
- 9 Points: Performs function fitting differential calculations using 9 points, starting with 5 frames from the beginning and ending with 5 frames from the end.

## 7.1.4 Graphing

Double click the analysis graph item node or click draw graph in the create graph dialog to display the analysis graph.



### ● Jump Frames

Move the mouse on the graph series and click to select the points (figure at the right) to jump to that frame.

Drag to move the frame.

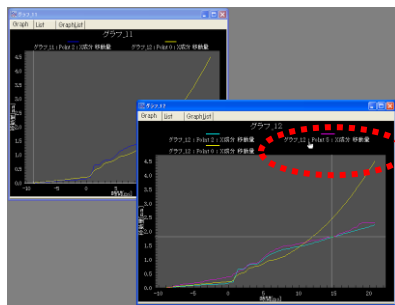


During playback, the cursor and position selected on the list move. Click a series during sync playback to jump all of the frames in the window.

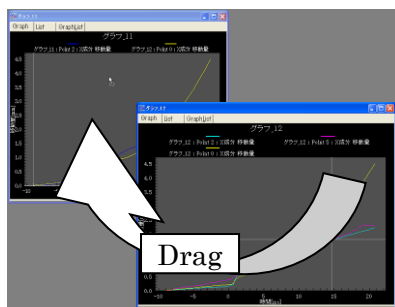
## ● Drag and Drop

A graph series can be added to other graphs with the same horizontal axis using drag and drop if the frame rates match.

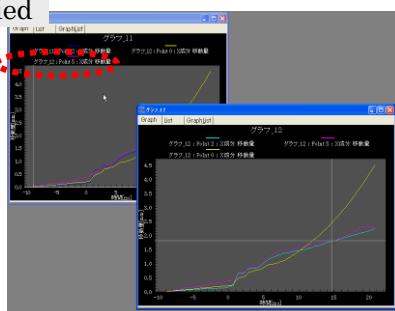
(A maximum of 6 axes can be added)



Select the series to be copied.

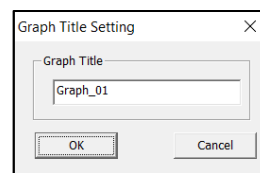


Dropped series are copied



## ● Change Titles

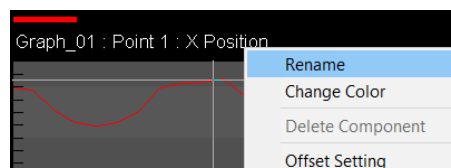
Double click on a section of the graph title to show the [Graph Title Settings] dialog. Input the title and click OK to change the title of the graph. The graph item node display on the project tree can be changed at the same time



## ● Series Settings

The name and color of the series can be changed for each series.

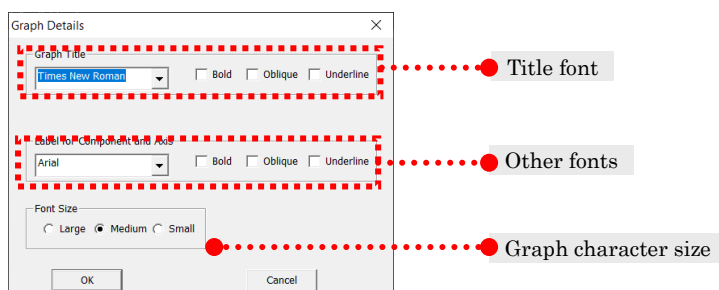
Right click on the name of the series or double click a point on the series to display the popup menu. Click on the settings to change.



## ● Font Settings

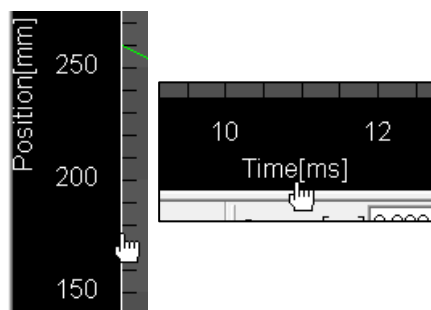
Click [Detailed Settings for Graphs] on the right click menu on the graph to display the [Detailed Settings for Graphs] dialog and set the graph font.

Sets the title font, series and axis font as well as the graph character size.



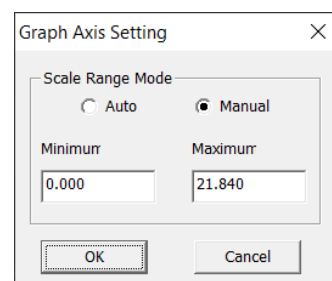
## ● Specify Axis

Double click on a part of the target axis (figure to the right) to set the data range for the horizontal and vertical axis, and to display the [Graph Axis Settings] dialog appears. If there are multiple vertical axes, the range for each axis can be set.



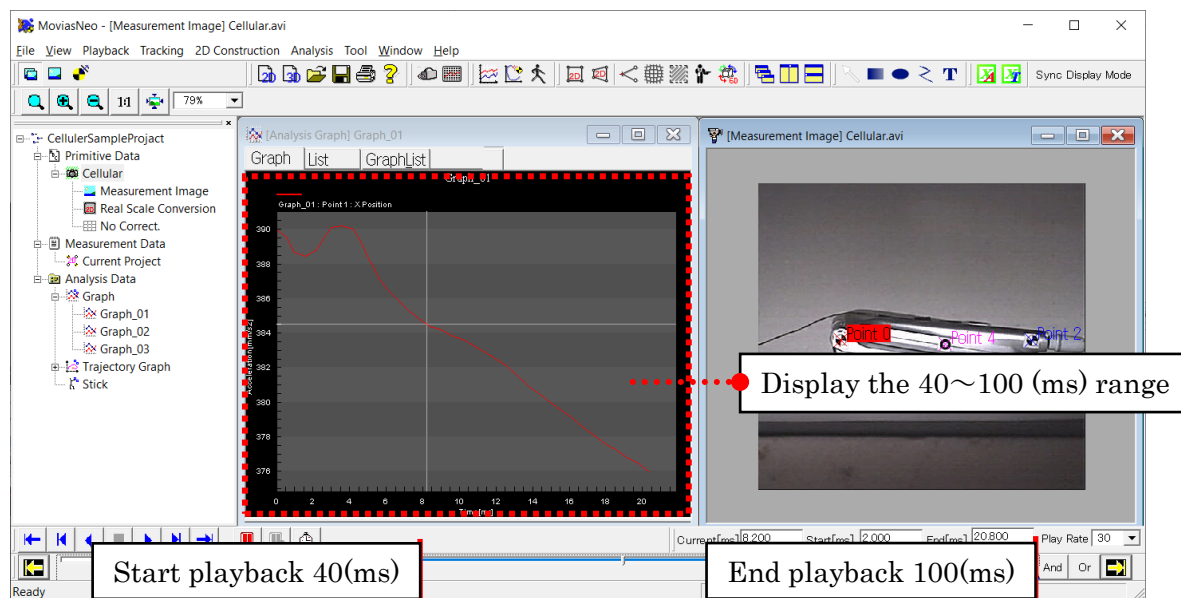
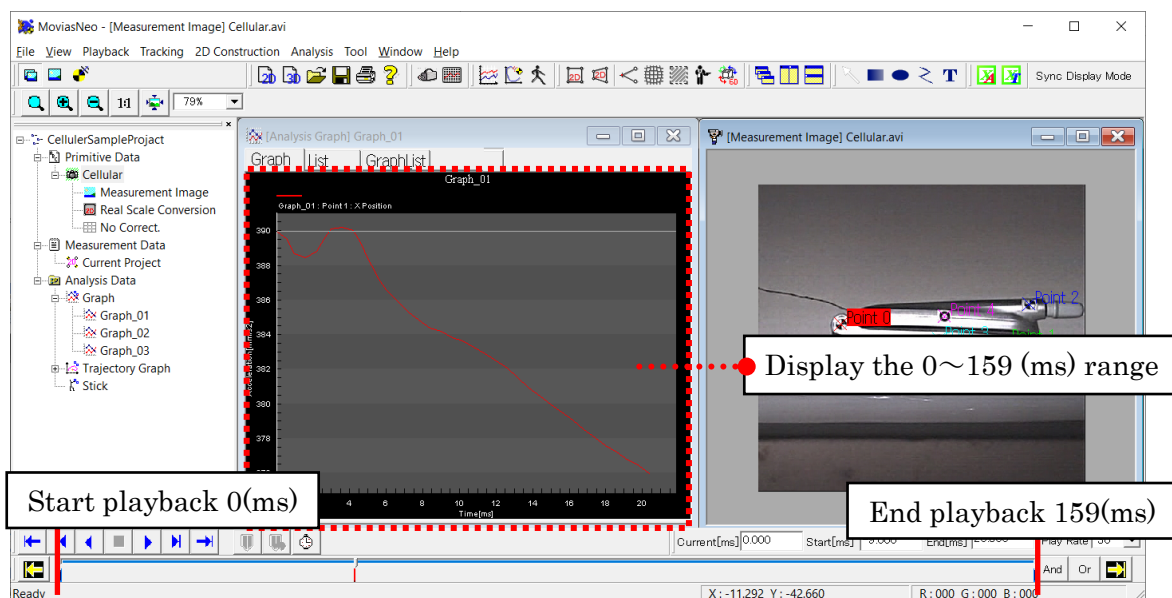
If [Auto] is selected, all of the data will be graphed. If [Manual] is selected, the desired range can be set. The default is [Auto].

If the vertical axis or horizontal axis is time or frame number, you can set the playback range using the playback slider.



If you set the playback range using a playback slider while in the display mode, the playback range will be reflected on the graph display range.





Top: Default playback range (All) Bottom: After setting the playback range. The graph display range changes with the playback range.

## ● Analysis Graph Information Dialog

Confirms the information for the current analysis graph.

Click [Graph Information] on the right click menu of the graph.

The [Analysis Graph Property] dialog appears so set [Auto Update of Graph] and confirm the [Graph Information].

### [Enable Auto Update of Analysis Graph] Check Box

Setting for auto updates on each graph. When correcting or deleting tracking measurement points or when correcting calibration, the finished graph is automatically updated with the latest data.

Check [Enable Auto Update of Analysis Graph] to automatically update the graph when creating measurement data (p. エラー! ブックマークが定義されていません。).

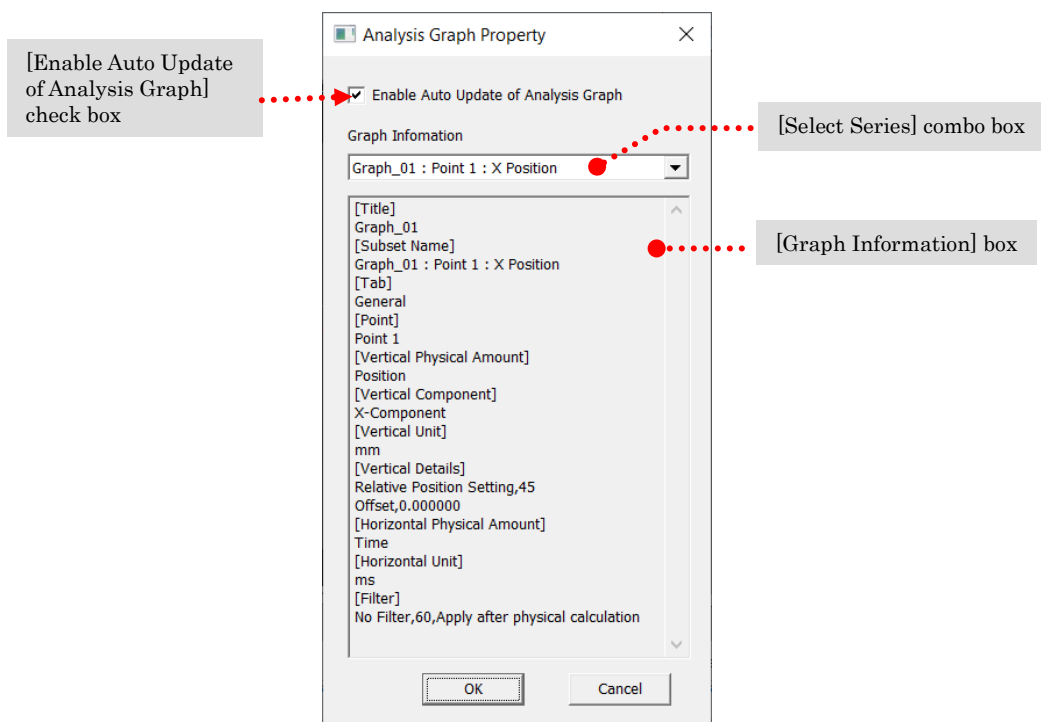
The default is checked. Uncheck and graphs are not automatically updated.

To enable this setting, the auto update graph settings in [Environment Settings] (p. エラー! ブックマークが定義されていません。) must be enabled.

### [Graph Information]

Displays all the analysis graph information, including [Physical Quantities], [Units], [Filter] and [Detailed Settings] specified during creation of the analysis graph.

Displays the graph information for the series selected with the [Select Series] combo box.



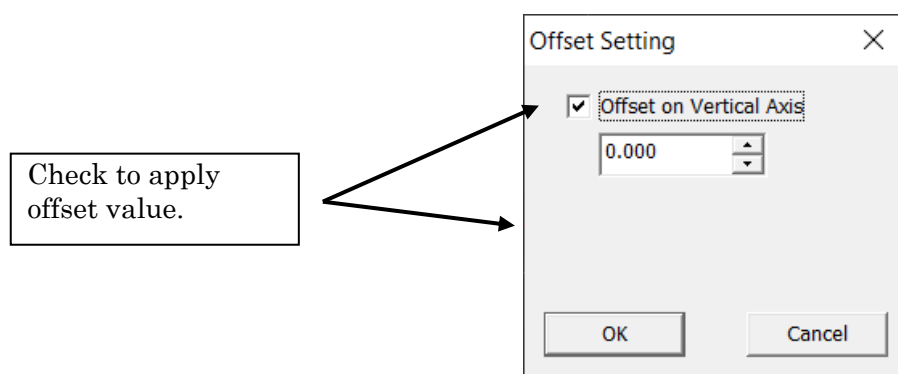
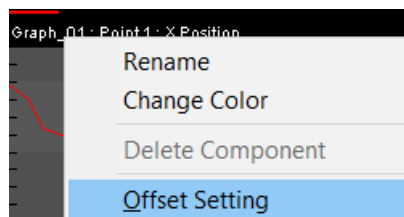
[Analysis Graph Information] Dialog

### ● Offset Graphs

Set the amount of offset for graphs of position • displacement • movement.

The values set are the same as those under the エラー! 参照元が見つかりません。 in the エラー! 参照元が見つかりません。 .

Click [Offset Settings] on the right click menu of the graph series to display the [Offset Settings] dialog.  
Set or cancel the offset with this dialog.




Change the values when checked to preview after applying the offset values to the series.  
Click OK to apply or cancel to return to the previous dialog

Only the physical quantities of position • displacement • movement on the vertical axis and horizontal axis can be used with [Offset Settings].

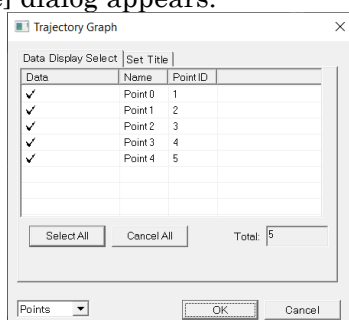
## 7.2 Trajectory Figures

### 7.2.1 Create a Trajectory Figure

Perform the following to create a trajectory figure of measurement data.

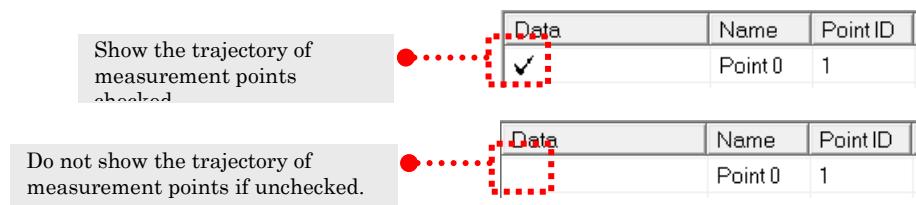
- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Analysis] ⇒ [Create a Trajectory Figure] on the menu.
- ✓ Click the trajectory figure node under the analysis data node on the project tree and then click [Create New] on the right click menu.

The [Create Trajectory Figure] dialog appears.



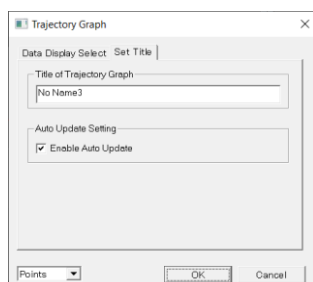
**Create Trajectory Figure Dialog**

Select the measurement points to display under the [Select Data to Display] tab.



After creating a trajectory figure, click [Properties] on the right click menu of the trajectory figure to switch between show/hide the measurement points and display the [Trajectory Graph] dialog.

The title and auto update of the trajectory figure can be set under the [Title Settings] tab (p. エラー! ブックマークが定義されていません。 ).



Click OK to add the trajectory figure to the project and display the trajectory figure

window.

## 7.2.2 Using Trajectory Figures

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Drag to change the perspective. Rotate 360° or tilt approximately 80°.

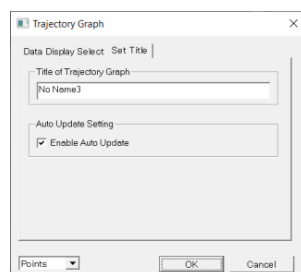
Right click the measurement point name or double click a point on the trajectory to display a popup menu and change the color or name.

Double click on the graph title to change the graph title.

### ● Auto Update of the Trajectory Figure

Setting to automatically update the trajectory figure. When correcting or deleting tracking measurement points or correcting calibration, the finished graph is automatically updated with the latest data.

Click [Properties] using the right click menu on the graph.



**Title Settings Tab in the [Trajectory Graph] Dialog**

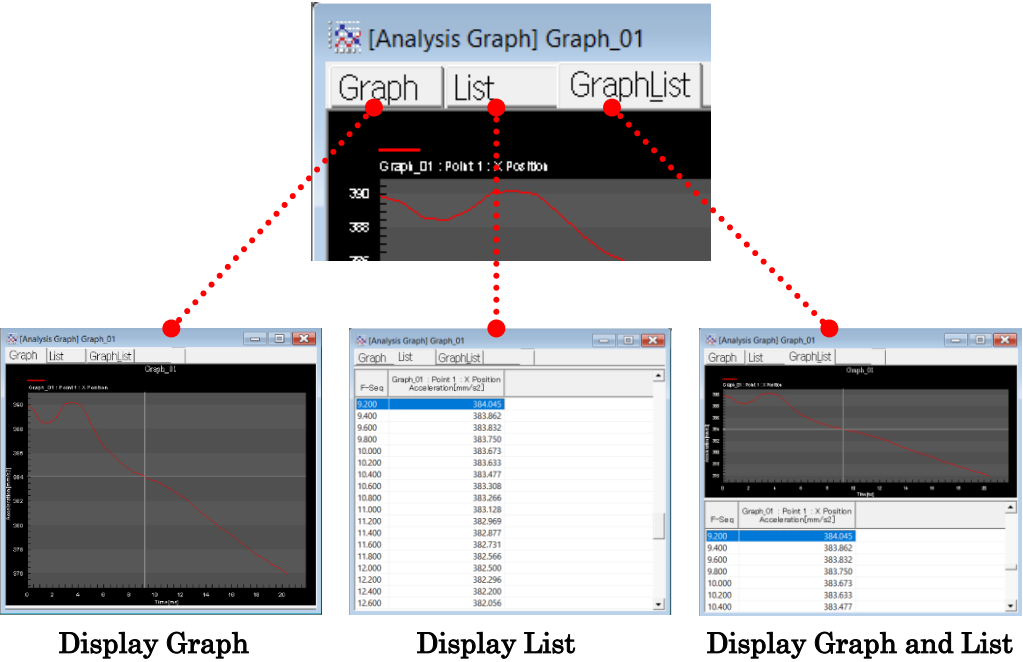
Check [Enable Auto Update] under the [Title Settings] tab of the [Trajectory Graph] dialog to automatically update the trajectory figure when creating measurement data (p. エラー! ブックマークが定義されていません。). The default is checked.

Uncheck and the trajectory figures are not updated.

To enable this setting, the auto update graph settings in [Environment Settings] (p. エラー! ブックマークが定義されていません。) must be enabled.

7.3 Analysis List

Switch between analysis graph • trajectory figure tabs to display the graph, the list or both the graph and the list.




## 7.4 Sticks

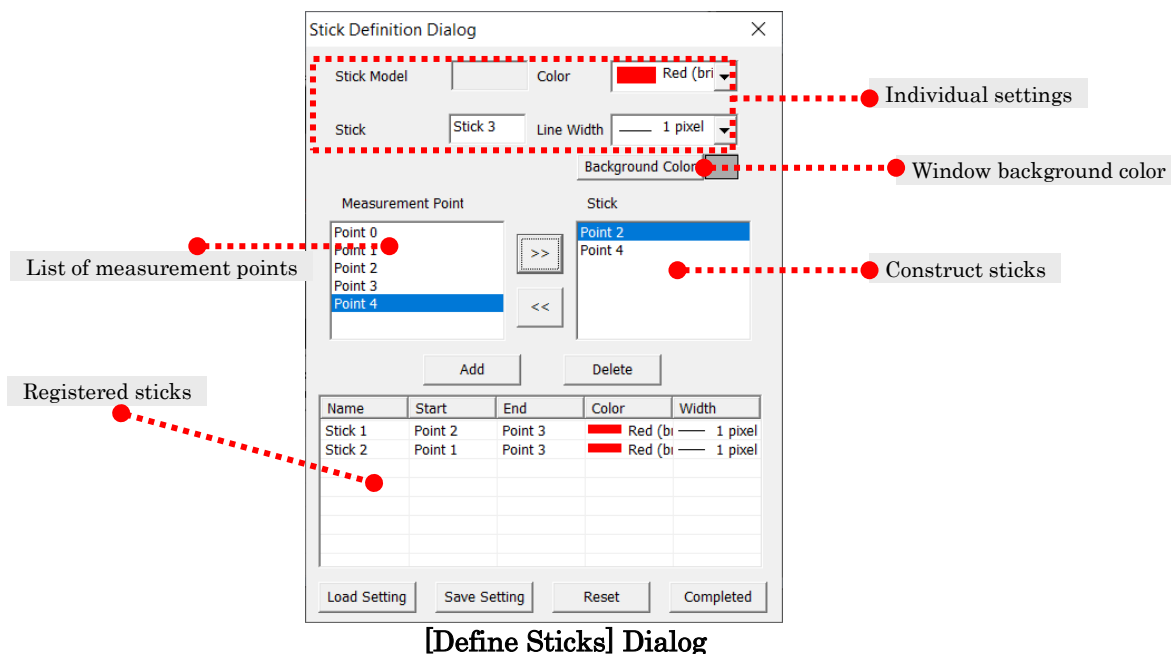
A straight line between measurement points is called a stick. Sticks are displayed in the stick window. Also, they can be superimposed on the measurement image window. 3D analysis results are drawn with points and lines (sticks).

### 7.4.1 Define Stick Dialog

To create or edit stick definitions, perform any of the following when the stick item node (refer to p. エラー! ブックマークが定義されていません。 ) in the project tree is not selected.

- ✓ Click  the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [Tool] ⇒ [Define Sticks].

The [Define Sticks] dialog appears.



#### Individual Settings

Settings for currently created sticks. Sets the stick name, color and thickness.

#### List of Measurement Points

Displays a list of measurement points available for constructing sticks.

#### Construct Sticks

Measurement points currently constructing sticks.

#### Window Background Color

Sets the background color for the stick window.



**Registered Sticks**

List of registered sticks.

After clicking Finish, the defined stick can be used.

**Load Settings**

Loads the defined stick saved in the file (\*.stk).

**Save Settings**

Saves the currently defined stick in a file (\*.stk).

**Reset**

Reverts to the settings from when the dialog was opened.

● **Stick Registration**

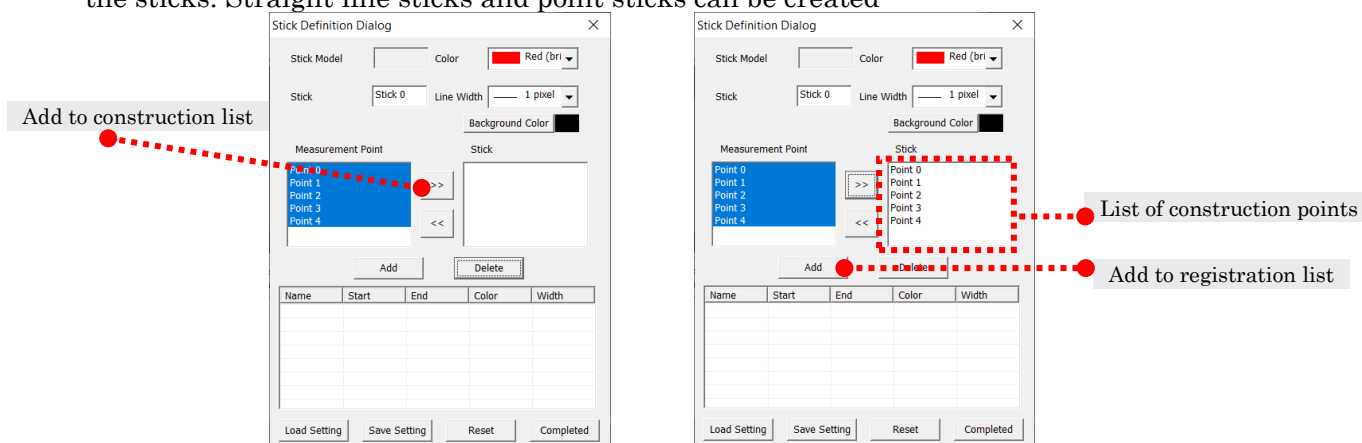
Sets the name · color · thickness of each stick and registers them to a list. To register a stick, perform either (a) エラー! 参照元が見つかりません。 or (b) エラー! 参照元が見つかりません。 .

Defined sticks are superimposed on the measurement image.

If the starting and ending points of a stick are the same, it is treated as a point. If specifying a series of multiple points, these connected points create a stick. For example, if adding “Point1”, “Point2”, “Point4”, “Point5”, “Point3” in that order, a total of four sticks will be registered, specifically “Point1 – Point2 stick”, “Point2 – Point4 stick”, “Point4 – Point5 stick”, “Point5 – Point3 stick”.

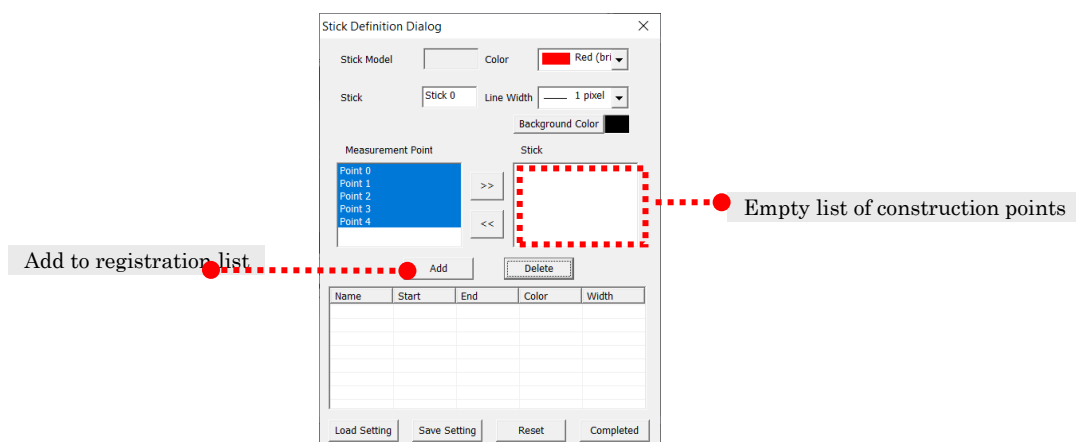
**(a) Using the Construction Point List**

After adding or deleting from the [List of Stick Construction Points], add them to register the sticks. Straight line sticks and point sticks can be created



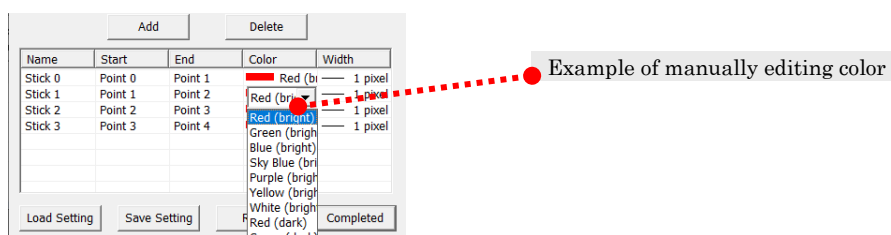
### (b) Manually Add to Registration List

Manually add to the registration list. Registration of straight line sticks is sequential.




### (c) Editing after Registration

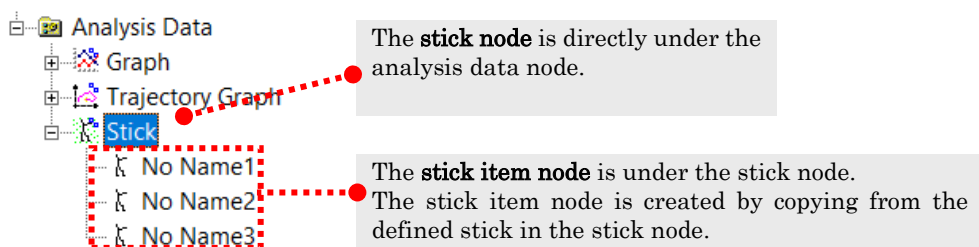
Double click on the item registered to manually edit the name, starting point, ending point, color or width.




## 7.4.2 Create and Edit Stick Item Nodes

The stick item node can be created after creating a defined stick. Perform any of the following.

- ✓ Click  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。
- ✓ Click [Analysis] ⇒ [Create Stick] on the menu.
- ✓ Click [Create New] on the right click menu under the analysis data node.



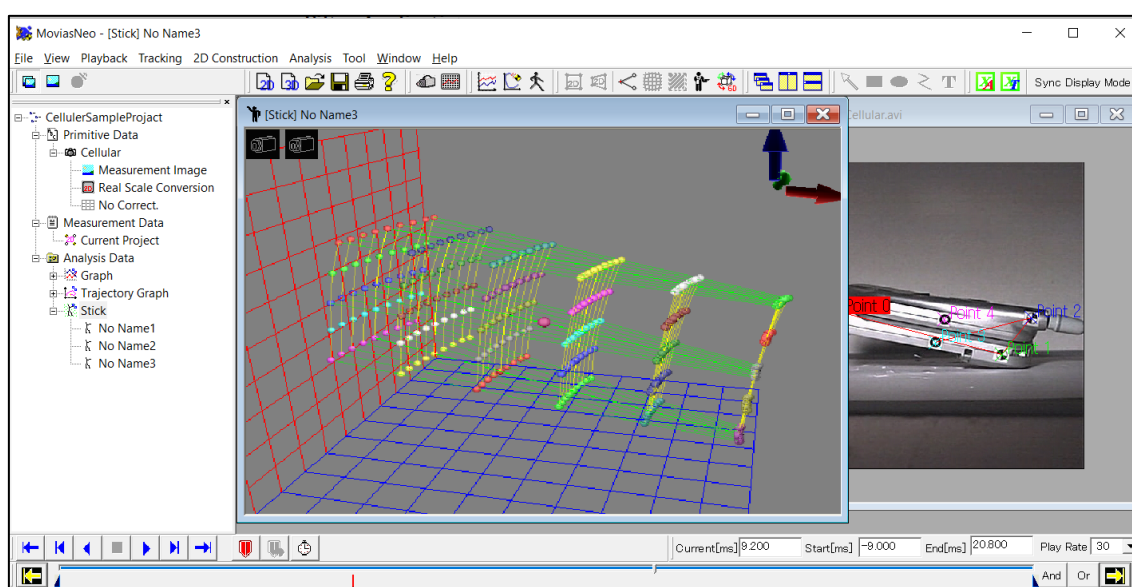
Perform either of the following on the project tree to edit the stick item node.

- ✓ Select the stick item node and click the define stick  button.
- ✓ Click [Edit Stick] on the right click menu in the stick item node.

The Stick Definition dialog appears. Edit the stick definition for the selected stick item node.

### 7.4.3 Stick Window

Use the mouse to create sticks. The right click menu has settings for [Superimpose Settings], [Projection Method], [Show Grid], [Rotation Center Settings] as well as [Save to Image File].



Overview of Stick Operation

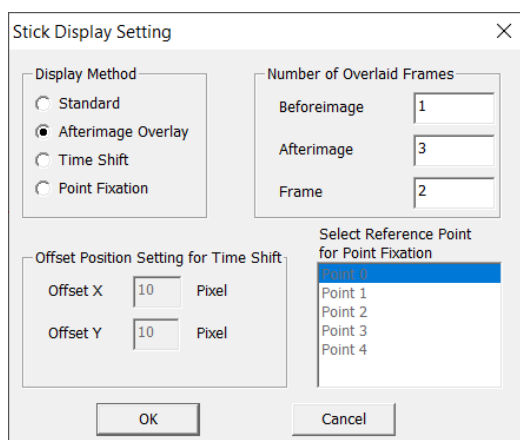
#### ● Mouse Operation

Use the mouse to display.

Rotate:	Drag
Zoom In:	Shift + drag upwards/rotate mouse wheel upwards
Zoom Out:	Shift + drag downwards/rotate mouse wheel downwards
Move Parallel:	Ctrl + drag/drag mouse wheel

## ● Superimpose Display Settings

Click [Superimpose Settings] on the right click menu and the stick display settings dialog will appear.



[Stick Display Setting] Dialog

Set the display method from [Standard], [Show Superimposed], [Time Shift] or [Superimpose Specified Points].

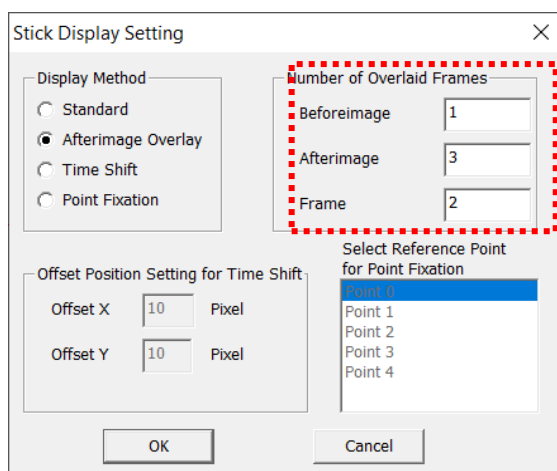
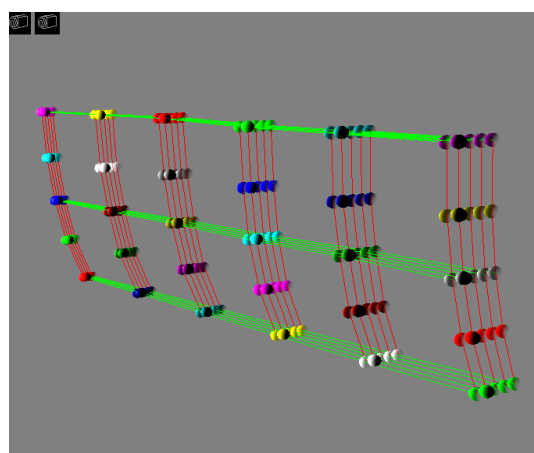
### Standard

Shows only the selected sticks.

### Superimposed

Sets the number of superimposed frames to show and displays the sticks in that range of frames. Frames not current are shown as semi-transparent. Sets the number of frames for the superimposed display.

### Display



If the number of superimposed frames to display is set as in the above figures, the following sticks for the frames are shown in the window when the current frame is 0.

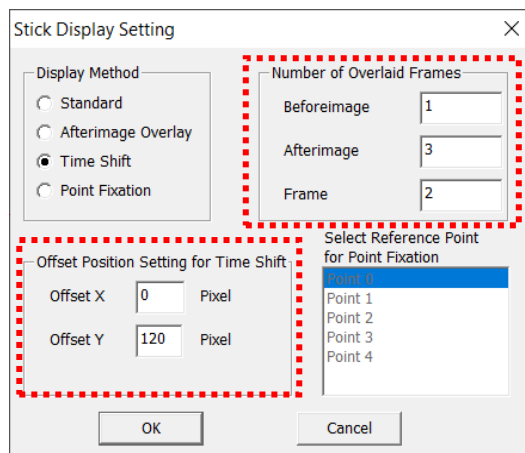
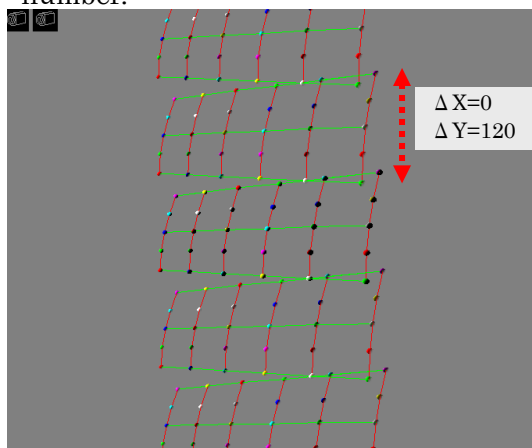
- Stick for the -9<sup>th</sup> frame
- Stick for the -6<sup>th</sup> frame
- Stick for the -3<sup>rd</sup> frame
- Stick for the 0 frame
- Stick for the 3<sup>rd</sup> frame

### Time Shift

Sticks for specified pixels are shifted to display afterimages.

Sets the number of superimposed frames to display and the offset settings for the amount of the shift.

The number of frames displayed before and after are automatically set to the same number.

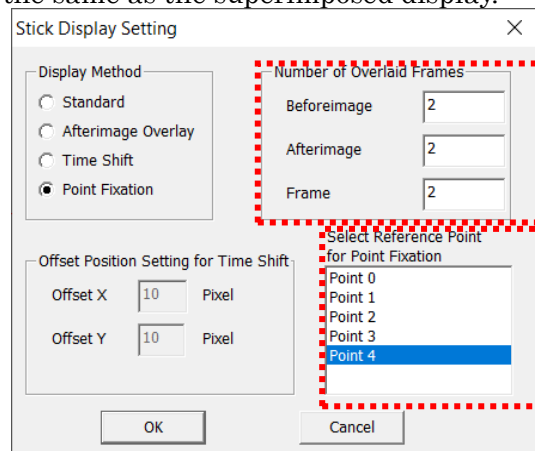
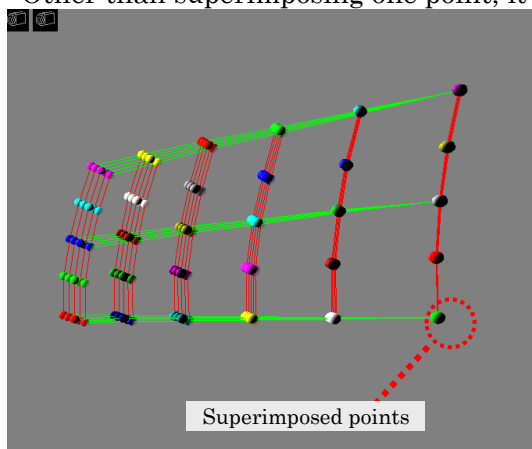


### Superimpose Specified Points

Superimposes the specified measurement points on the current frame for a superimposed display.

Sets the number of superimposed frames to display and the standard superimposed points.

Other than superimposing one point, it is the same as the superimposed display.



### ● Projection Method

Select the projection method with the right click menu.

Select from [Perspective Projection], [Front Orthogonal Projection], [Top Orthogonal Projection] and [Side Orthogonal Projection].

### Perspective Projection

Converts the perspective for display.

Objects far away are shown smaller and closer objects are larger.

### Front Orthogonal Projection

Converts the current display to the front orthographic display. Displays without

regard to distance.

### Top Orthogonal Projection

Point viewed is shown from the camera top orthographic perspective. Displays without regard to distance.

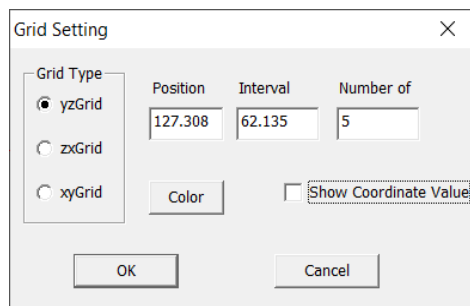
### Side Orthogonal Projection

Point viewed is shown from the camera side view orthographic perspective. Displays without regard to distance.

## ● Show Grid

Displays a grid on the X,Y,Z planes. Click [Show Grid] on the right click menu → then [y-z plane], [z-x plane], [x-y plane] to switch the grid from show/hide.

For settings for each plane, click [Show Grid] on the right click menu ⇒ [Grid Properties] to display the [Grid Settings] dialog.



### Select Grid

Grid for the target settings. Settings for [Grid Position], [Grid Scale], [Number of Lines] and [Color] for the selected grid.

### Grid Position

Designate the offset from the coordinate axis on the grid plane.

### Grid Scale

The scale for the grid.

### Number of Lines

Number of lines on the grid.

### Color

Designates the color of the grid.

### Show Coordinates

Shows the grid position in the window.

## ● Rotation Center Settings

Select the rotation center for mouse rotation.

### Center of Gravity for Measurement Points

Use for the center of gravity.

### Select a Measurement Point as the Center of Gravity

Set a specific measurement point as the center of gravity.

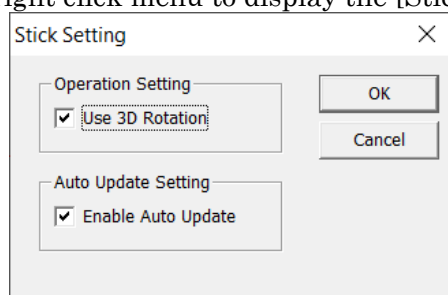
Click a measurement point on a stick to select.

### Calibration Starting Point

Establishes a calibration starting point.

- **Stick Settings**

Click [Properties] on the right click menu to display the [Stick Settings] dialog.



**[Stick Settings] Dialog**

**Use 3D Rotation**

Sets limits for the 3D rotation relative to the mouse drag operation.

Check for 3D rotation. Uncheck so there is no 3D rotation. Limits it to 2D rotation. The initial value when creating sticks during 2D analysis has [Use 3D Rotation] disabled.

The initial value for 3D analysis enables [Use 3D Rotation].

**Enable Auto Update**

Check to enable automatic updates to stick displays when measurement points are changed. The default is checked. Uncheck and automatic updates of stick displays are not conducted.

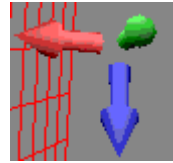
To enable this setting, the auto update graph settings in [Environment Settings] (p. エラー! ブックマークが定義されていません。 ) must be enabled.

## ● Coordinate Axis

The axis showing the current coordinates is shown at the top right of the window

The X, Y and Z axis colors are red, green and blue, respectively.

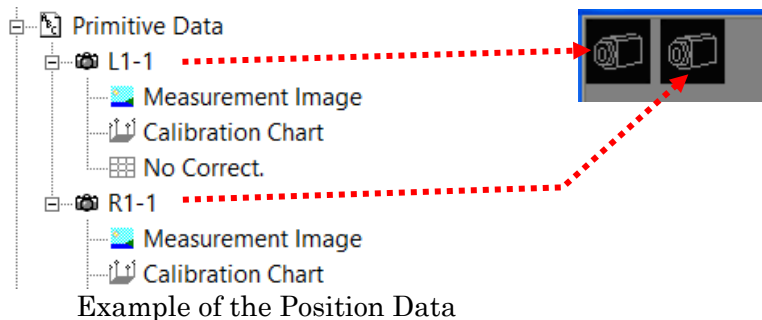
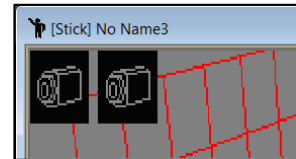
Click [Show Coordinate Axis] on the right click menu to switch between show/hide.



## ● Camera Icon

Icon in the upper left of the window. Set the perspective to the position of the camera clicked to reset the mouse

Data on the position of the camera icon is arranged in order from the camera item node on the project tree. (Refer to the example in the following figure.)



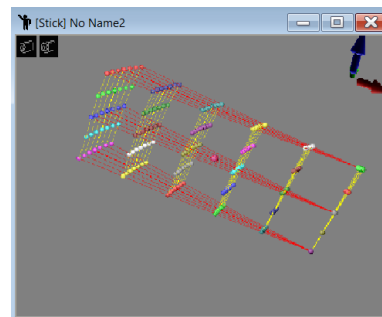
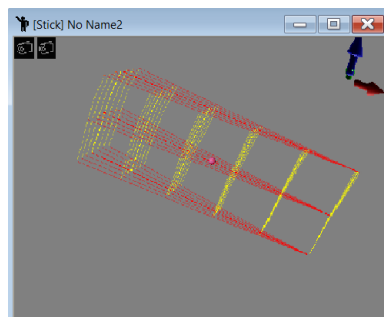
Cameras not calibrated are not set even if they are clicked.

## ● Show Measurement Points

Setting to display all of the points with measurement results.

Click [Show Measurement Points] on the right click menu to switch from show/hide. Measurement points are displayed after the sticks are displayed.

The figure on the left does not show them, while they are shown in the figure on the right.



## ● Show Rotation Center

Shows the points indicating the center of rotation. Click [Show Rotation Center] on the right click menu to switch between show/hide.



## 7.5 Auto Update Graphs

Settings for analysis graphs as well as trajectory figures and sticks to automatically update graphs.

If correcting or deleting tracked measurement points or if correcting calibration, completed graphs are updated with the latest data when the measurement data is updated.

The auto update graph settings in [Environment Settings] (p. エラー! ブックマークが定義されていません。 ) must be enabled.

Also, the auto update settings can be individually set for each graph.

Refer to the following for individual auto update graph settings.

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エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 )

エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 )

## 7.6 Simple 6DOF Measurement

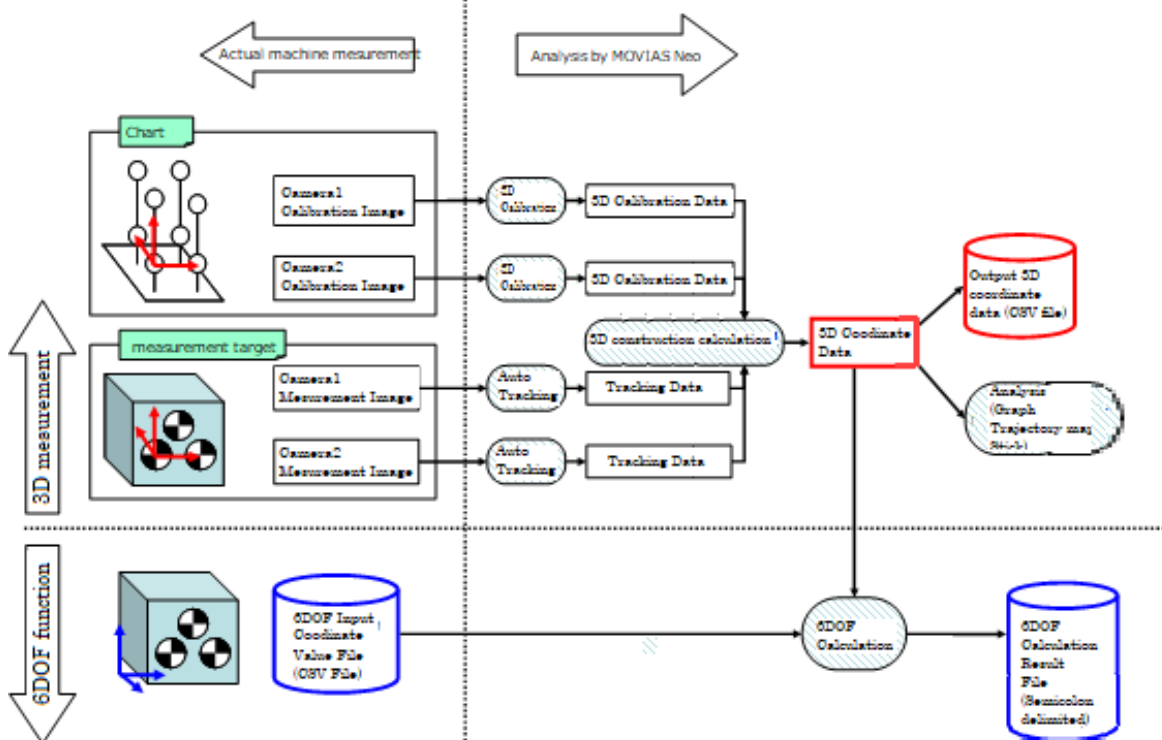
Performs 6DOF measurement for the measurement target. Since 3D measurements are linked, create a 3D measurement project to perform 6DOF measurement.

The following inputs and files are needed to perform 6DOF measurement.

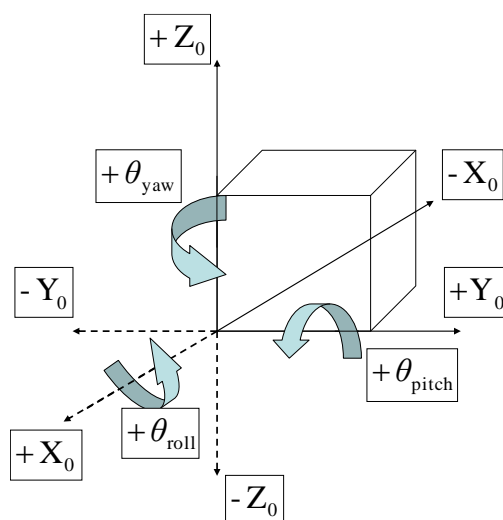
- ✓ 4 or more measurement points.
- ✓ エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)

Measurement results are output as [6DOF Analysis Result Files]

Refer to エラー! 参照元が見つかりません。 (p. 7-55) for details.



The relationship between the 6DOF calculated values ( $X$ ,  $Y$ ,  $Z$ ,  $\theta_{roll}$ ,  $\theta_{pitch}$ ,  $\theta_{yaw}$ ) is shown in the figure to the right. When each axis is viewed from the + direction, the angle is calculated with the counterclockwise rotation as the positive rotation direction. Also, the coordinates are displaced from the top frame coordinates.

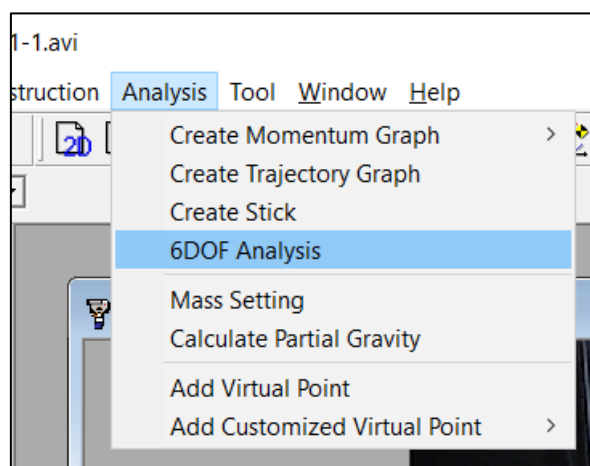


### 7.6.1 6DOF Calculation Process

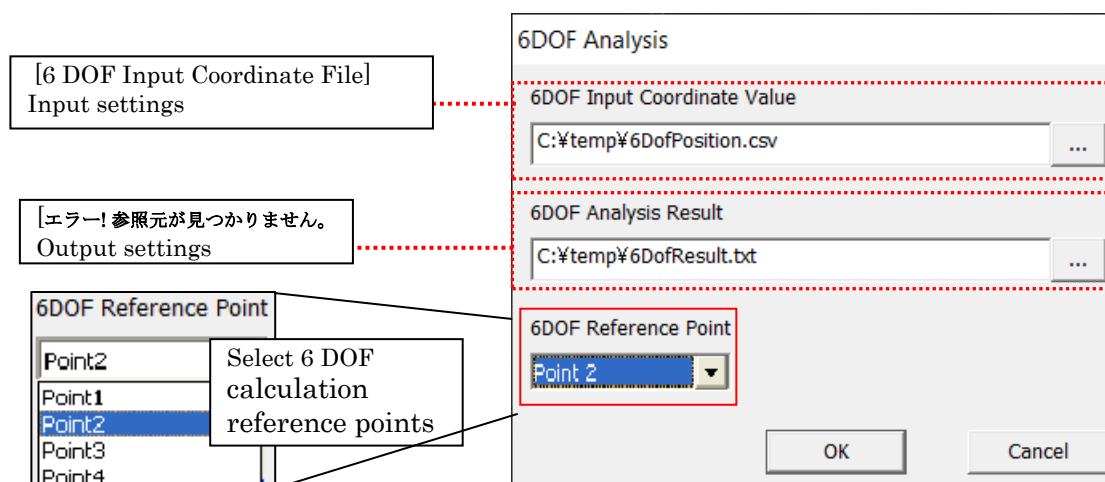
[Construct 3D Measurement Data] must be completed to perform 6DOF calculations. Check to make sure construction of the 3D measurement data has been completed.

The procedure is as follows.

1. Select [Analysis] ⇒ [6DOF Analysis] on the menu to display the [6DOF Analysis Dialog].



6DOF Analysis Menu



6DOF Analysis Dialog

2. Set the input for the [6DOF Input Coordinate File] and the output for the [6DOF Analysis Results File]. Also, since a list of names of points is input to [6DOF Calculated Reference Points] with [6DOF Input Coordinate File], select a point to be the 6DOF calculation reference point.
3. Click [OK] to export the 6DOF analysis results file.

### 7.6.2 6DOF Input Coordinates File

---

Coordinate positions with markers on the measurement target are required for 6DOF calculations. Measure the separate marker positions and create a file. The 6DOF position and rotation is calculated with the coordinates of this file.

The file format is as follows. Input numbers as integers. If the line heading is not a number, it is considered a comment and is disregarded. The input coordinate units are 3D calibration units.

Measurement point ID, X coordinates, Y coordinates, Z coordinates

1,	10,	10,	3,
2,	20,	10,	3,
3,	10,	20,	3,
4,	20,	20,	3,

**Example of 6DOF input coordinate file. The markers on the measurement targets are noted on each line.**

### 7.6.3 エラー! 参照元が見つかりません。

The エラー! 参照元が見つかりません。 format is as follows.

The coordinates and rotation (Roll/Pitch/Yaw) for the designated points are output for each time. They are separated by “;”.

If the 6DOF calculations are for a time that is not possible, the following time data will be output for that line.

Time ;	X ;	Y ;	Z ;	Roll ;	Pitch ;	Yaw
0.000;	0.000;	0.000;	0.000;	0.000;	0.000;	0.000
0.005;	-0.050;	-0.030;	-0.074;	-0.014;	0.053;	-0.010
0.010;	0.476;	0.136;	-0.085;	-0.017;	-0.043;	0.009
0.015;	-0.102;	0.094;	-0.034;	0.001;	0.010;	0.010
0.020;	-0.113;	-0.044;	-0.104;	-0.013;	0.053;	-0.010
			:			
			:			
10.665;	-0.003;	0.396;	-0.019;	-0.058;	0.008;	0.002
10.670;	0.028;	0.533;	-0.003;	-0.069;	0.003;	0.002
10.675;	0.000;	0.570;	0.001;	0.075;	0.000;	0.000

**Example of a エラー! 参照元が見つかりません。**

The 6DOF calculation results for the top frame are fixed at  
0.000; 0.000; 0.000; 0.000; 0.000; 0.000; 0.000.

#### Time:

Units for times are fixed at “seconds”.

#### X, Y, Z:

Displacement from the top frame of the [6DOF Calculation Reference Point].

The coordinates are those from the [エラー! 参照元が見つかりません。].

The units are the units from calibration.

#### Roll, Pitch, Yaw:

The angle units are degrees.

The range for Roll, Pitch, Yaw is as follows.

$$-180^{\circ} < \theta_{\text{roll}} \leq 180^{\circ}, -90^{\circ} \leq \theta_{\text{pitch}} \leq 90^{\circ}, -180^{\circ} < \theta_{\text{yaw}} \leq 180^{\circ}$$

The final rotation is calculated as  $\mathbf{R} = \mathbf{R}_x(\theta_{\text{roll}})\mathbf{R}_y(\theta_{\text{pitch}})\mathbf{R}_z(\theta_{\text{yaw}})$ .  
 An example of each rotation is as follows.

$$\mathbf{R}_x(\theta) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{pmatrix}$$

$$\mathbf{R}_y(\theta) = \begin{pmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{pmatrix}$$

$$\mathbf{R}_z(\theta) = \begin{pmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$







## 8. Other Operations

### 8.1 Export

#### 8.1.1 Export as CSV

The currently active window data is exported in the CSV format.  
The data output varies according to the type of window.

**List of Tracking Data:** Tracking data • measurement point (quadrant) angle

**List of Measurement Data:** Measurement data coordinates

**List of Analysis Data:** Data values shown with analysis data

**List of Waveform Data:** Data values after setting the filters

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for the CSV format.

Perform any of the following to export data in the CSV format

- ✓ Click [File] ⇒ [Export] ⇒ [Measurement Coordinate Data] on the menu.
- ✓ In the tracking mode, click [Save Tracking Data As] ⇒ [CSV Format] on the right click menu in the measurement image window.
- ✓ Click [Save Data in File Format] ⇒ [CSV Format] on the right click menu in the list of tracking data / measurement data / analysis data / waveform data.

Detailed settings can be made when exporting CSV files.



#### ● Detailed Settings

When exporting in the CSV format, click detailed settings in the save file dialog to perform the following settings.

##### Time Range for the Export Data

Set the time range for the data to be exported.

##### 2D Calibration Parameters

Check to export the 2D calibration parameters.

Enabled while exporting the measurement data list.

##### Select Measurement Points

Click [Select Measurement Points] to display the [Select Measurement Points]

dialog. Use this dialog to select the measurement points to export.

**Comments**

Enter comments relating to the export data.

## 8.1.2 Print

---

Prints the currently displayed window.

The print results vary by the type of window.

<b>Image Window:</b>	Prints the current image displayed (also prints the superimposed items)
<b>Graph Window:</b>	Prints the current graph
<b>List Window:</b>	Prints the numerical data
<b>Stick:</b>	Prints the current stick displayed

Perform any of the following to print.

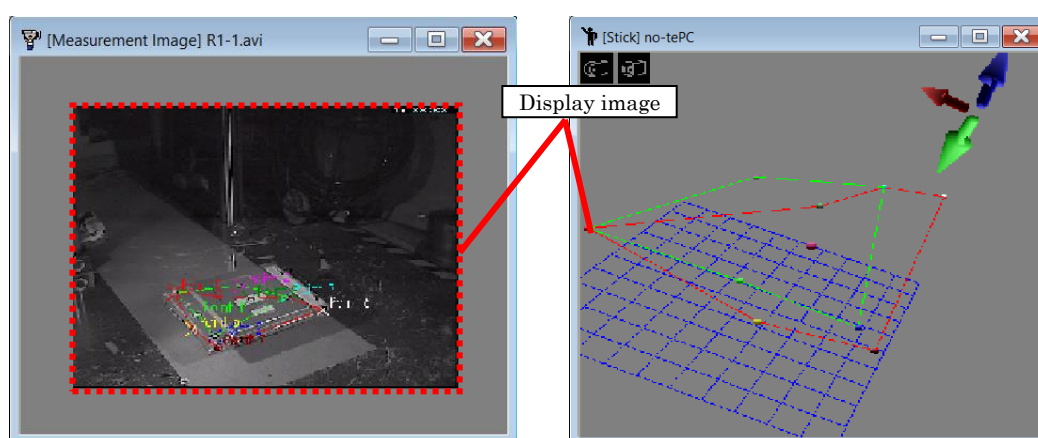
- ✓ Click [Print Screen] on the right click menu of the image window.
- ✓ Click [Print Graph] on the right click menu of the graph window.
- ✓ Click [Print] on the right click menu of the list window.
- ✓ Click [Print] on the right click menu of the stick window.

### 8.1.3 Export as AVI

The [Export as AVI File] function exports the displayed window images to AVI files. Superimposed items (trajectories, sticks or annotations) are also exported. Zoomed or processed images are exported unchanged. Specify the [Compression Program] and [Resize] in the [Export AVI File Settings] dialog. If optical distortion correction is applied during AVI export of measurement images, the distortion corrected image can be exported.

Refer to p. 8-4 for the AVI File Export Procedure and p. エラー! ブックマークが定義されていません。 for the エラー! 参照元が見つかりません。 .


The export area is shown in the following figure.

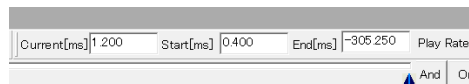


With the image window, the range of the image is exported to the AVI file. (parts not in the window are not exported). With the stick window, the entire window is exported. The size and aspect ratio of the AVI file standard to be exported is the size of the currently displayed image (inside the dotted lines in the figure above).

## ● AVI File Export Procedure


The AVI file export procedure is as follows.

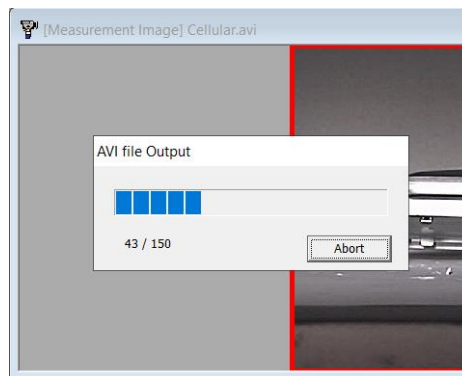
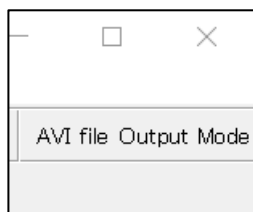
- ① Access the AVI file export window (image · stick) and adjust the size. If an image, select the pixel size  for the エラー! 参照元が見つかりません。 to enable output of the entire image. We recommend AVI file export when the entire image area is displayed.
- ② Designate the export range  
Set the playback range and designate the export range.
- ③ [Export AVI File Settings] dialog  
To start an AVI export, perform any of the following to display the [Export AVI File Settings] dialog.
  - ✓ Click [File] ⇒ [Export] ⇒ [AVI File Format Window Image] on the menu.
  - ✓ Click [Export AVI File] on the right click menu in the measurement image window / stick window.



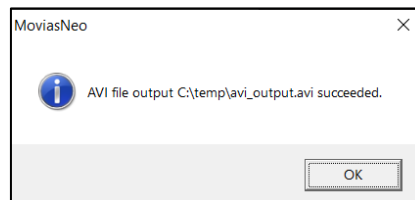
Specify the file name and folder to be exported and designate the desired “resize” and “compression codec”.

Refer to p. エラー! ブックマークが定義されていません。 for details of the エラー! 参照元が見つかりません。

Click OK  after setting the [Export AVI File Name] and the [Export AVI File] appears on the mode display bar at the top right, and the AVI export will automatically start.



- ④ Once playback of the specified playback range is done, a message appears and the AVI file export processing ends. If paused during AVI file output, output will be only until the frame where paused.

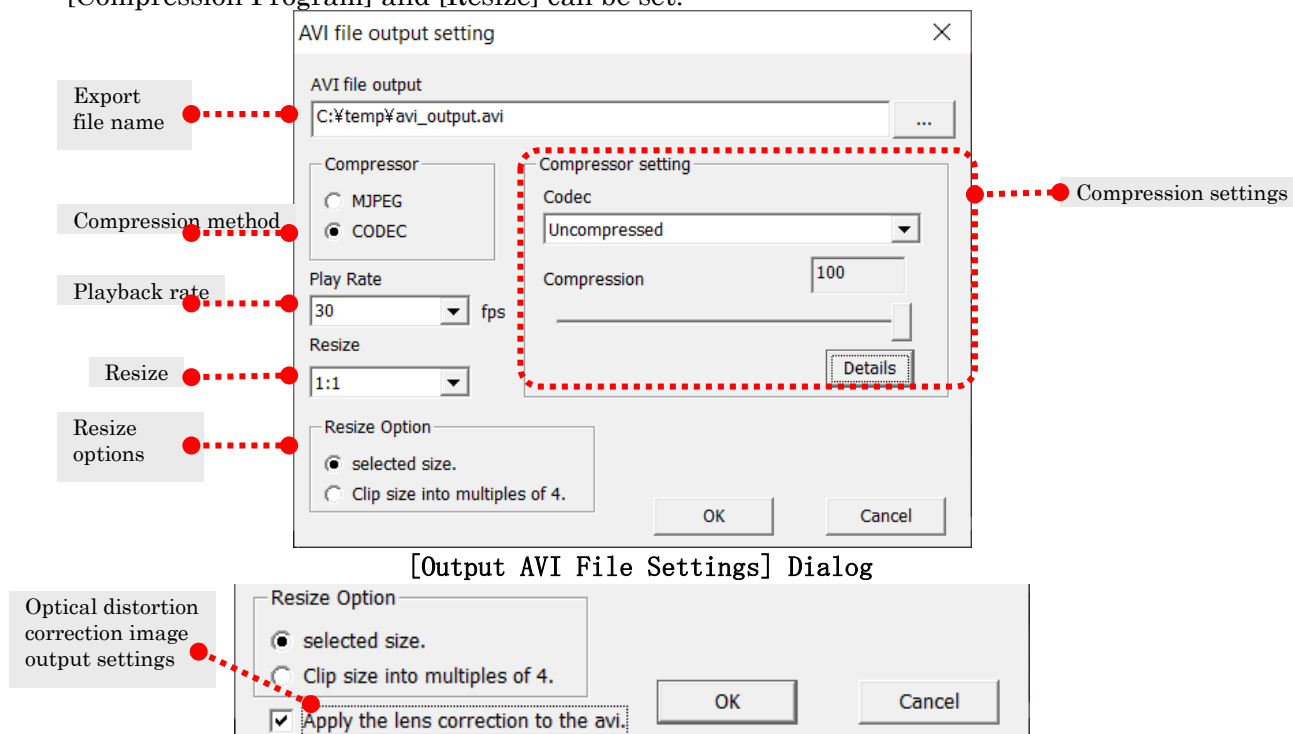


Finally, confirm the exported AVI file and make sure the image range and quality is as desired.

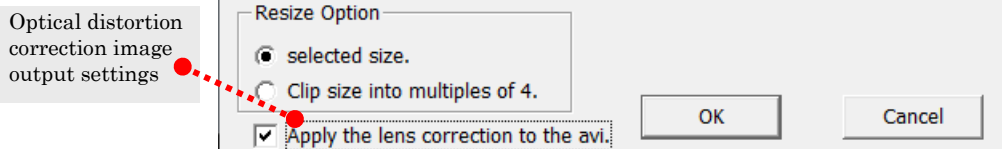


## • [Export AVI File Settings] Dialog

Designates the name of the AVI file export in the [Export AVI File Settings] dialog. The [Compression Program] and [Resize] can be set.



[Output AVI File Settings] Dialog



[Export AVI File Settings] Dialog (if optical distortion correction image is applied)

OK

Saves the settings and starts the AVI export.

## Export AVI File Name

Input the path and file name for the AVI file to be exported.

## Compression Method and Compression Program • Compression Quality

Compression settings. Specify the codec and the quality.

Click [Details] to display the detailed settings dialog for the selected codec.

Nothing will be displayed if the codec is not compatible with the detailed settings dialog. In this case, contact the codec manufacturer for questions relating to codec. Set the compression rate with the [Compression Quality] slider in [Compression Settings].

MJPEG: AVI compression using Motion JPEG.

CODEC: AVI compression with the codec selected under [Compression Programs].

**Playback Rate**

Specify the playback rate for the AVI export. Unrelated to the [Playback Rate] on the [Playback Settings Control Bar].

Select the playback rate from 1~30 frames/sec or annually input a number.

**Resize**

Designate the magnification of the AVI image size to be output.

The following two types can be selected for [Resize].

Magnification

“1: 1”, “75%”, “50%”, “25%”, “125%”, “150%”, “175%”, “200%”

Fixed Size

“640x480”, “480x360”, “320x240”

With fixed size, the export is enlarged or reduced so it fits the specified size while keeping the aspect.

**Resize Options**

Export as is. (default)

Export at the size specified in [Resize] (75%, 640x480 or such).

Round to multiples of 4.

After applying the resize settings, the frame size is rounded to multiples of 4.

Make a border on the left/right sides or the top/bottom of the image so the image becomes that size and export to AVI.

The settings for “round to multiples of 4” use a codec required for sizes in multiples of 4 so use for AVI file export.

Some codecs may only handle certain sizes.

Contact the codec manufacturer for any questions relating to codecs.

**Optical Distortion Correction Settings**

Used when distortion correction is applied to measurement images. When checked, the image exported reflects the distortion correction. If not, the standard image is exported. If there is an AVI export with distortion correction, the items superimposed on the image are only measurement points, trajectories and sticks.

- **Example of Export AVI File Settings**

This shows an example of AVI export.

For example, AVI exports according to the following image window.

Image Frame Size	464x464
Image preprocessing	None
Zoom rate	121%
Displayed image size	561x561

The following settings can be made in the [Export AVI File Settings] dialog.

### Resize

1. If “1: 1”, then  
the export AVI size: 561x561  
Image is exported at “identical to the displayed image”.
2. If “640x480”, then  
the export AVI size: 640x480 (image area size 480x480)  
Exported image is centered with “displayed image is enlarged to a 480x480 image” and then exported.  
(the image area size is the size when the displayed image is fit to 640x480.  
With an image that has a layout that is landscape, it may be fit to the landscape size.)
3. If “75%”, then  
the export AVI size: 420x420  
Image is exported as an “displayed image is shrunk to a 0.75x image”.

### Codec

Codec attempts to create a file with the [export size] that reflects the results of the abovementioned resize.

You will get an error if the size is not compatible with the codec used

For example, if using “IndeoR video 5.1”, the width and height must be sized in multiples of 4. In the example above, the “1: 1” size is an incorrect size and the export will fail.

Exports can be made with the “1: 1” size by applying [Round to multiples of 4] in the [Resize Options].



### 8.1.4 Save to Image File

Exports the window image currently displayed to a file. Select an image format from BMP, JPEG, PNG, and TIF.

<b>Image Window:</b>	Exports the currently displayed image to a file.
<b>Graph Window:</b>	Exports the current display to a file.
<b>Stick Window:</b>	Exports the current display to a file.

Perform any of the following to save the window image to a file.

- ✓ Click [Copy to Image File] in the right click menu of the image window.
- ✓ Click [Copy to Image File] in the right click menu of the graph window.
- ✓ Click [Copy to Image File] in the right click menu of the stick window.

The Save As dialog appears so assign a file name to save.

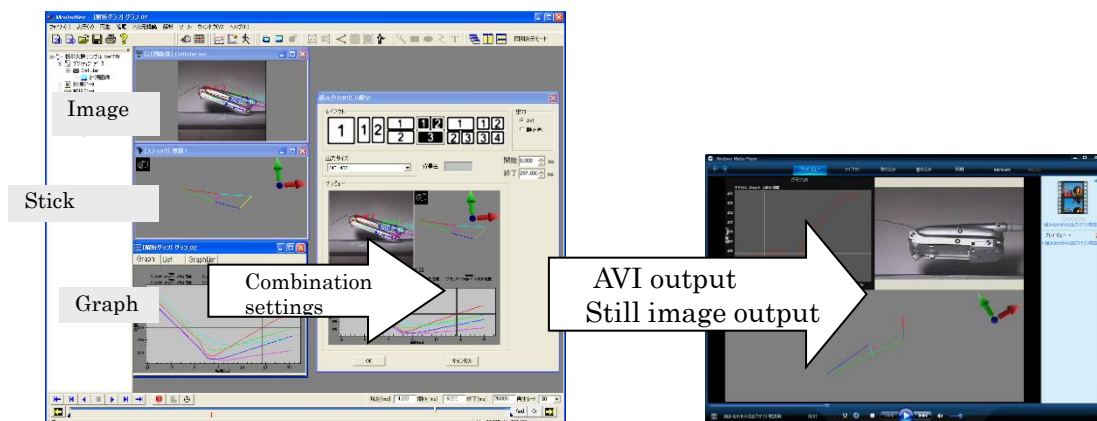
During JPEG output, the image quality settings can be made. Set the image quality in a range from 0~100. The image quality drops as the value decreases, but the file size also decreases. The image quality improves as the value increases, but the file size also increases. The default value is 90.



### 8.1.5 Merged Export

This is a function to merge window exports from multiple windows.

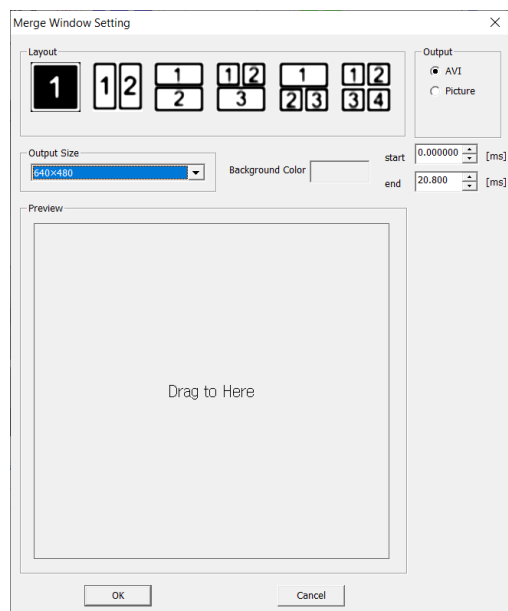
Images, graphs and sticks can be combined and exported as AVI exports or still images. For example, export images and graphs as synchronized video or multiple graphs as AVI exports.



Perform the following to display the export window and enable merged exports.

- ✓ Click [File] ⇒ [Export] ⇒ [Merged Export].

The [Merged Export Settings] dialog appears.



### Layout

Combined layout. Select from 6 types.

### Export

Select AVI or still image for the export format.

### AVI Export Time Range (Start • End)

Specify the AVI export time range.  
The default sets the playback range on the playback slider bar when the dialog is displayed.

### Background Color

Specify the background color (color of the area where the image is now shown).

### Export Size

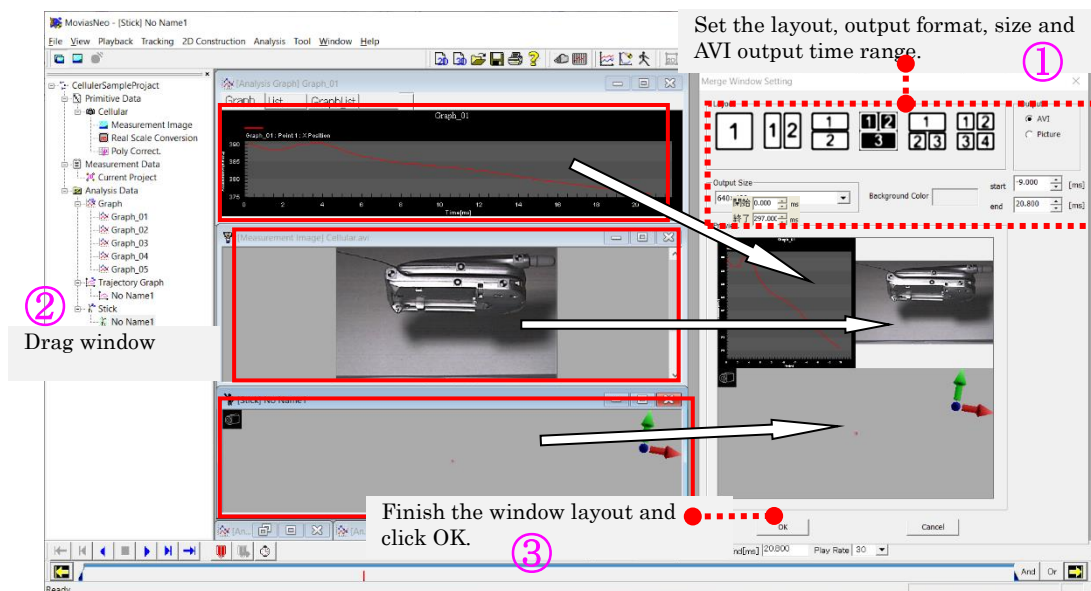
Select the export size.  
Available sizes include “640x480”, “1280x1024”, or “sum of window size” (p. エラー! ブックマークが定義されていません。 ).

### Preview

Drag the window to this area to see a preview of the contents of the window.  
Display of the part previewed can be switched according to the selected layout.

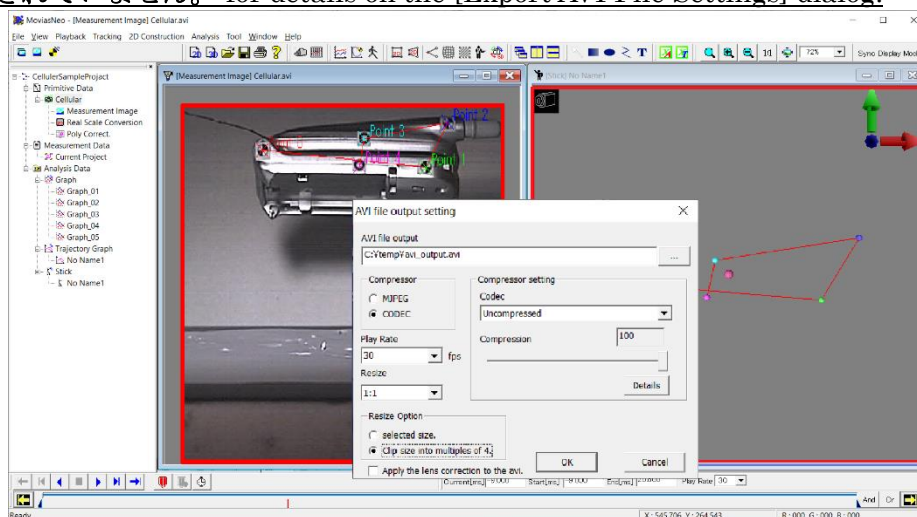
## ● Merged Export Procedure

- ① Specify the layout, export format and export size.  
Specify the export time range when AVI is selected as the export format.
- ② Drag the window to export to inside the dialog preview window.
- ③ Click OK to export.



After clicking OK, the following appears according to the export format (AVI, still image).

- ✓ If AVI is selected for exports, the [Export AVI File Settings] dialog appears. Refer to p. 8-4 for the AVI export procedure and p. エラー! ブックマークが定義されていません。 for details on the [Export AVI File Settings] dialog.



After finishing the AVI export settings, click the set button. The video for the export window is sequentially exported.

- ✓ If still image is selected as the export, the [Save As] dialog appears. Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details.

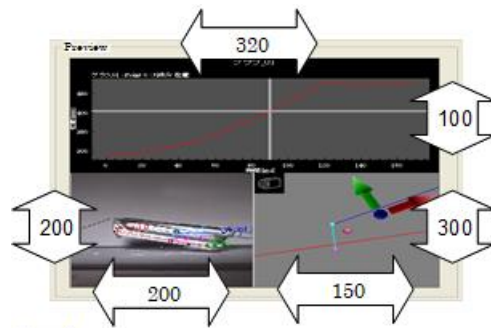
- **Sum of Window Size**

Exports the sizes necessary to arrange all of the windows in specific positions.

If the layout to the right, exports as

Width: 350 (= 200 + 150 > 320)

Height: 400 (= 100 + 300 > 200 + 100)



- **Aspect Ratio for Each Window after Export**

The image window • stick window are resized and merged to the export size that keeps the aspect ratio. The graph window does not save the aspect ratio and is fit to the export size.

## 8.1.6 Export Graphs to Excel

Exports analysis graphs in projects to Excel.

エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。

Analysis graphs are exported to Excel.

エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 . Save settings for calculation formulas repeated for analysis graph data to Excel that will save time for the user during analysis. Add specific processing to an Excel spreadsheet output in (a) so MOVIAS Neo can be repeatedly utilized

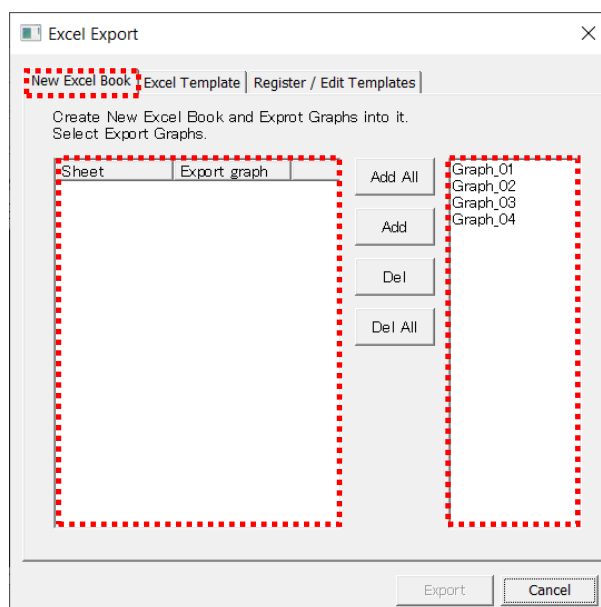
エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。

Exports analysis graph data to the Excel template created in エラー! 参照元が見つかりません。 .

### (a) Batch export of graphs to Excel

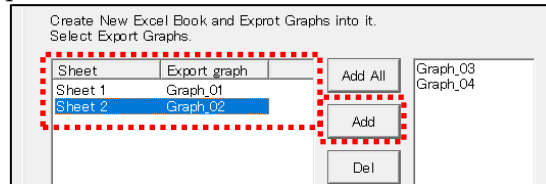
Perform the following.

1. Show the analysis graph to export to Excel.
2. Perform either of the following to show the [New Excel Book] tab in the [Excel Export] dialog.
  - ✓ Select [File] → [Export] → [Batch Export Graphs to Excel] from the main menu.
  - ✓ Click the エラー! 参照元が見つかりません。 (L) on the エラー! 参照元が見つかりません。 .



[New Excel Book] Tab

- All the analysis graphs are shown in the [List of Graphs Not Registered]. Select the graph in the [List of Graphs Not Registered] and click [Add] to add the graph exported to Excel to the [Export List] from the [List of Graphs Not Registered]. In this example, [Graph of Angles] is exported to [Sheet 1] and [Graph of X Coordinates] is exported to [Sheet 2].

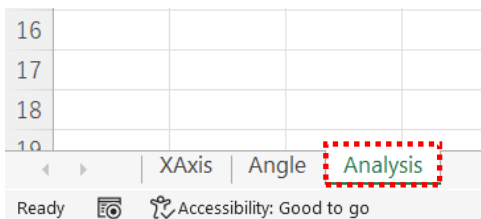


- After adding the graphs that require export, click [Export]. The save dialog appears so assign a name to the Excel spreadsheet and save it. Excel starts, and the Excel spreadsheet created will automatically open.

#### (b) Create an Excel Template

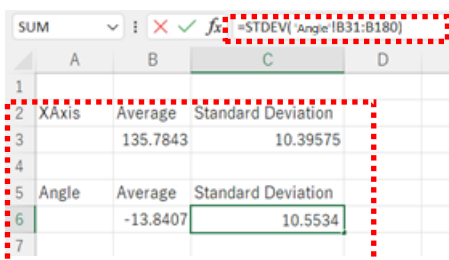
Perform the following.

- Create an Excel spreadsheet based on the [Excel Template] file. In this example, use [Batch Export Graphs to Excel] to create an Excel spreadsheet called [Test Book.xls] and edit it as an [Excel Template].
- Excel spreadsheets from [Batch Export Graphs to Excel] are opened in Excel.



Add new individual user calculations and sheets showing graphs.

In this example, the Excel spreadsheet called [Analysis Spreadsheet] is added.

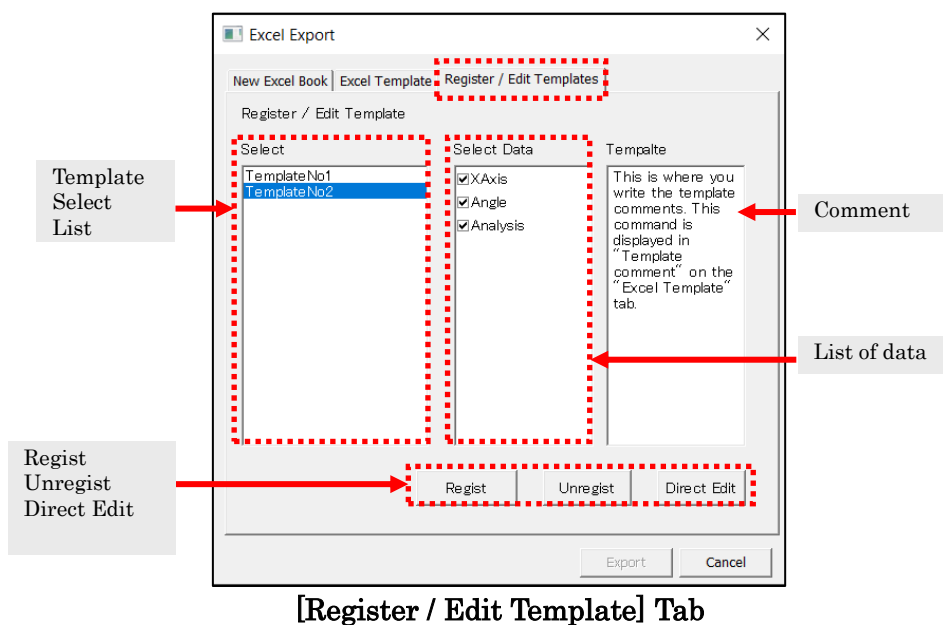


Add individual calculations to the analysis spreadsheet added.

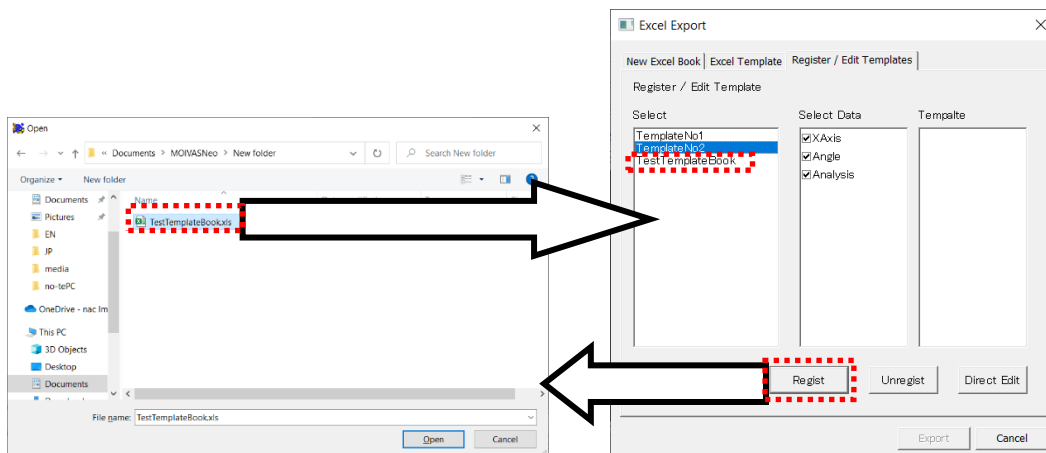
In this example, the X coordinate average, standard deviation and angle average, and standard deviation are calculated. After editing the analysis spreadsheets, save to a file and close Excel.

3. Perform any of the following to show the [Register / Edit Templates] tab in the [Excel Export] dialog.

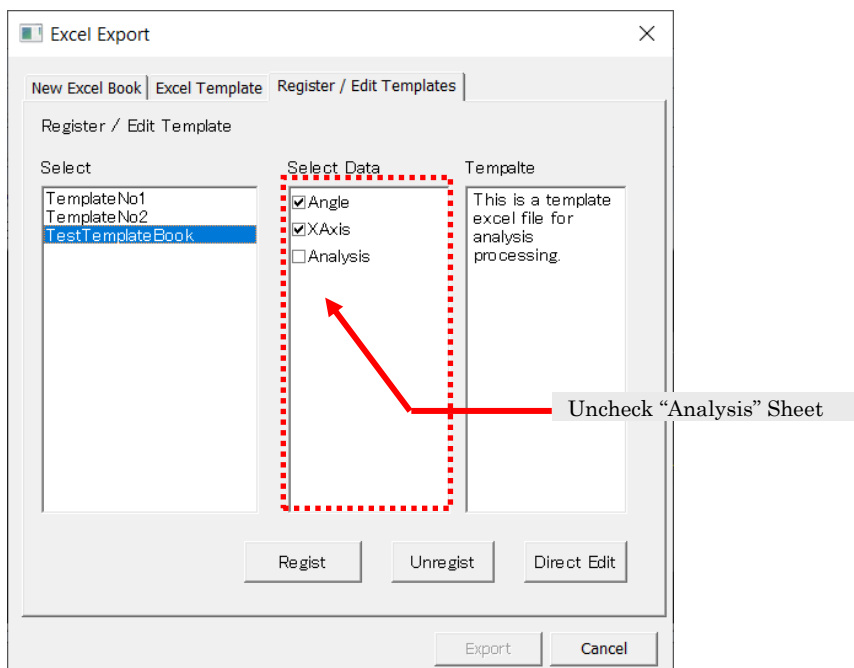
- ✓ Select [File] → [Export] → [Batch Export of Graphs to Excel] from the main menu. The [Excel Export] dialog will appear, so select the [Register / Edit Template] tab.
- ✓ Click the エラー! 参照元が見つかりません。 (🔍) on the エラー! 参照元が見つかりません。 . The [Excel Export] dialog will appear and the [Register / Edit Template] tab will be displayed.
- ✓ Select [File] → [Export] → [Batch Export of Graphs to Excel] from the main menu. The [Excel Export] dialog will appear, so select the [Register / Edit Template] tab.
- ✓ Click the エラー! 参照元が見つかりません。 (🔍) on the エラー! 参照元が見つかりません。 . The [Excel Export] dialog will appear and the [Register / Edit Template] tab will be displayed.



4. Click [Register] and the file selection dialog appears so the previously created Excel spreadsheet is registered as the [Excel Template].  
In this example, [Test Book.xls] is registered.



5. A list of Excel spreadsheet templates appears in the [Select Data Spreadsheet] so uncheck the spreadsheets not previously exported.  
In this example, [Analysis Spreadsheet] is an individual calculation spreadsheet so uncheck to avoid its export.



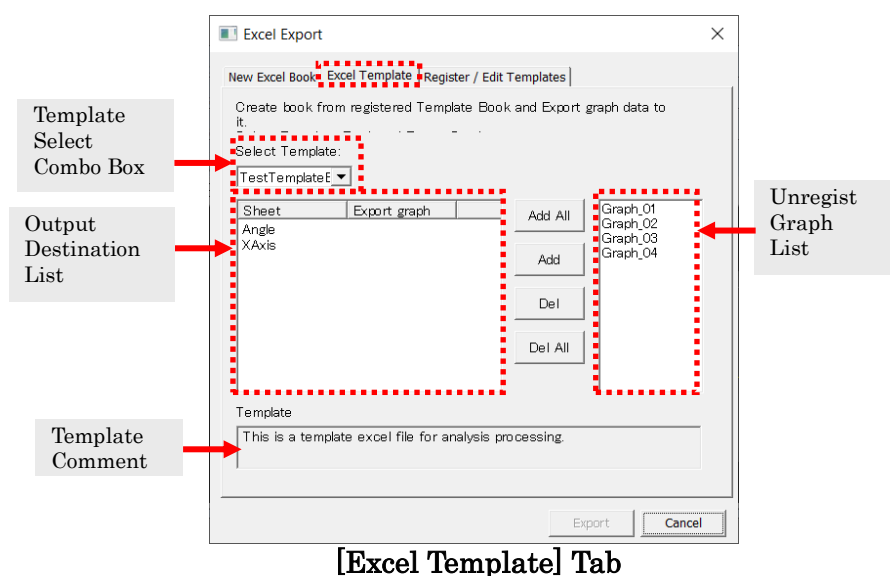
If necessary, enter comments. When comments are exported to an Excel template, they are displayed when that template is selected.



## (c) Export Graph to an Excel Template

Perform the following.

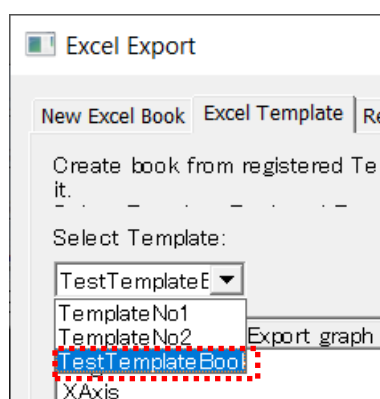
1. Display the analysis graph to export to the Excel template.
2. The [Excel Export] dialog appears and then the [Export Excel Template] tab is displayed.
  - ✓ Select [File] → [Export] → [Batch Export of Graphs to Excel] from the main menu
  - ✓ Click the エラー! 参照元が見つかりません。 (X) on the エラー! 参照元が見つかりません。 .



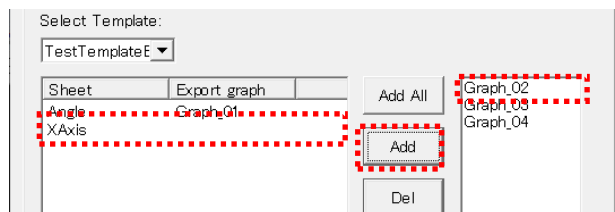
[Excel Template] Tab

All the displayed analysis graphs are shown in the [List of Graphs Not Registered].

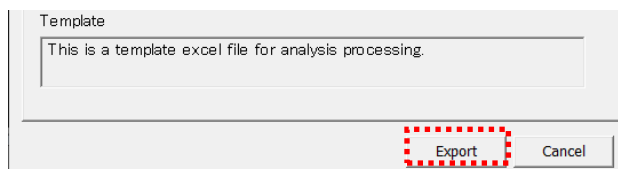
3. Select the template to be exported with the [Select Template] combination box.



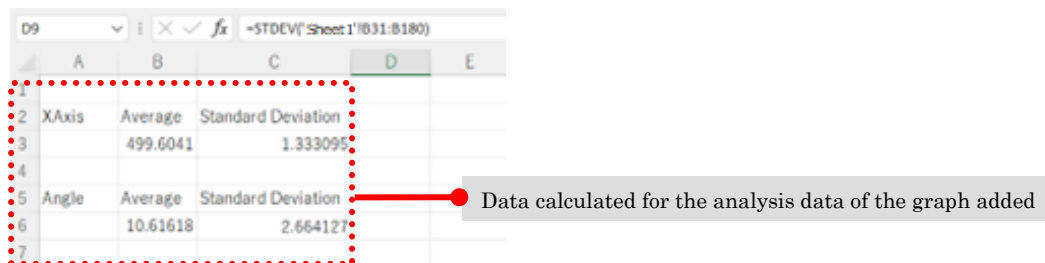
4. Add the graph to be exported to the Excel template using [Export List] from the [List of Graphs Not Registered]. Select a spreadsheet from the [Export List] and select a graph from the [List of Graphs Not Registered] the click [Add]. In this example, the [X Coordinate Graph\_02] is added to the [X Coordinate Spreadsheet] and the [Angle Graph\_02] is added to the [Angle Spreadsheet].



5. After adding the graphs requiring export to the export list, click [Export].



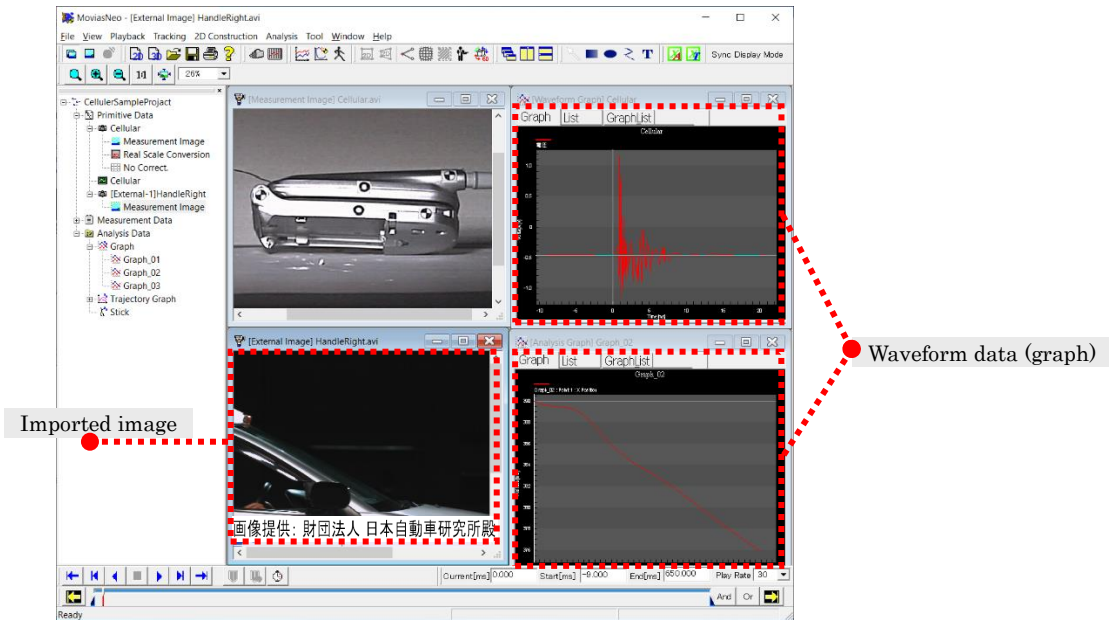
6. The Save dialog appears so assign a name to the Excel spreadsheet and save. Excel will start, and the Excel file created will automatically open.



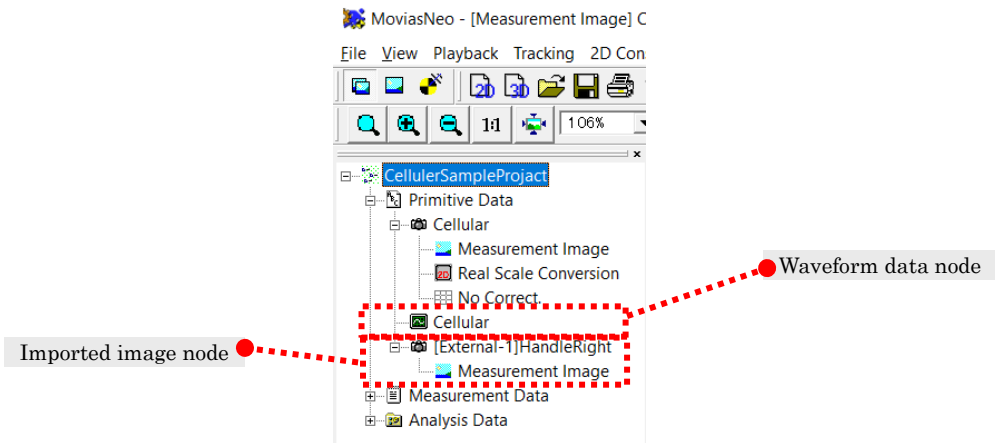
If using the Excel VBA macro function, Excel can perform advanced processing. After exporting the data to the Excel spreadsheet, MOVIAS summons a procedure called MoviasStart(), which is used when performing automatic processing after exporting.

8.2 Import

External images and waveform files can be imported to current analysis projects. Display, playback, and synchronized playback is possible with imported data. A filter can be applied to waveform data.



Overview of Import




Project Tree after an Import

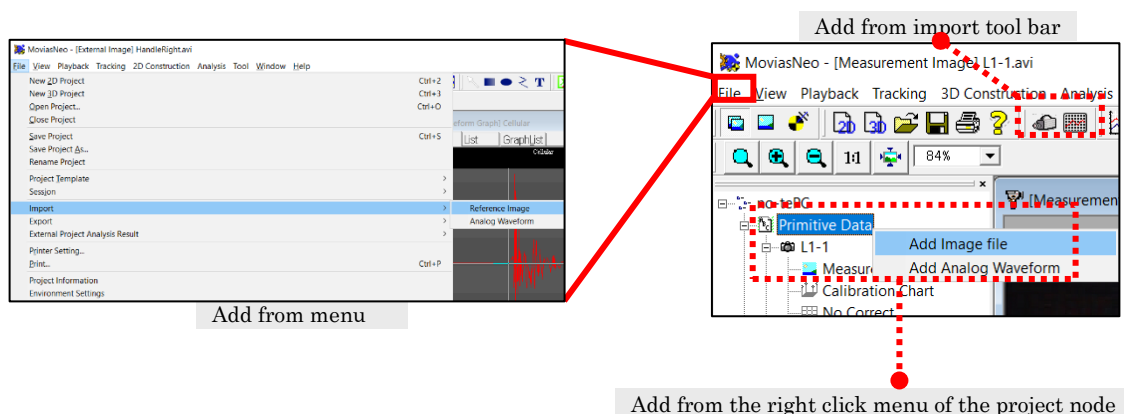
## 8.2.1 Add Images

Imports images to projects.

Perform any of the following to import images.

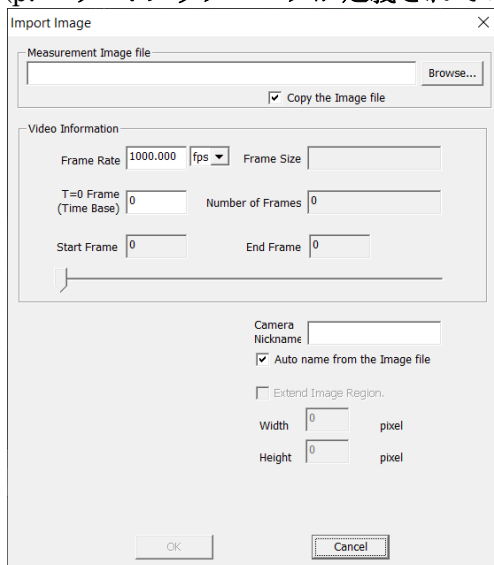
- ✓ Click Add Images  on the エラー! 参照元が見つかりません。 on the エラー! 参照元が見つかりません。 .
- ✓ Click [File] ⇒ [Import] ⇒ [Reference Image] on the menu.
- ✓ Click [Add Image File] on the right click menu of the primitive node.

Each operation is performed from the following locations in the figures.

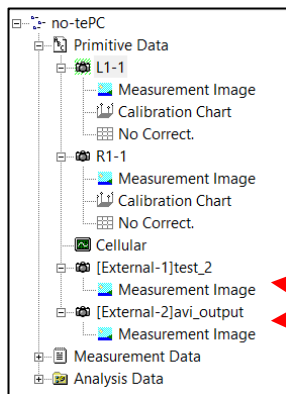


The [Import Image] dialog appears.

The contents shown and method of operation are identical to that in the [Create 2D Analysis Project] dialog (p. エラー! ブックマークが定義されていません。 ).



**[Import Image] Dialog**

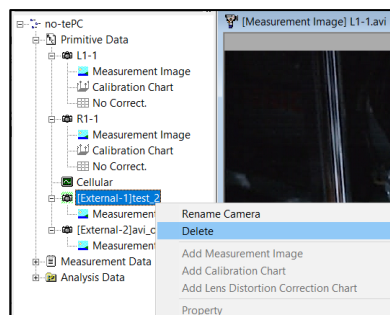


After adding, the external image node is added to the project tree. [External-\*\*] is added to the top of the node name. (\*\* is a consecutive number)

External image node added

Imported images can only be displayed, played, and sync played. Analysis processing such as tracking, and calibration cannot be performed.

Deletion of imported images is performed using [Delete] on the right click menu of the external image node.




## 8.2.2 Add Waveforms

Imports waveform data files into projects. Imported waveform data is displayed on a graph or a list.

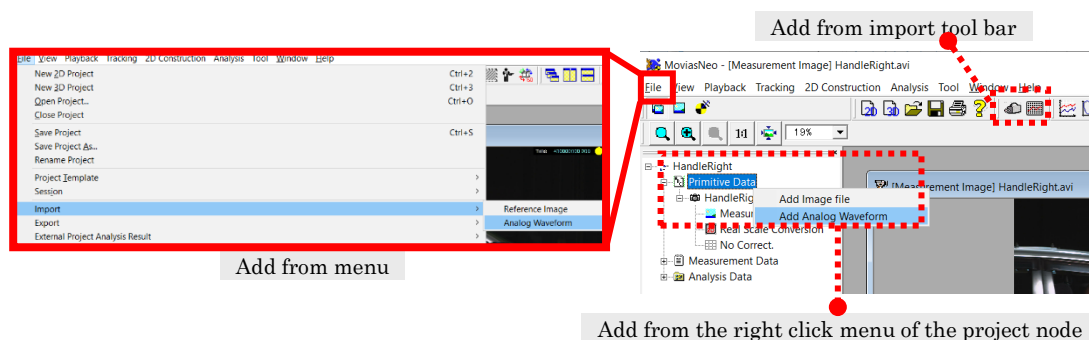
The supported waveform data file formats include CSV graph data (\*.csv), Library Wave File (\*.WVB) and Nac Wave File (\*.nwf)

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) or エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on CSV graph data.

Perform any of the following to import waveform data.

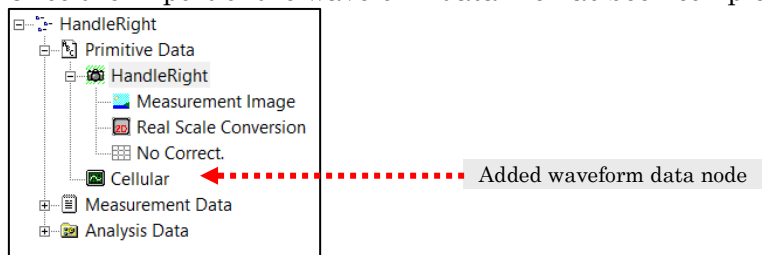
- ✓ Click on the エラー! 参照元が見つかりません。  on the エラー! 参照元が見つかりません。 .
- ✓ Click [File] → [Import] → [Analog Waveform Data] on the menu.
- ✓ Click [Add Analog Waveform] on the right click menu of the primitive node

Each operation is performed from the following locations in the figures.



If selecting a CSV file as the waveform data file to add, all the data is imported. If selecting analog waveform data “Library Wave File (\*.WVB)” or “Nac Wave File (\*.nwf)”, the import method can be specified.

Once the import of the waveform data file has been completed, the graph appears.



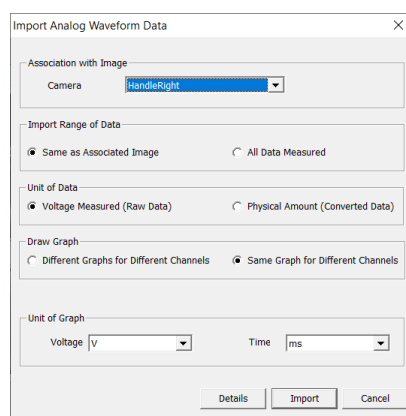
## ● CSV Graph Data

Loads the CSV graph data. (Ignores the line type, display range)

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) or エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details.

## ● Analog Waveform Data

Loads the analog waveform data files created with Wave-in (Image, waveform sync display software manufactured by Library, Inc.) or analog waveform data files created in the MEMRECAM waveform input software or the fxLink waveform input software. The data range and units can be set when importing.



**Import Analog Waveform Data Dialog (Simplified Setting)**

### Affiliation with the Image

Select the analog waveform data to be imported and the camera affiliated with it.

### Import Range

Select the range of the affiliated image or the entire range of measured data (entire range of analog waveform data).

### Data Units

Select from [Measured Voltage (raw data)] or [Physical Quantity (converted data)]. Cannot be selected if there aren't any parameters for converting physical quantities into analog waveform data. Treated as measured voltage.

### Draw Graph

Select from [Each Channel on a Separate Graph] or [All Channels on a Single Graph]. [Each Channel on a Separate Graph]

Plots the data for multiple channels input on separate graphs. (For example, 3 graph windows are created from data measured on 3 channels.)

[All Channels on a Single Graph]

Plots the data from each channel together on a single graph window. If selections were made in [Select Series] in the detailed dialog, only the selected series are imported.

## Units Used in the Graphs

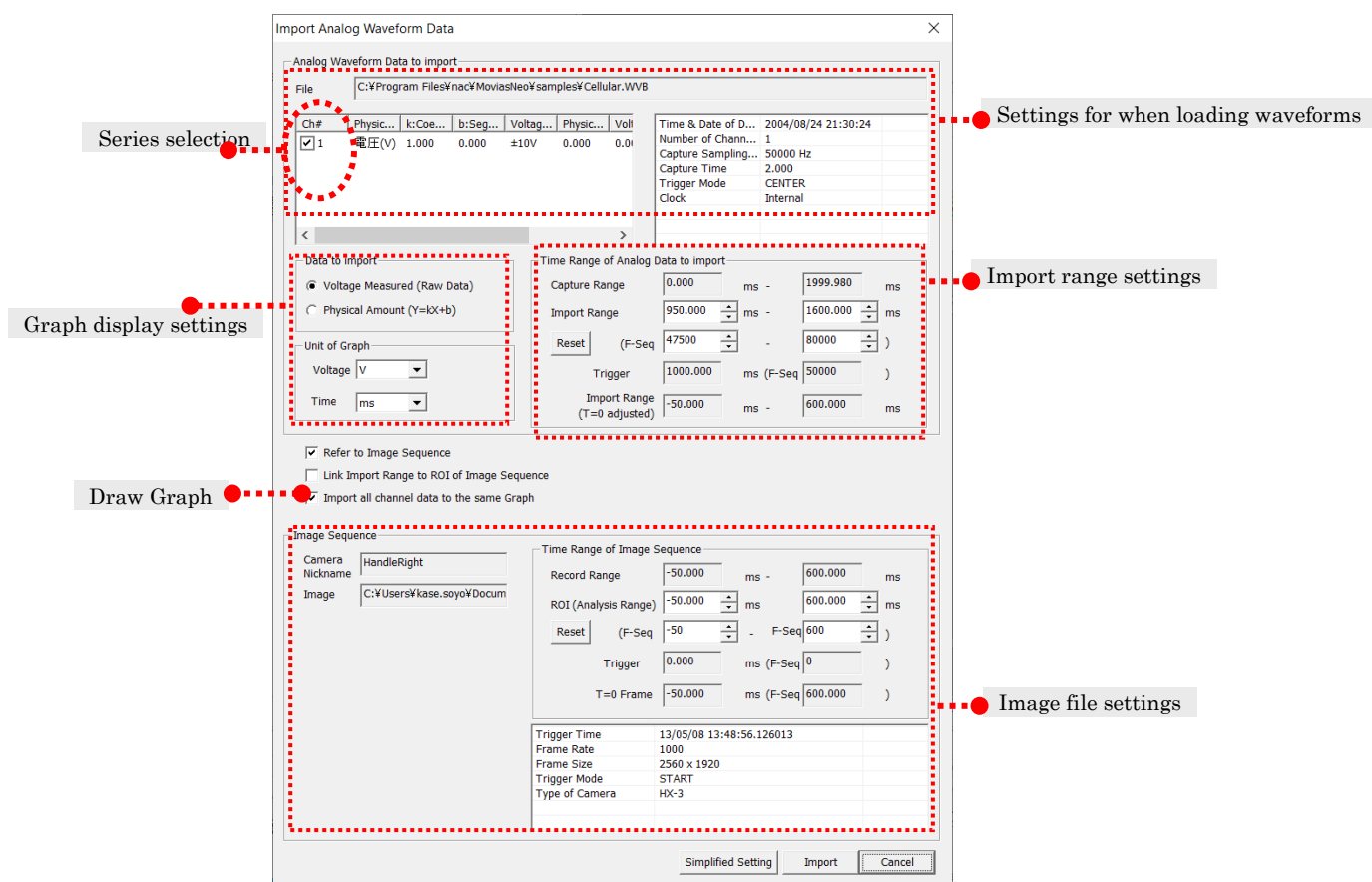
Select the units for displaying graphs.

- ✓ Voltage  
Setting for the vertical axis units.  
Select either V or mV. If selecting physical quantities in [Data Units], it is treated as V.
- ✓ Time  
Select the units for time for the waveform data.  
Select from sec, msec or  $\mu$  sec.

## Detailed Settings

Displays the import analog waveform data dialog (detailed settings).

Sets the details for the import method for the analog waveform data.



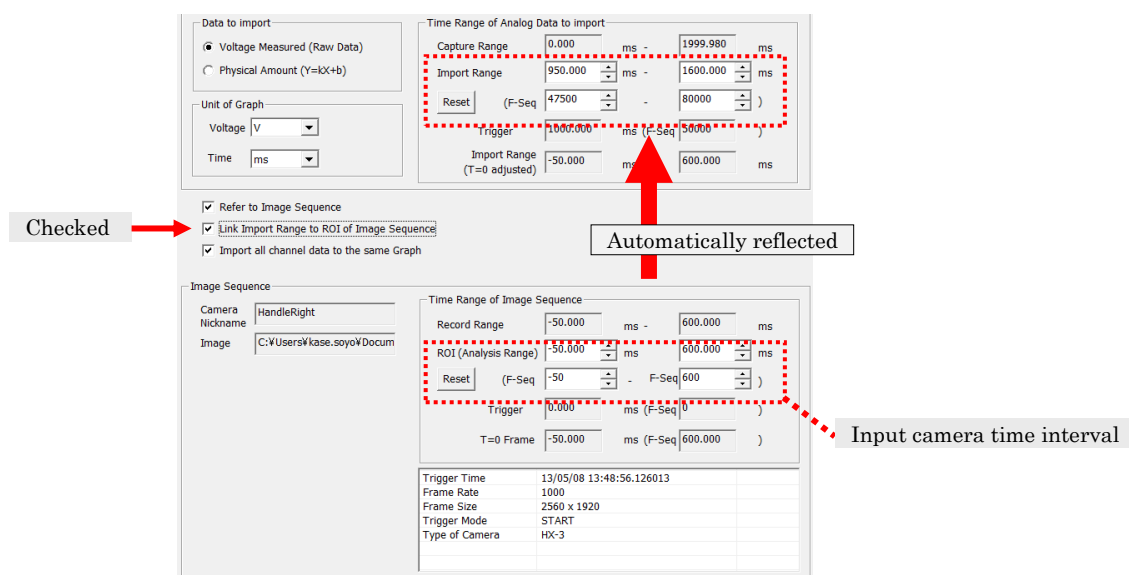
**Import Analog Waveform Data Dialog (Details)**

Set the import range with the [Time Range of Analog Data to Import].

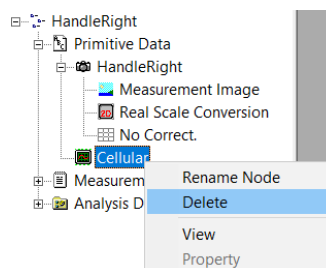
If [Link Import Range to the Target Range of the Sequence] is enabled, use the camera data values and set the import range for the analog waveform data.

Even if the image file [ROI (Analysis Range)] is changed, the measurement image playback range is not affected. Set only the import range for the analog waveform data.) Switch the checked part of [Series Selection] to select the series to load. Switch the checked part of [Draw Graph] to select whether to draw all channels on a single graph.



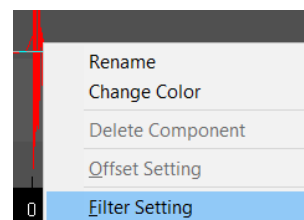


Deletion of waveform data is performed by clicking [Delete] on the right click menu of the waveform data node.

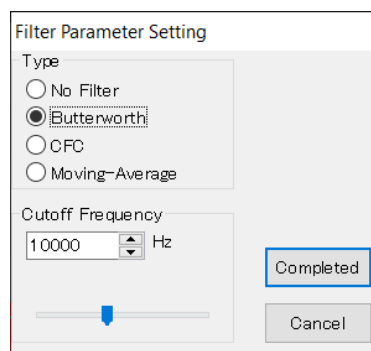


## ● Filter Settings

Sets the filter for each channel used for waveform input. To set the filter, click [Filter Settings] on the right click menu of the channel shown on the graph (figure to the right).



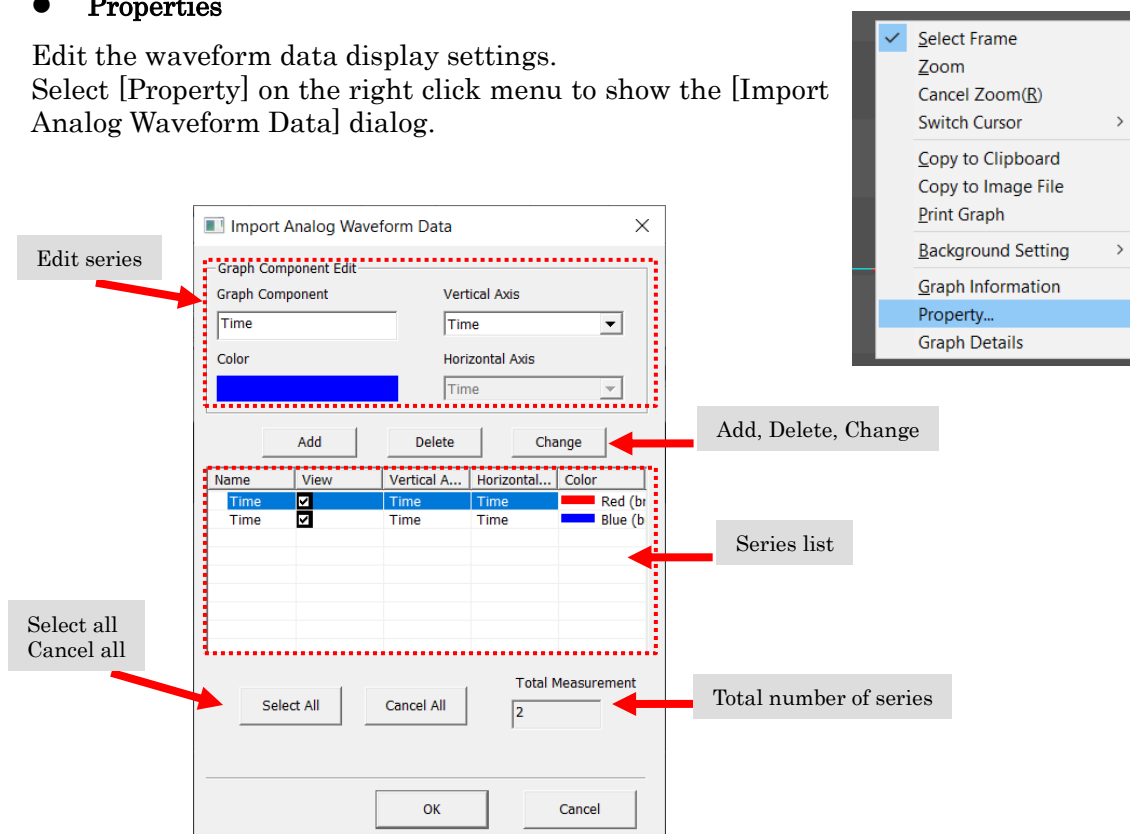
Select [Type] from the [Filter Parameter Settings] dialog and set the parameters for each filter. The filter effect can be checked right after the parameters are changed. Click [Completed] to apply the current filter and close the dialog.



## ● Properties

Edit the waveform data display settings.

Select [Property] on the right click menu to show the [Import Analog Waveform Data] dialog.



Double click on [Name], [View], [Vertical Axis] and [Color] on the series list to manually edit. The data on the horizontal axis cannot be changed.

Also, add, delete, and change the series with the [Add], [Delete], and [Change] buttons.

### Add

Adds the series set in the series editing section to the list of series.

### Delete

Deletes the series data selected in the list of series.

### Change

Changes the series data selected in the list of series to the contents set in the series editing section.

### Select All

Turns [View] ON for all the series in the list of series.

### Cancel All

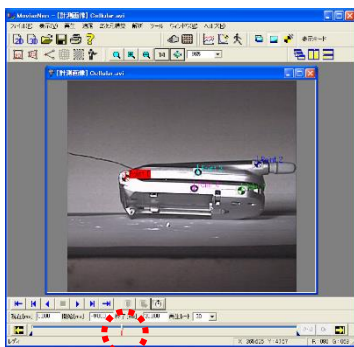
Turns [View] OFF for all the series in the list of series.

### 8.3 Correction of T0 Frames (Time Starting Point)

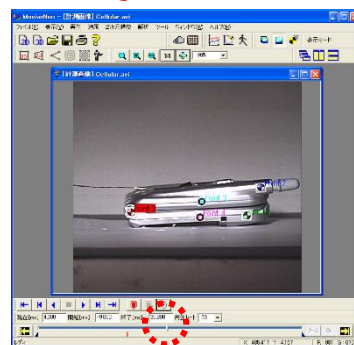
If the measurement image window or the waveform graph is displayed, the displayed frame can be set as the T0 frame (time starting point).

To correct the T0 frame (time starting point), click [Playback] ⇒ [Time Starting Point Setting] from the menu.

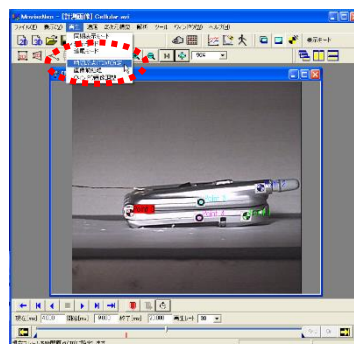
Changes cannot be made to the original file during T0 frame correction.



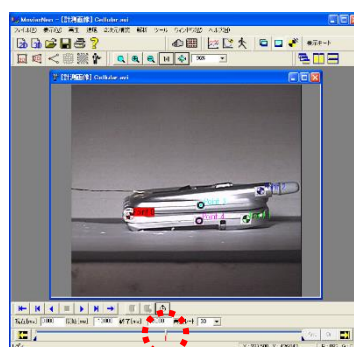
Access the camera image for the T0 frame (time starting point) to be corrected.



Move to the desired frame.



Click [Playback] ⇒ [Time Starting Point Settings] on the menu.



This finishes the corrections to the T0 frame (time starting point).

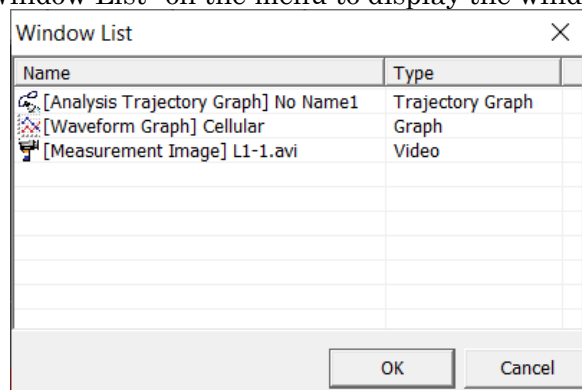
After corrections to the T0 frame (time starting point) are finished, the construction processing is automatically performed on the 2D analysis project.

For 3D analysis projects, manually perform エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) again.



## 8.4 Window List

The window list displays the name and type of the window currently displayed. Click “Window” → “Window List” on the menu to display the window list.



Window List

Perform either of the following to activate the selected window.

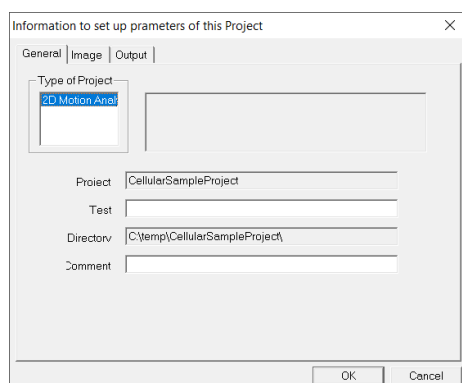
- ✓ Double click a window on the list to display.
- ✓ Click [OK] when the selected window is displayed.

## 8.5 Project Information

Makes the settings for the current project file. Changes are made for each project.

Click [File] → [Project Information] on the menu to display the project information.

### • [General] Tab



#### Type of Project

Shows the type of the current project.

#### Project Name

Shows the name of the current project.

Refer to エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on changing the project name.

#### Test Number

Input the test number.

#### Directory

Shows the folder where the current project file is saved.

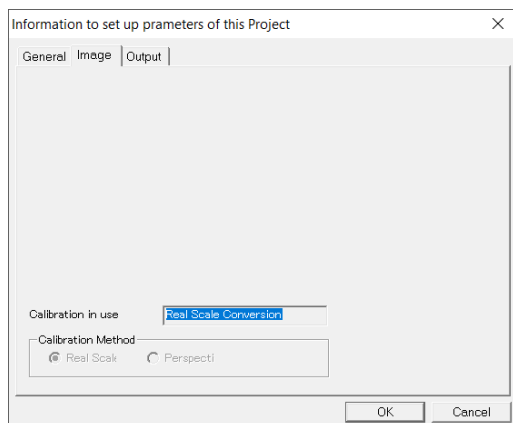
#### Comments

Input comments related to the project.

## ● [Image] Tab

Verify and change the calibration method under the [Image] tab.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for a description of the calibration methods.

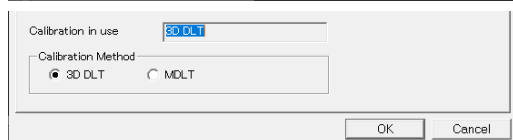


### Calibration Used

Shows the calibration method currently used.

### Calibration Method

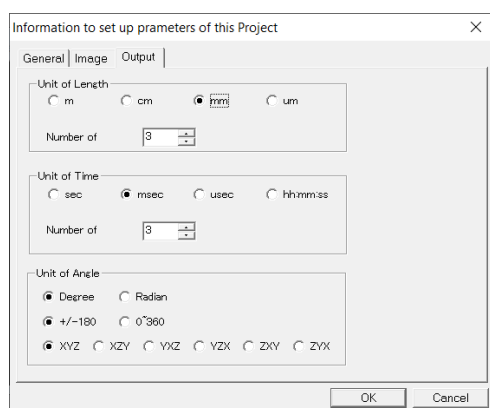
Select 3D DLT or MDLT for a 3D analysis project.



Top: 2D analysis project  
Bottom: 3D analysis project

## ● [Output] Tab

Sets the units and number of decimal places used for display and CSV export.



### Units of Length

Select from “m”, “cm”, “mm”, “um” for units used for length.

### Units of Time

Select from “sec”, “msec”, “usec” for units used for time. Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 )for details on time units.

Set the number of decimal places to display. Set in a range from “1~16”. The default is “3”.

### Unit of Angle

Select from “Degree”, “Radian”, and select from “+/-180”, “0-360” for units used for angle.

Select from “XYZ”, “XZY”, “YXZ”, “YZX”, “ZXY”, “ZYX” for euler angles.

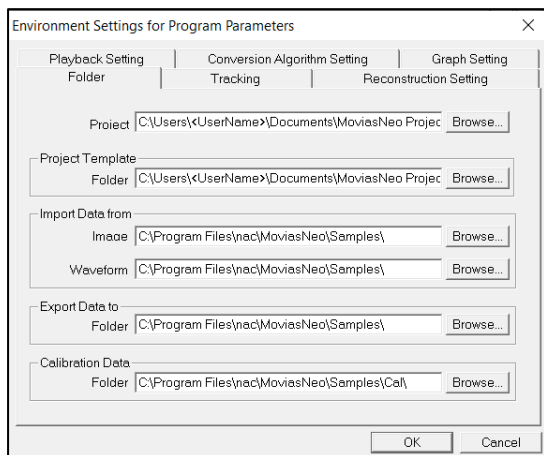


## 8.6 Environment Settings

Application settings for MOVIAS Neo. Changes are made to the application. Click [File] → [Environment Settings] on the menu to display the environment settings.

### ● [Folder] Tab

Sets the folder first referenced when selecting a file or folder. Select the folder settings with the [Browse] button. Manual input is acceptable.



#### Project Directory

Folder where the project data is saved.

#### Project Template File

Folder where the project template file is saved.

#### Import Data From

Folder first opened when importing image data or waveform data.

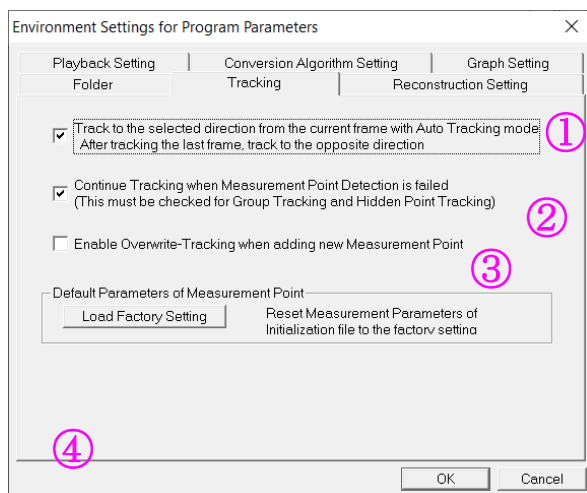
#### Export Data To

Folder first opened when exporting.

#### Calibration Data

Folder first opened when importing • saving calibration data.

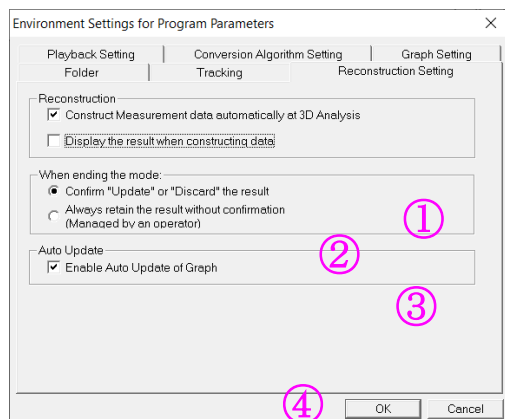
### ● [Tracking] Tab



- ① Check to track in the reverse direction once tracking in one direction is done. Can also be set using the tracking properties dialog.
- ② Check to continue auto tracking if there is a failure in auto tracking. Can also be set using the tracking properties dialog.
- ③ Check to enable tracking when measurement points are newly added.
- ④ Reset all of the default measurement point parameters saved. Does not change the tracked data.



● **[Reconstruction Setting] Tab**



- ① Check to automatically construction measurement data during 3D analysis once the tracking and calibration is done. Generally, automatically constructed during 2D analysis.
- ② Check to display the frame information where construction failed when constructing data. Not shown if all frames are successful. Used for both 2D analysis and 3D analysis.
- ③ Confirm when the mode is finished. Used for both 2D analysis and 3D analysis.

**Confirm [Update] or [Cancel] the Results**

Displays a confirmation message to save results that were changed when an operation mode has finished, such as the tracking mode or real scale conversion.

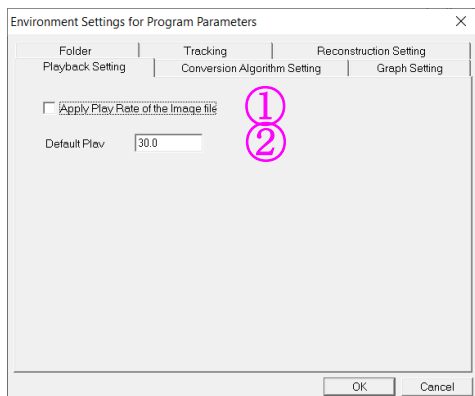
Select either save changes or revert to the previous state and cancel the changes.

**Save the Results without Confirming (handled by an operator.)**

Do nothing when the mode is done.  
Saves the project at the operator's discretion.

- ④ Check to enable automatic update settings for graphs.

## ● [Playback Setting] Tab

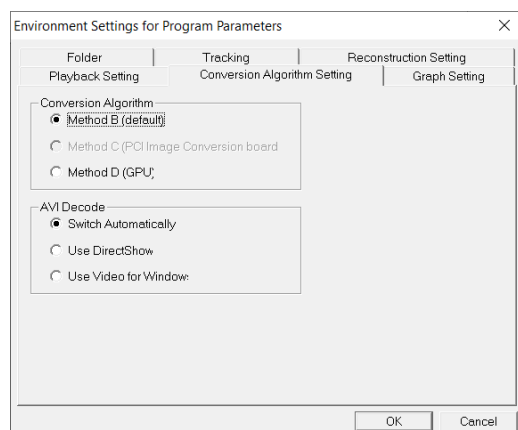


Check to use the playback rate saved for the image.

Designates the default playback rate. Used for graph playback or when playback of the image file in ① “cannot be used”.

## ● [Conversion Algorithm Setting] Tab

Settings for MCFF file playback • conversion settings and AVI file playback.



### Conversion Algorithm

Select the MCFF file playback and conversion method.

#### Method B (Default)

Default playback and conversion method. Playback and conversion performed with the software (CPU).

#### Method C (PCI High Speed Conversion Board)

Method using the optional PCI image conversion board.

#### Method D (GPU)

Method using the graphic board equipped with a GPU that is compatible with the optional [MCFF high-speed conversion software]. High speed playback • conversion of MCFF files.

### AVI Decode Settings

Performs playback settings for AVI files.

#### Switch Automatically

Initially tries to perform AVI playback using [DirectShow]. If that fails, AVI playback is attempted using [Video for Windows]. The default is [Switch Automatically].

#### Use DirectShow

AVI playback using [DirectShow]. This is the playback method before MOVIAS Neo Ver2.10.

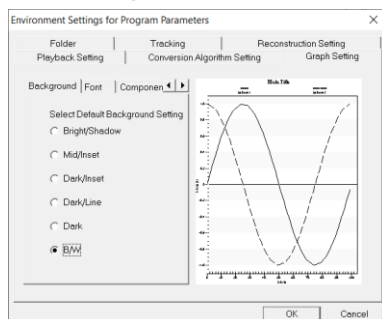
#### Use Video for Windows

Performs AVI playback using our common components.

## ● [Graph Setting] Tab

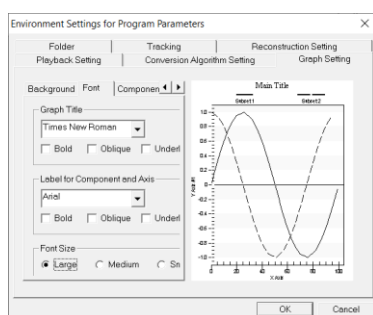
Designates the style when creating graphs. Applied to newly added [Analysis Graphs] and [Create Graph] dialog

### (a) [Background] Tab



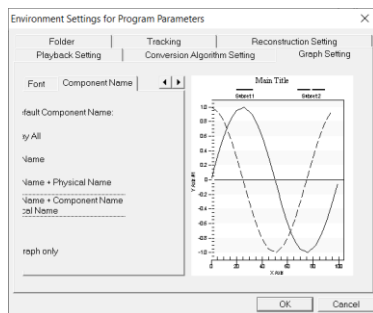
Performs background settings for graphs. To change individually after a graph is created, go to [Background Settings] on the right click menu of the graph window.

### (b) [Font] Tab



Sets the graph font. To change individually after a graph is created, go to [Detailed Settings] on the right click menu in the graph window.

### (c) [Component Name] Tab



Select the series name when creating an analysis graph in the Create Graph dialog.

The series name selected is as shown in the table below.

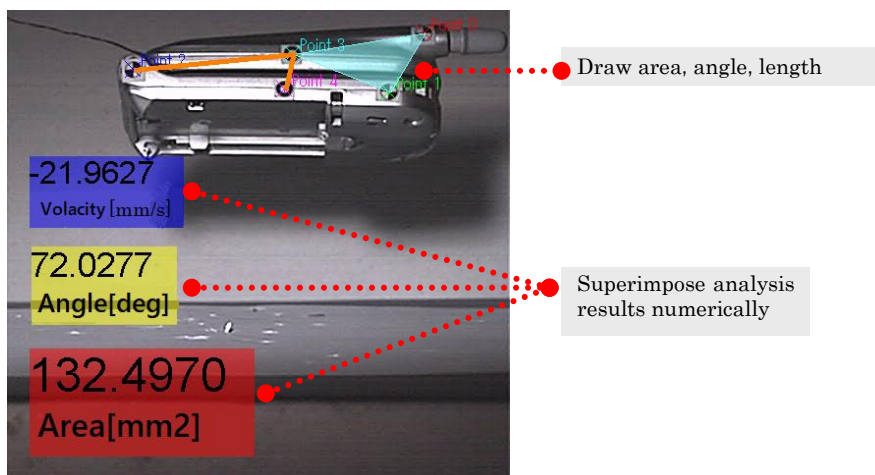
Selection	Example of Series Name for the Graph Created under the General Tab	Examples of Series Name for the Graph Created under the Length, Angle and Area Tabs
All	Graph 1: Point1: X position	Graph 1: Length: Lz
Measurement Point Name	Point1	Length
Measurement Point Name + Physical Quantity	Point1: position	Length
Measurement Point Name + Component + Physical Quantity	Point1: X position	Length: Lz

## 8.7 Annotation Function (Draw Figures, Superimpose Analysis Results)

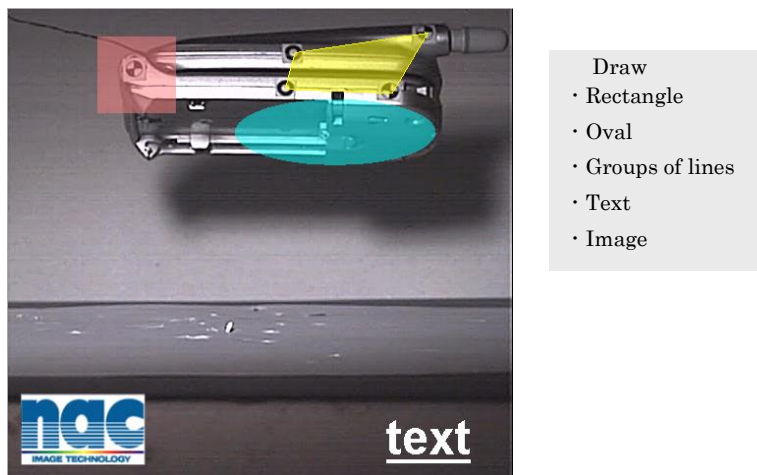
Function to draw figures on the measurement image and superimpose analysis results on the image.

Superimposing the analysis results makes it possible to visually verify the area and angle on the measurement image. Also, it can be used as a tool to enhance the display by emphasizing the tracking shown by drawing the measurement points as a figure.

The figure on the measurement image is exported as shown when exporting to print, AVI output, clipboard, image file.



**Example of Superimposing Analysis Results**



**Example of Figures to Draw**

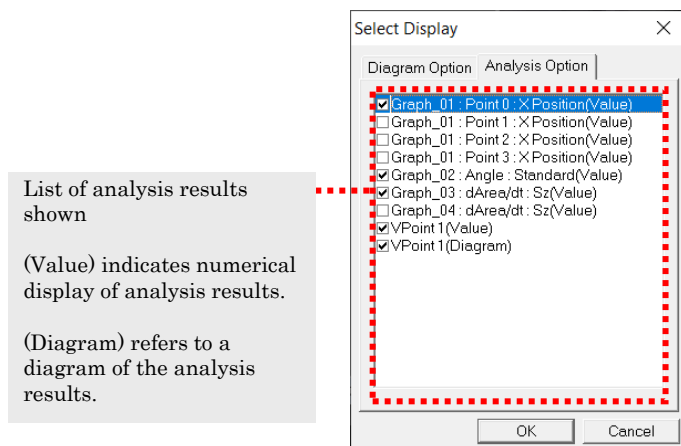
The following functions are also available.

- ✓ Show a figure of the tracked measurement points
- ✓ Rotate the figure to match with the rotation of the quadrant (only with a group of lines)
- ✓ Export coordinates (only with a group of lines)
- ✓ Reuse already completed figures in other projects

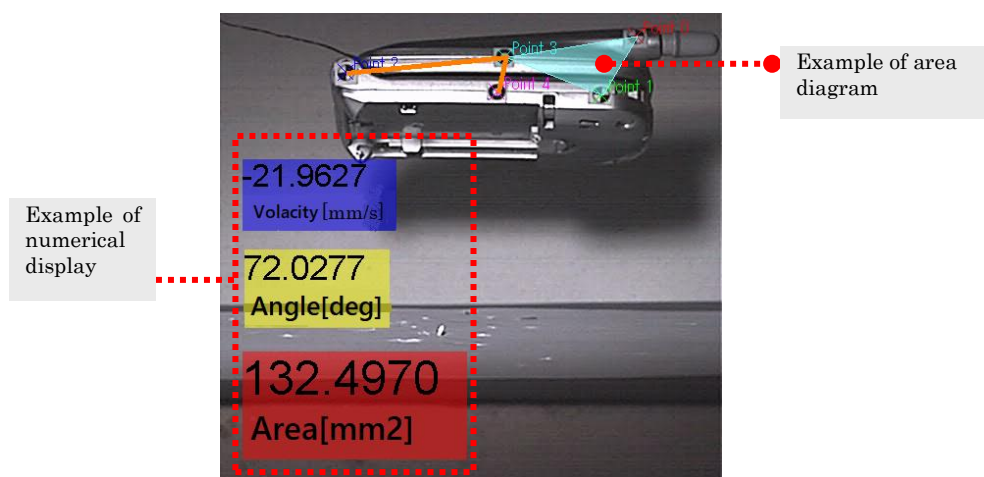
### 8.7.1 Show Analysis Results

Superimposed display of the figure of the analysis results on the image and superimposed display of the numerical values.

Select [Select Diagram to Show] from the right click menu on the measurement image. The [Analysis Option] tab in the [Select Display] dialog appears. A list of the analysis results that can be displayed in the project is shown under the [Analysis Option] tab. Checked items are superimposed on the image.



[Analysis Option Tab] in the [Select Display Dialog]



Some items created with analysis option cannot be edited.

Click [Select Diagram to Display] from the right click menu on the measurement image to display the Select Diagram to Display dialog. Use this dialog to select the analysis results to superimpose.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details.


Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ), エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for the properties used for superimposing the analysis.

## 8.7.2 Draw Figures

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Draw a figure on the measurement image. Figures that can be drawn include rectangles, ovals, straight lines, text and images.

Perform either of the following to draw figures.

- ✓ Select [Add Rectangle], [Add Oval], [Add Lines], and [Add Text] from [Tool] on the menu.
- ✓ Select any icon  on the figures toolbar on the エラー! 参照元が見つかりません。 .

### Rectangle • Oval

Drag to make a rectangle and the figure is drawn inside the rectangle.

### Lines

Input lines by dragging. Then, each click will input a connecting line. Double click to stop drawing lines and finish line input.

### Text

Drag to make a rectangle and display the text input dialog. Then enter the text and click OK.


### Image

After drawing a rectangle, load an image from the figure properties.

Refer to エラー! 参照元が見つかりません。 ] Tabs (p. エラー! ブックマークが定義されていません。 ) for details.

## 8.7.3 Using Figures

---

Click on [Select] from [Tool] on the menu or select  on the figure's toolbar on the main control bar, then click a figure to show the status of the figure selected.

In the selection status, delete, reorder sequence, move, resize, and rotate can be applied to the figures. Delete, Move, Resize, Rotate is not possible in figures for the analysis results (length, angle, area). The text in analysis results can be moved.

While in the selection status, double click inside a figure to show the [Figure Properties] dialog.

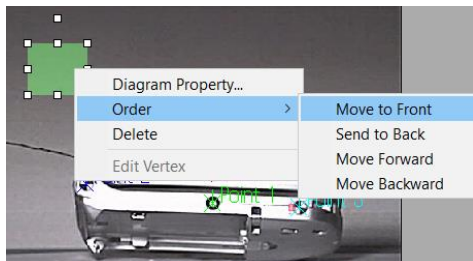
Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details on the [Figure Properties] dialog.





## ● Using Figures with the Right Click Menu

Right click from the figure selection status and the following menu appears.



### Figure Properties

Shows the Figure Properties dialog.

Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。)  
for details.

### Sequence

Changes the sequence for drawing the figures. Select from “Move to Front”, “Send to Back”, “Move Forward” or “Move Back”.

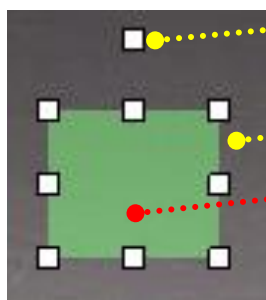
### Delete

Delete the figure.

### Edit the Peak (only with a group of lines)

Add and delete the peaks.

## ● Move, Resize, or Rotate Figures



● Drag to rotate. With a group of line segments, the target angle can rotate with “Not Rot”.

● Drag the green rectangle to resize.

● Drag inside the figure to move.

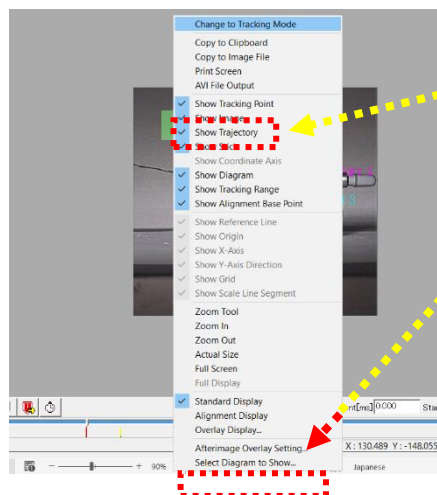
The figure can be moved, resized, and rotated from Figure Properties. For details, refer to the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).

## ● Undo and Redo

Click [Undo] from [Tool] on the menu to undo the operation on the figure. Click [Redo] from [Tool] on the menu to start again.

### 8.7.4 Switch between Show, Hide Figures

Switch between show/hide all of the figures or switch them individually.  
Select the following items from the right click menu on the measurement image.



#### Show Figure

Switch between show, hide all of the figures displayed.

#### Select Diagram to Show

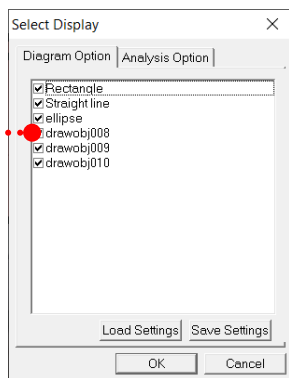
Set each figure to show · hide.

Refer to the エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。) for details.

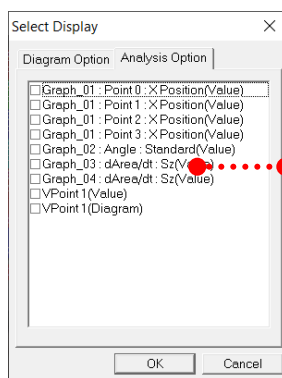
### 8.7.5 Select Diagram to Show Dialog

Click [Select Diagram to Show] from the right click menu on the measurement image to display the [Select Diagram to Show] dialog. Select show or hide for the figure and the analysis results.

Shows a list of diagram created.



[Diagram Option] Tab



[Analysis Option] Tab

Shows a list of the analysis results that can be displayed. The figure and the numerical values can be selected.

A list of the figures created appears on the list under the [Select Figure] tab. Switch between show and hide.

A list of analysis data or virtual points and center of gravity that can be displayed in the project is shown in the list under the [Select Analysis] tab. The virtual point and center of gravity figures can only be displayed in 2D analysis projects.

“(Figure)” shows the analysis data superimposed on the image. Select the length, angle, area or virtual point and center of gravity. “(Numerical Values)” shows the numerical values for the analysis data or the coordinates for the virtual point and center of gravity. Use [Load Settings] under the [Select Figures] tab to position the saved figure on the measurement image. The figure selected from the list with [Save Settings] is saved to the file.

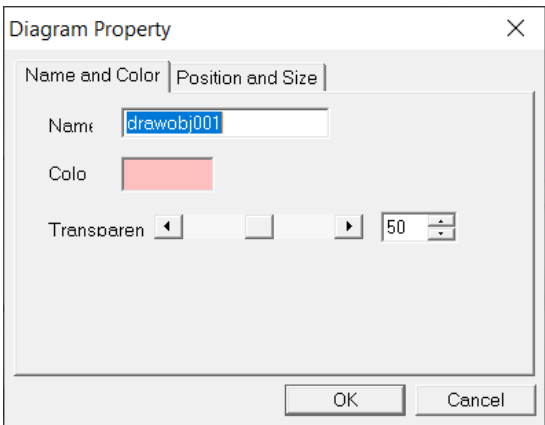
8.7.6 Figures Properties

Make all types of settings for the figures.

Click [Figure Properties] in the right click menu of the figure selected or double click inside the area of the figure to show the [Figure Properties] dialog.

(a) [Name and Color] Tabs

This item displays the rectangle, oval, line, and text properties.



**Name**

Set the name of the figure.

**Color**

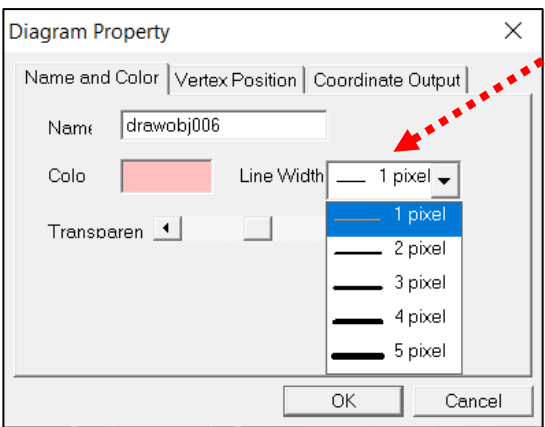
Set the color of the figure.

**Transparency**

Sets the transparency of the fill color.  
(0-100%)

**Image**

Shows the properties of the rectangle. Shows the image on the currently drawn rectangle. Select enable, disable display or keep, and change the aspect ratio.

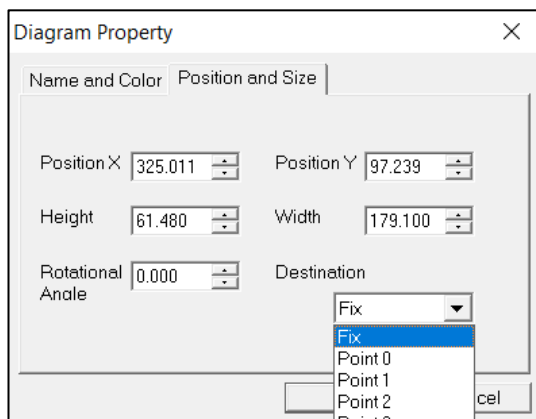


**Line Width**

Shows the properties of the line segments.  
Set the thickness of the line segments.

## (b) [Position and Size] Tabs

This item shows the properties for the rectangle, oval, and text.

**Position X, Y**

Set the center position of the figure.

**Height, Width**

Set the height or width.

**Rotation Angle**

Displayed for rectangles and ovals.

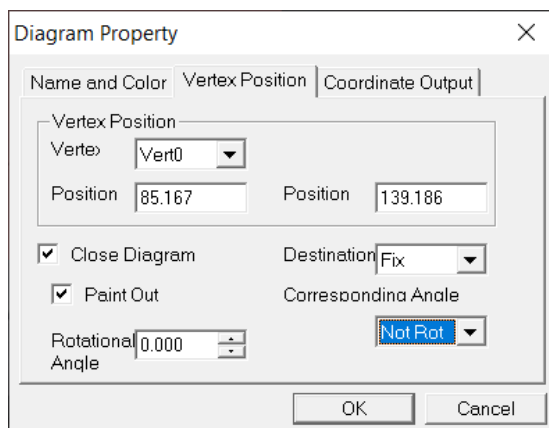
Set the rotation angle for the figure.

**Destination**

Draws the figure matching the position of the selected measurement points. Select fixed to fix the position of the figure.

## (c) [Peak Position] Tab

This item displays the properties for the group of lines.

**Peak Position**

Set the peak position. Select the peak and input values for X and Y. The peak position, destination, and corresponding angle are not set in the figure properties for the analysis results.

**Close Figure**

Check to close the line segment group (connect the starting point with the ending point).

**Fill**

Once a figure is closed, fills in with the color set in [Name and Color].

**Destination**

Draws the figure matching the position of the selected measurement points. Select fixed to fix the position of the figure. The peak position, destination, and corresponding angle are not set in the figure properties for the analysis results.

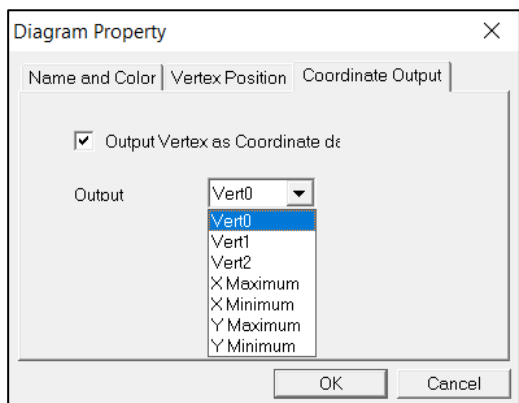
**Corresponding Angle**

Sets the angle of the point at the [Destination].

Set no rotation ("Not Rot"), quadrant angle ("Quadrant Angle") or group rotation angle ("GroupA" etc).

## (d) [Export Coordinates] Tab

This item displays the properties for the group of lines. Coordinate export calculations are performed at the same time as the calculations for 2D calibration. If using this function to export coordinates, set the export coordinates and then click calibrate to display the dialog. There is no need to make these settings again.

**Export Peak Position as Coordinate****Data**

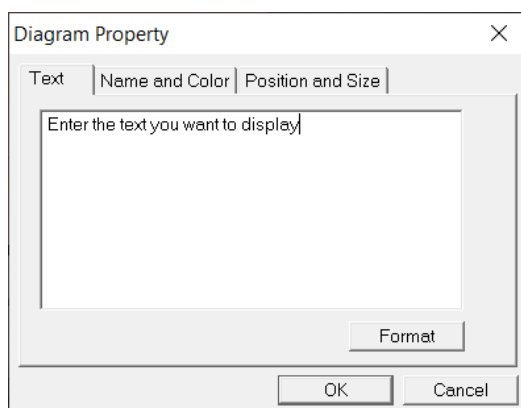
Check to export the coordinates for the peak position selected with the export coordinates combination box.

**Export Coordinates**

Export the data on the peak position for the group of lines or the minimum or maximum values for X and the minimum or maximum values for Y. Determination of the maximum or minimum uses the coordinate system after 2D calibration.

## (e) [Text] Tab

This item displays the properties for the text.

**Text**

Input the text to display. Text, height, and width cannot be set in the text properties for the analysis results.

**Format**

Set the font.

### 8.7.7 Analysis Using the Annotation Function

The annotation function can be used to perform analysis on measurement points that cannot be tracked by using a coordinate export function for groups of lines.

The procedure is as follows.

- (a)
- (b) エラー! 参照元が見つかりません。
- (c) エラー! 参照元が見つかりません。
- (d) エラー! 参照元が見つかりません。
- (e) エラー! 参照元が見つかりません。

The following example tracks a video file for crash tests.

Tracking is performed on the head of the dummy. As shown in the video on the right, the head is hidden and cannot be tracked.

Tracking is performed using the annotation coordinate export function.



**On-board dummy**  
Tracks the outline of the head



**Video at the instant of the crash**  
Since the dummy has leaned forward, part of the head is hidden and cannot be tracked

#### (a) Tracking

Tracks standard measurement points. Track either quadrants or track groups to track angles. In the figure to the right, the quadrants are tracked because the angles need to be tracked.

Add  
quadrants



### (b) Add Annotation

Create a figure by drawing an outline around the tracked measurement points. Either add a new figure or load a saved one.

Adjust the figure to match by using resize or rotate on the image.



画像提供: 財団法人 日本自動車研究所 殿

The figure to the right is an example where the head of the dummy is outlined

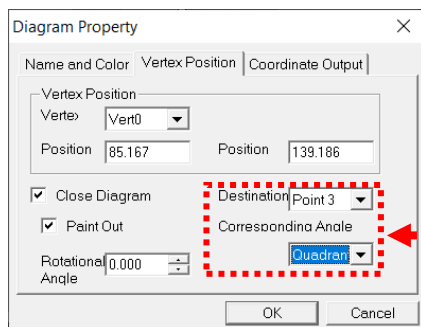
Add line segments to make an outline

### (c) Link Tracking Points and Angles for Annotation

Set the properties of the drawn annotation.

Set the movement tracked in “(a)” as the [destination] and the angle at “Point0” as the [quadrant angle]. Thus, the annotation tracks the movement of the dummy’s head during playback.

After linking, the group of lines cannot be rotated so adjust the shape of the figure before linking.



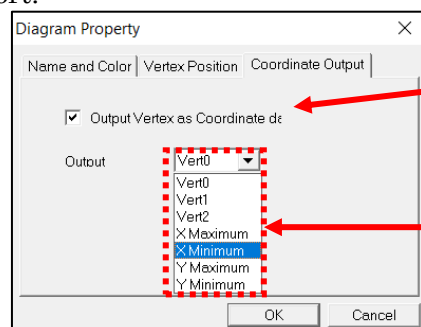
Tracked movement settings.  
Destination : Point0  
Corresponding angle:  
Quadrant

### (d) Export Settings

Setting to export the coordinates for the annotation set in “(c)”.

Select the peak exported from the coordinate export tab and click OK.

With this annotation, the figure below shows peak coordinates set to the maximum X value for export.



Check to enable

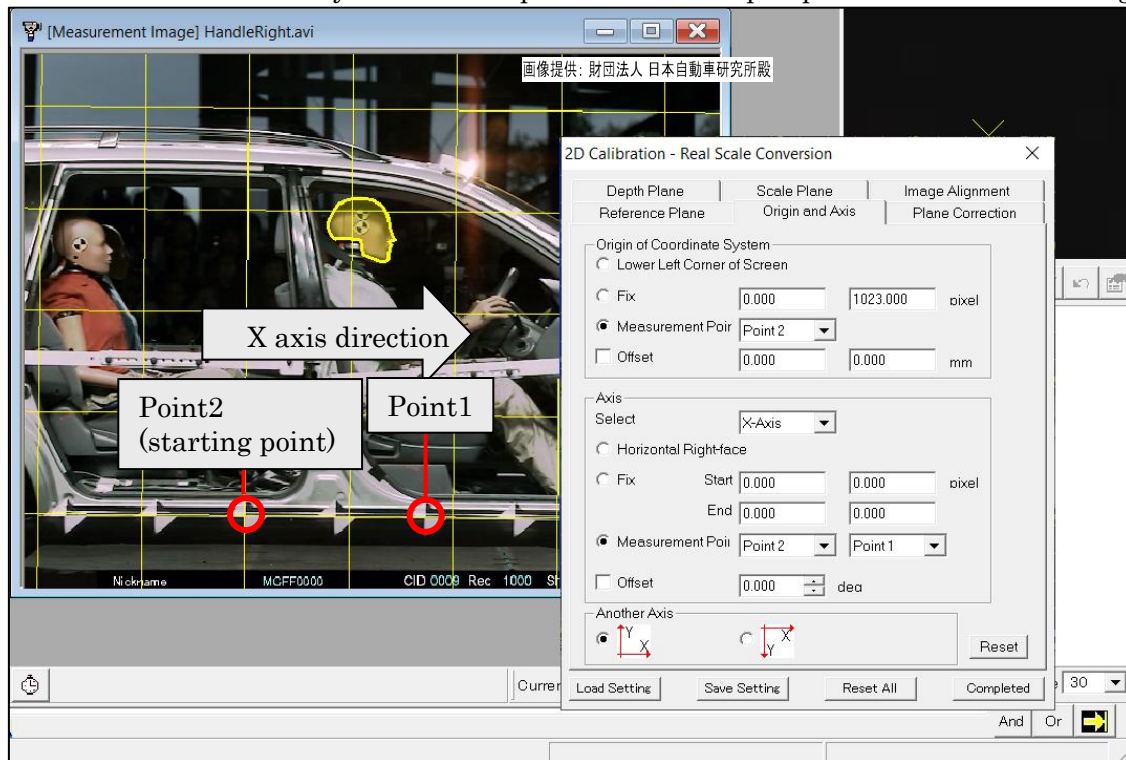
Select peak to export



### (e) Calibration

Calibrates and creates measurement data.

After calibration, if the annotation export coordinates are set, perform calibration again. Performs calculations only to close the open real scale (or perspective) conversion dialog.



### 2D Calibration

Set the starting point as Point2, with the X axis direction Point2 to Point1

### (f) Check Measurement Data

Displays the list from the current project on the project tree. Check that the peak coordinates for the maximum X value have already been exported to the list

#1 (m)	Point 2 X(mm)	Point 2 Y(mm)	dx(mm)/XZ軸方向 X(mm)	dx(mm)/YZ軸方向 Y(mm)
0000	49.108	-0.000	-47.228	-56.413
0000	48.989	-0.000	-47.344	-57.089
0000	48.937	-0.000	-47.852	-56.571
0000	49.016	-0.000	-46.906	-57.837
0000	48.456	0.000	-46.763	-56.950
0000	48.419	-0.000	-47.392	-57.790
0000	48.674	-0.000	-46.517	-56.597
0000	48.007	-0.000	-47.094	-57.659
0000	48.908	-0.000	-42.815	-64.090
0000	48.338	-0.000	-43.302	-64.404
0000	48.757	0.000	-45.760	-58.035
0000	49.030	-0.000	-45.393	-58.611
0000	48.369	-0.000	-45.125	-59.302
0000	49.025	-0.000	-44.557	-58.704
0000	48.133	0.000	-41.394	-66.681
0000	48.946	-0.000	-40.892	-66.057
0000	48.448	-0.000	-40.823	-64.935
0000	48.279	-0.000	-43.712	-57.876
0000	48.799	-0.000	-39.705	-66.576
0000	48.999	-0.000	-42.856	-59.146
0000	49.141	0.000	-41.967	-59.616
0000	48.385	-0.000	-39.466	-66.795
0000	49.124	-0.000	-41.179	-59.406
0000	48.270	-0.000	-41.131	-68.472
0000	49.097	-0.000	-36.320	-66.167
0000	48.468	-0.000	-38.908	-59.453
0000	49.186	-0.000	-37.645	-59.706
0000	48.453	-0.000	-36.302	-66.059
0000	49.206	-0.000	-33.644	-67.016
0000	48.144	-0.000	-36.441	-60.479
0000	49.071	-0.000	-35.015	-61.325

Exported coordinates added to measurement data.

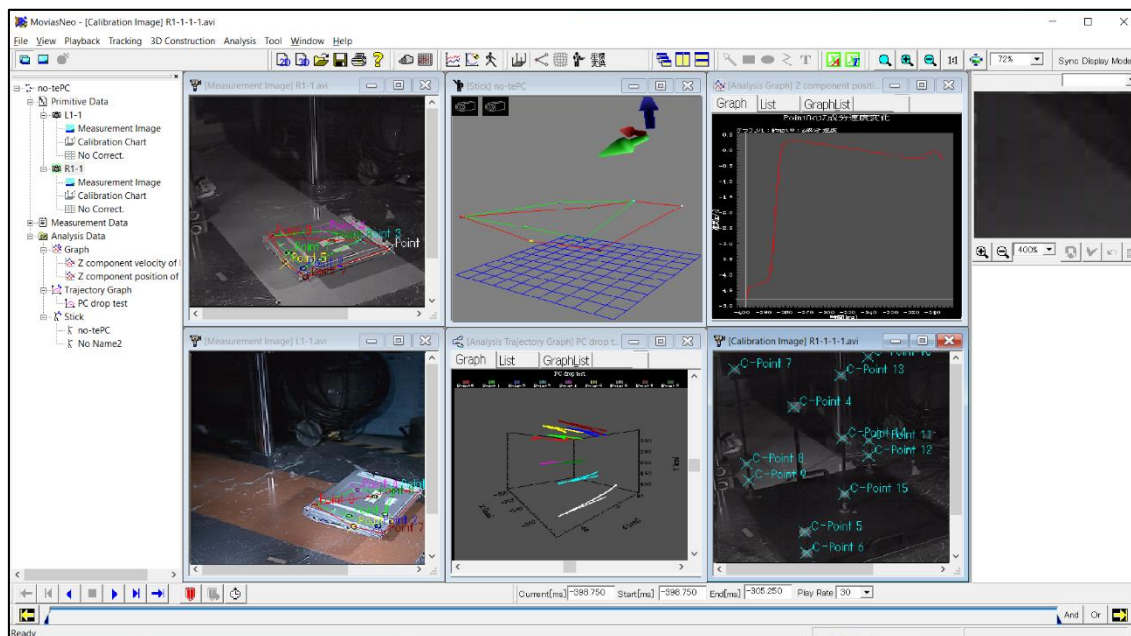
In this example, only one point is exported but there can be one point exported for each line.

Add multiple lines to export multiple peaks.



## 9. MOVIAS Neo Viewer

MOVIAS Neo Viewer opens projects created in MOVIAS Neo and displays the analysis results, including the videos and graphs already created.



Since this is a dedicated viewer, it cannot create new tracking points or new graphs. It operates even without a MOVIAS license key. Additionally, results analyzed with MOVIAS Neo can be displayed on other PCs.

MOVIAS Neo Viewer functions are as follows.

MOVIAS Neo Viewer presents data analyzed with MOVIAS Neo on other PCs so it can be distributed to other researchers.

Since a MOVIAS license key is not required, any PC that satisfies the necessary operating environment (p. エラー! ブックマークが定義されていません。 ) can display analysis results from MOVIAS Neo.

Images and graphs can be viewed but not edited.

The method of operation is identical to that used for MOVIAS Neo.



## 10. MOVIAS Neo Options

### 10.1 Image Alignment and Overlay Function

#### 10.1.1 Basic Functions

The [エラー! 参照元が見つかりません。] is an optional extension of MOVIAS Neo, which requires a license key to operate.

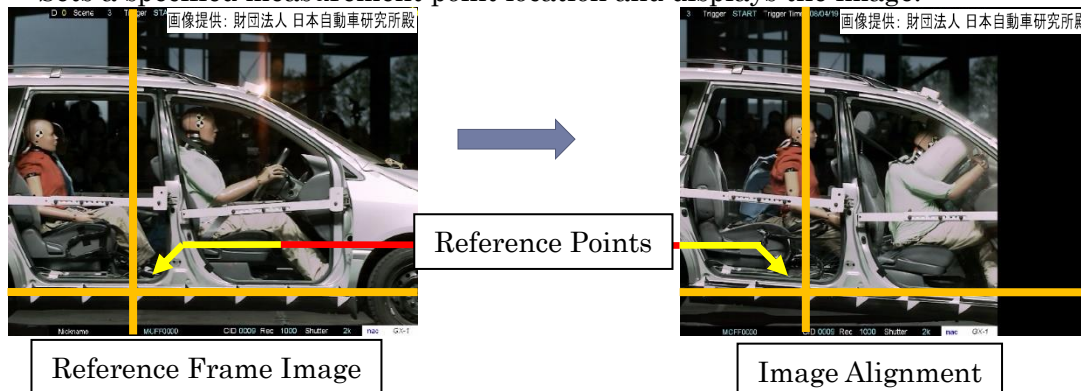
The functions are as follows.

- ✓ Image Alignment: The function to display an image using a specific point as the standard.
- ✓ Overlay Display: The function to superimpose two images for display.
- ✓ Afterimage Display: The function to superimpose the images from the previous and subsequent frames for the display.
- ✓ Export AVI or still image files for the above contents and output to print or to a clipboard.

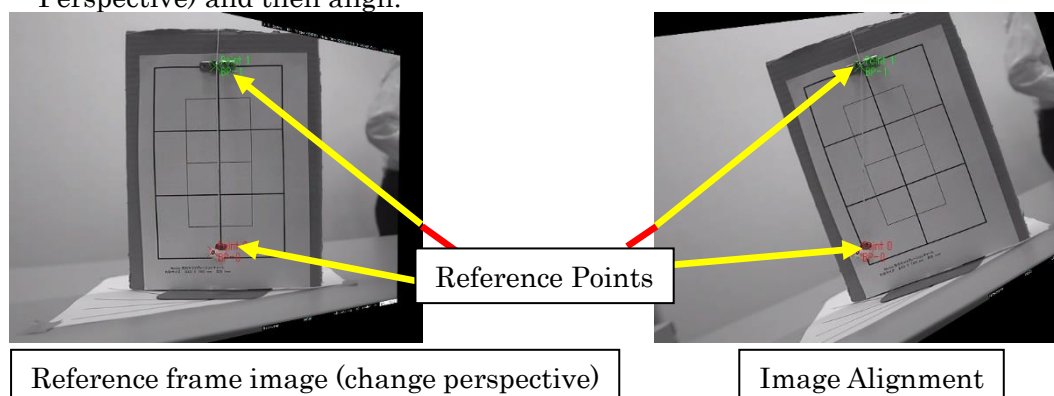
The following displays are available with this function.

#### ● Image Alignment

Sets a specified measurement point location and displays the image.



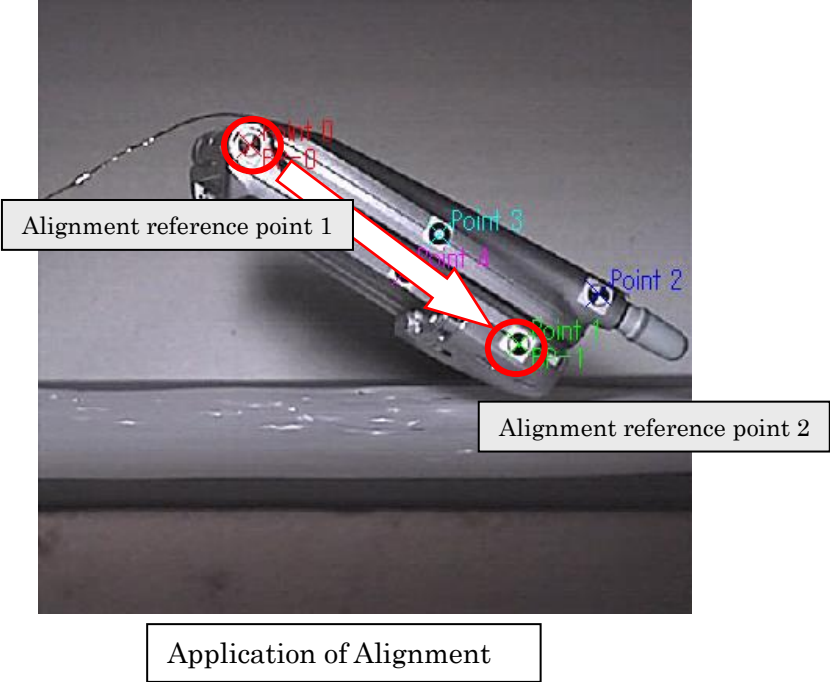
If making image alignment settings from a change in perspective, create an [Image Viewed from the Front] from the change perspective settings (Correct Image Perspective) and then align.



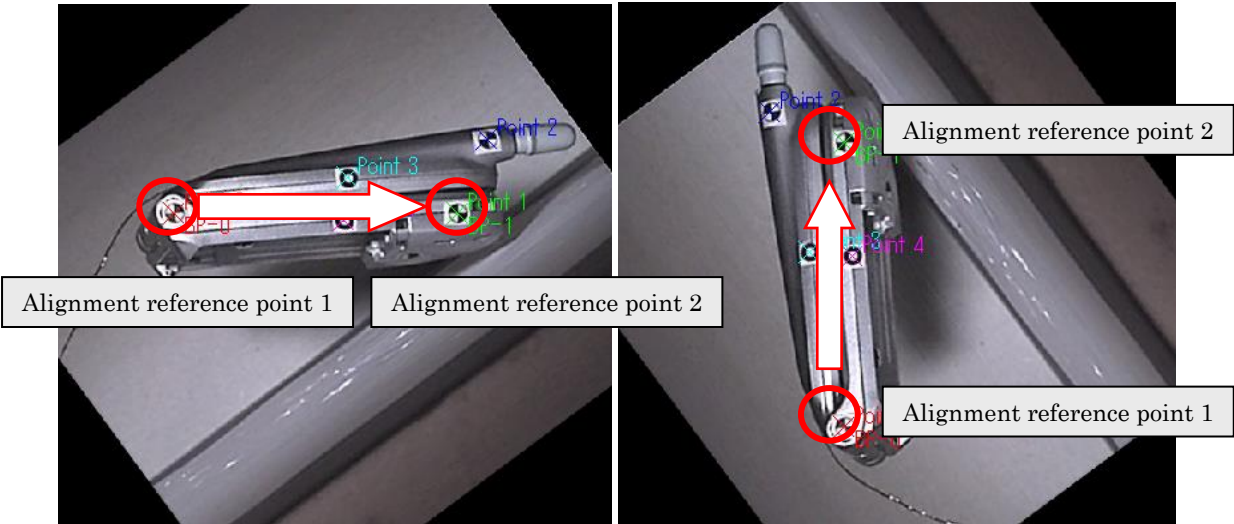
● **Screen Alignment Function**

Function to rotate the image so that the two image alignment reference points are “screen horizontal right facing” or [screen vertical left facing]. Screen alignment processing is applied after the image alignment processing.

An example of the application of the screen alignment function is shown below.



Application of Alignment



The vector from reference point 1 to reference point 2 shown when alignment with the screen horizontal alignment is applied rotates the image so it is horizontal and facing right.

The vector from reference point 1 to reference point 2 shown when alignment with the screen vertical alignment is applied rotates the image so it is vertical and facing up.

### ● Overlay Display

Displays two images superimposed. The differences between the images can be visually compared.



### ● Afterimage Display

Displays the afterimages of the image.

With image alignment, the afterimage can be shown aligned.

With overlay display, the base image and the overlay image can both be set for afterimage.

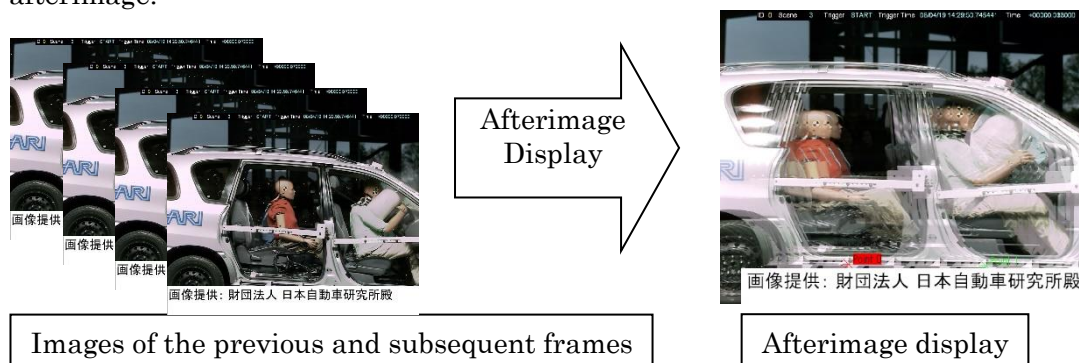


Image alignment, overlay display and afterimage display are functions to visually verify differences in the images. For example, when comparing repeated movement, images are aligned, and the differences can be visualized for quantitative analysis.

## 10.1.2 Operating Environment

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The following environment is required to use these functions.

- ✓ PC with MOVIAS Neo Ver2.10 or later installed
- ✓ MOVIAS license key containing the license for these functions

These functions process large images, so operation with the recommended MOVIAS Neo specs may be slow. Therefore, we also recommend the following specifications.

### Recommended Operating Environment

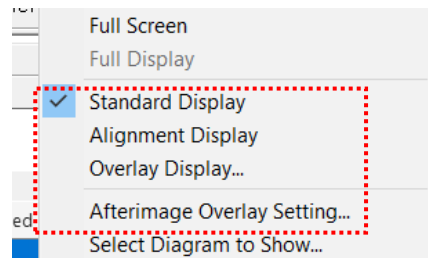
CPU:	Recommend Core2 Duo 2GHz or the equivalent
Memory:	Recommend 2GB or more
Hard Drive:	Free space of 150MB or more for software installation (200GB or more of data space is recommended)
Monitor:	Resolution 1280x1024 or higher
OS:	Windows 11 64bit, Windows 10 64bit / 32bit, Windows 7 64bit / 32bit, Windows Vista (SP2 or later) 64bit / 32bit, Windows XP (SP3 or later) 32bit
DirectX®:	Microsoft DirectX 9.0C or later
Other:	CD-ROM drive required for installation USB port for MOVIAS license key Equipped with dedicated GPU for graphics Ex: NVIDIA: FX880M
Recommended PC:	M4500 or greater from Dell

### 10.1.3 Operating Method

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Enable this function with the following MOVIAS Neo display settings.

Standard display  
Alignment display  
Overlay display  
Afterimage display



Click [Standard Display], [Alignment Display] or [Overlay Display] from the right click menu on the image window to switch displays.

If selecting [Standard Display] or [Alignment Display] and the image window is reopened, the selected display will still be shown.

If [Overlay Display] is selected, operation is only possible in the overlay window. Switch the display to [Standard Display] or [Alignment Display] to end the overlay display.

Settings for the afterimage display can be made at the same time as the [Standard Display] and [Alignment Display].

Use [Standard Display] for analysis (tracking, calibration, and such).

[Merged Export] is not available with [Overlay Display]. After importing [Overlay Display] to a project using the [Import Image] function from [Export AVI File], perform [Merged Export] for the external image.



## 10.1.4 Image Alignment

### ● Image Alignment

This function sets the position of the specified measurement points and displays the image.

Use with 2D analysis projects.

With 1 point, image alignment is performed using horizontal and vertical movement.

With 2 points, image alignment is performed using similarity transformation.

If performing alignment settings using change perspectives, conduct image alignment through projective transformation.

Perform [Copy to Clipboard], [Save Image File], [Print], [Export AVI File] or [Merged Export] with image alignment.

### ● Image Alignment Process

Perform the image alignment settings in the [Real Scale Conversion] dialog or the [Change Perspectives] dialog.

Open the image window to perform alignment. After finishing auto tracking, open the [Real Scale Conversion] dialog or the [Changing Perspectives] dialog and make the settings for image alignment.

Make the settings for image alignment according to the following procedure.

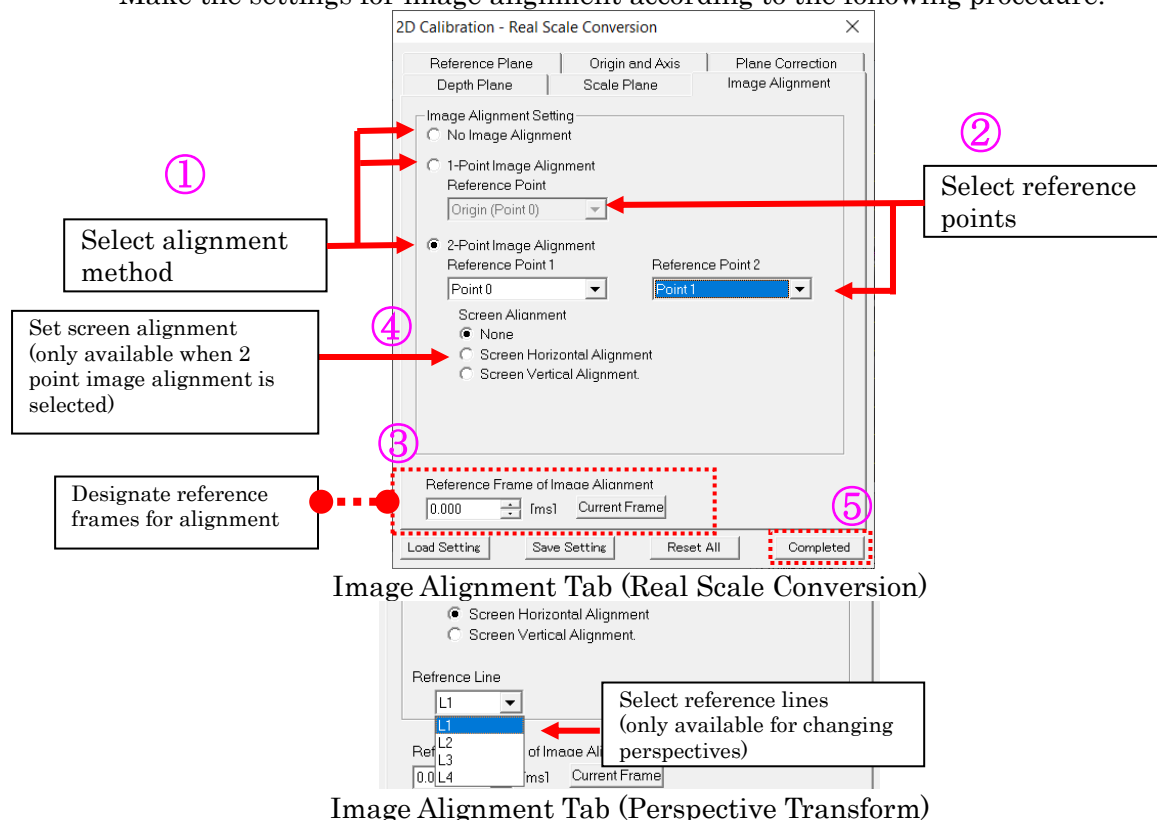

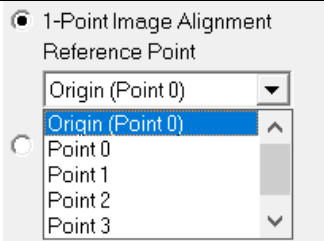
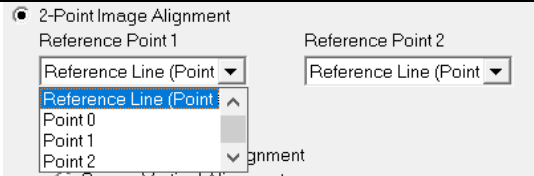


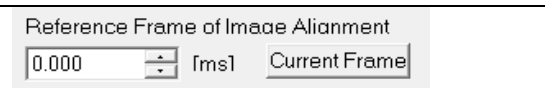
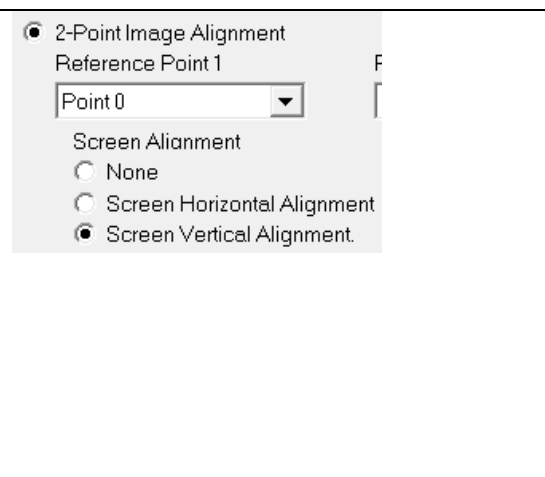
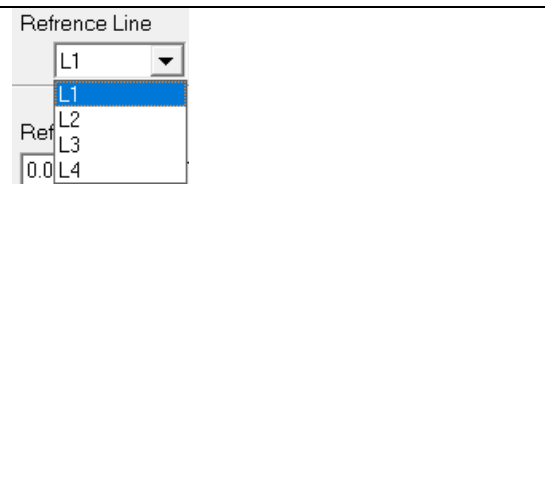


Image alignment procedure

- ① Select the alignment method.
- ② Select the reference points for alignment.
- ③ Select the reference frames for alignment.
- ④ If selecting 2-point alignment, make the settings for screen alignment.
- ⑤ Select the reference lines for changing perspectives.
- ⑥ After finishing the real scale conversion or change perspectives settings in another tab, click [Finish].

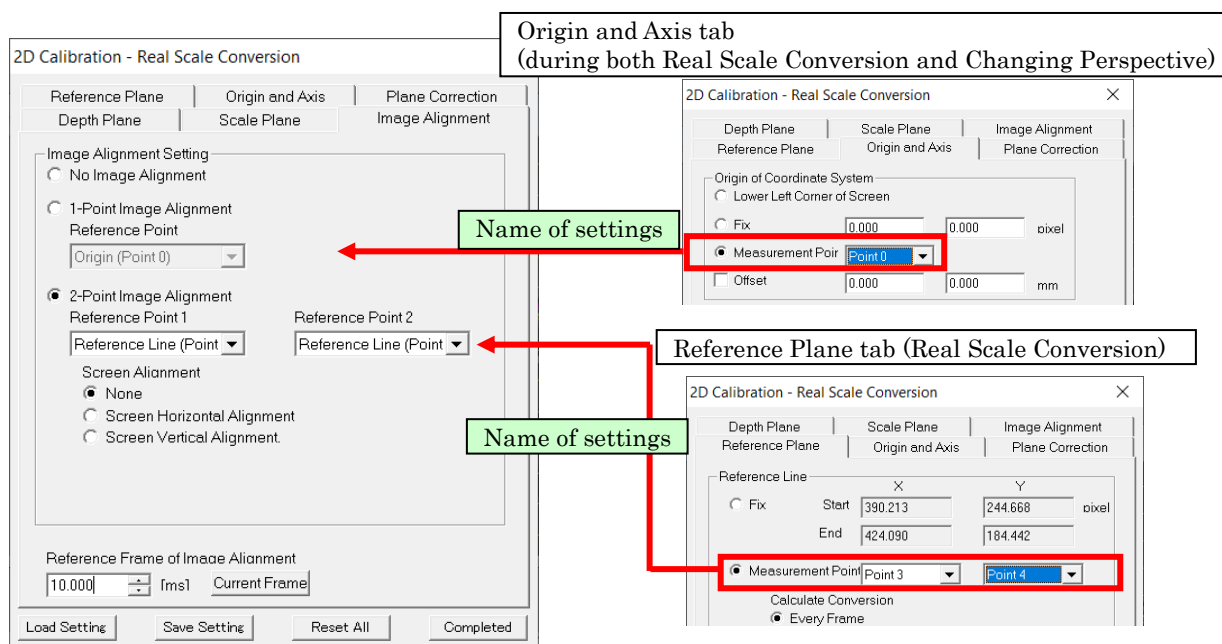
● Settings for Image Alignment

	<p>No setting for alignment. Initial setting.</p> <p>Alignment is not shown even if [Alignment Display] is selected on the right click menu in the measurement image window.</p>
	<p>Designate one reference point for alignment.</p> <p>Image alignment performed on the origin set with the [Origin and Axis] tab during the selection of the [Origin (XXXX)]. “XXXX” is the name of the point set with [Each Frame] for the origin.</p> <p>Image alignment is performed with the measurement points selected unless selected as noted above. (applies only to image alignment)</p>
	<p>Specify two reference points for alignment.</p> <p>Image alignment is performed on the points set with the [Reference Plane] tab of the [Real Scale Conversion Dialog] during [Reference Line (XXXX)] selection. “XXXX” is the name of the point set when specifying the tracking points.</p> <p>Image alignment is performed with the measurement points selected unless selected as noted above. (applies only to image alignment)</p>

	<p>Input the reference frames for image alignment. Click on the current frame to set the timing of the current display.</p>
	<p>Screen alignment settings (can be set only with 2-point image alignment)</p> <p>Performs image rotation so the vector connecting the reference points for image alignment is in the specified direction.</p> <p>No screen alignment: No screen alignment.  Screen horizontal alignment: Image rotation so the alignment reference points are screen horizontal right facing.  Screen vertical alignment: Image rotation so the alignment reference points are screen vertical top facing.</p>
	<p>Reference Line (can be specified only when changing perspective)</p> <p>(In general) With the exception of during 2 point image alignment, the reference points and reference lengths during image conversion are selected from lines L1, L2, L3, and L4 used during エラー! 参照元が見つかりません。(p. エラー! ブックマークが定義されていません。).</p> <p>If the line is slanted, the converted image will also have the corresponding slant. Depending on the aspect ratio, if a short line is selected, the entire image can be shown converted.</p>

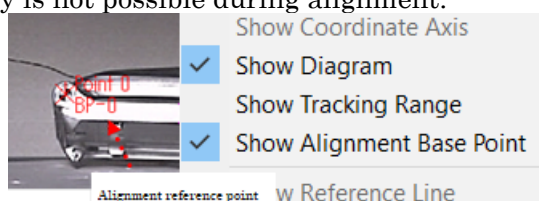
If [Origin (XXXX)] is selected in [1 Point Image Alignment], alignment is performed with the measurement points selected with the starting point coordinates from the [Origin and Axis] tab.

If [Reference Line (XXXX)] is selected in [2-Point Image Alignment], alignment is performed with the measurement points selected with the measurement points for the reference line segments under the [Reference plane] tab.



### ● Alignment Display Right Click Menu

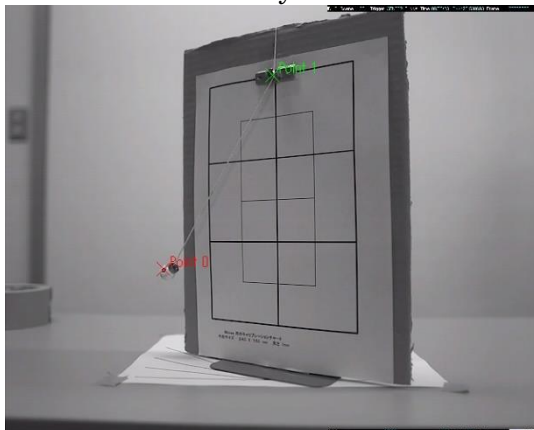
Switch from show or hide the display name for the reference points aligned from the [Alignment Reference Points] on the right click menu. Annotation display is not possible during alignment.




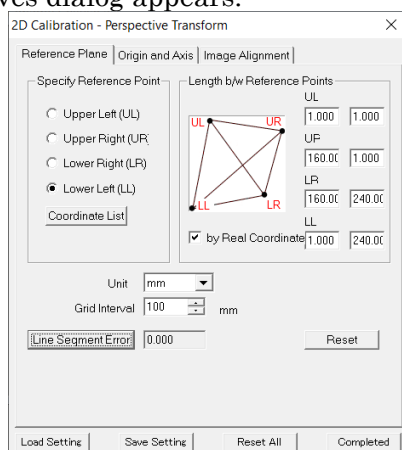
## ● Procedure for Correcting the Image Perspective

Next is a description of the procedure used for image alignment from changing the perspective.

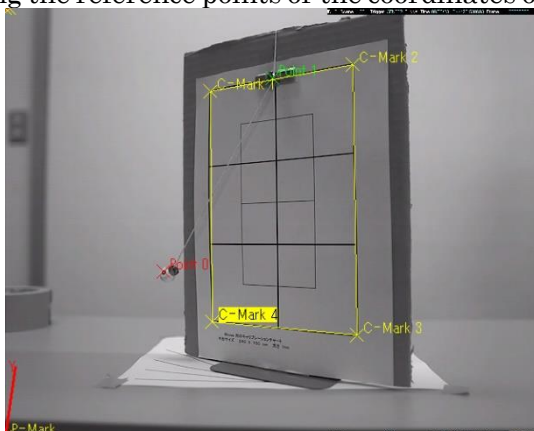
1. The measurement points are automatically tracked.



2. Click change perspective  on the main control bar and the [Reference Plane] tab of the change perspectives dialog appears.

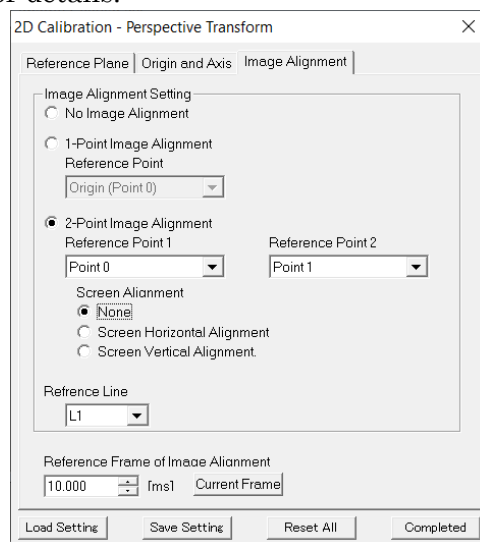


3. Click the points corresponding to the changing perspectives reference points (top left corner, top right corner, bottom right corner, and bottom left corner) and input the true length connecting the reference points or the coordinates of the reference points.

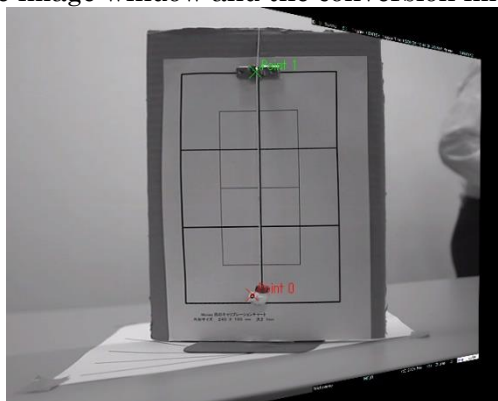


Distortion from filming at an incline as mentioned above is corrected and the coordinates can be determined.

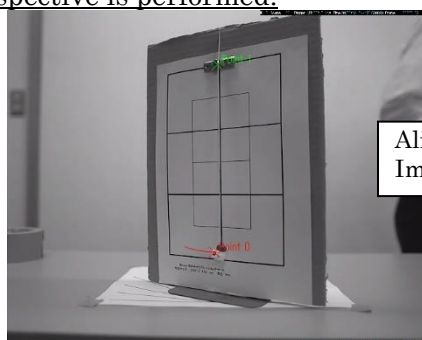
4. The [Image Alignment] tab appears and settings for image alignment can be performed as necessary.  
The settings are identical to the image alignment settings for true scale conversion. Refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for details.



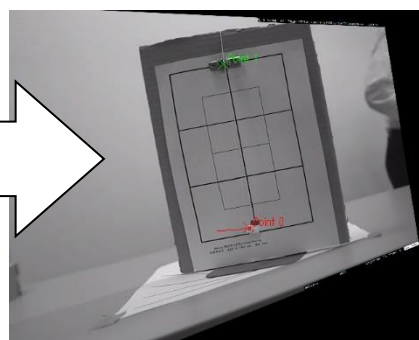
5. After finishing the settings for changing perspectives, select [Alignment] from the right click menu of the image window and the conversion image will appear.



During a change in perspective, if [Alignment] is selected from the right click menu of the image window even when [No Image Alignment] is selected, correction of the image perspective is performed.



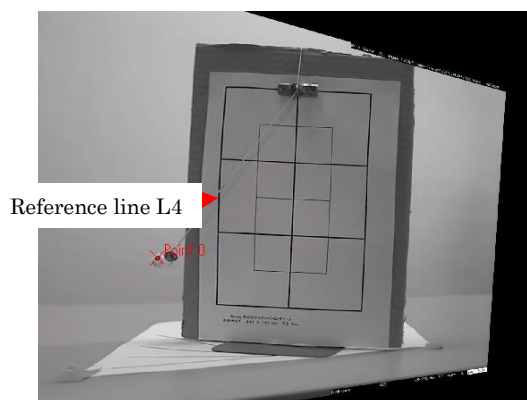
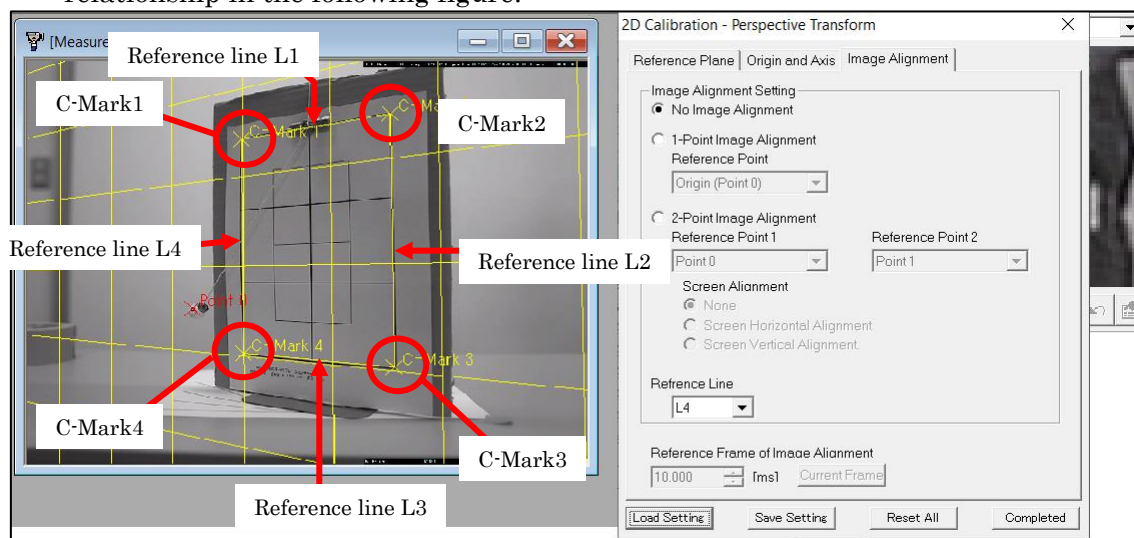
Normal display



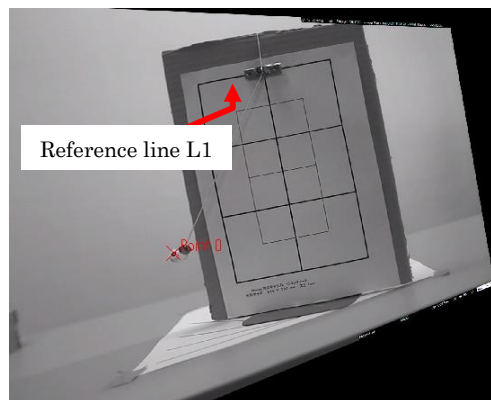
Correcting the image perspective

(Create image to view from the front)

6. When changing perspective, if no alignment or 1 point image alignment is selected, set the reference lines according to the incline of the plane for which [Alignment] is to be performed. With frames that do not have reference points, alignment is shown using the selected reference lines, even if 2-point image alignment is selected. Select the reference lines from the reference lines for changing perspective. The arrangement is the same as that in the figure for エラー! 参照元が見つかりません。  
(p. エラー! ブックマークが定義されていません。). An example is shown in the relationship in the following figure.



If L4 is selected as the reference line



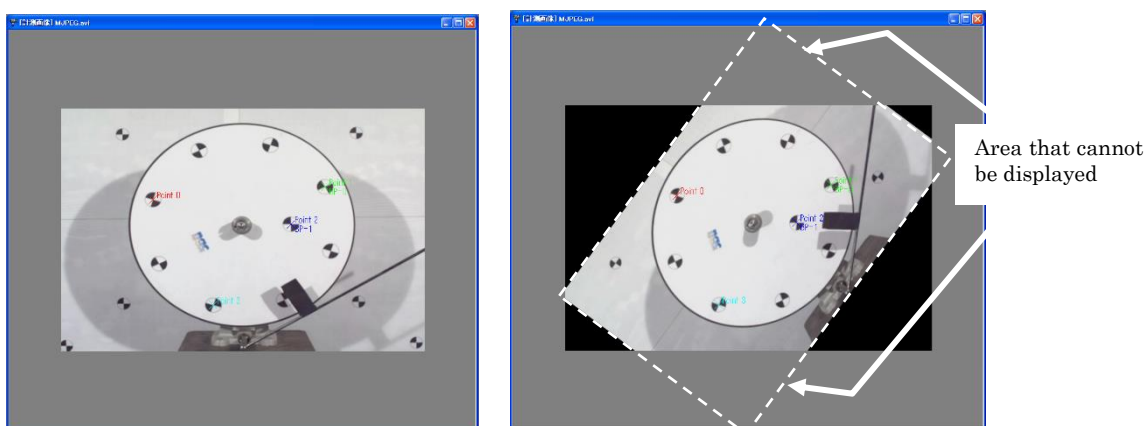
If L1 is selected as the reference line

Depending on the selected reference line, the image for the results of the changed perspective alignment may have an exaggerated incline. Select the appropriate [Reference Line] for the incline of the plane. Also, if you cannot select the desired axis for the reference line, consider adding two fixed points for separate image alignment and perform 2-point image alignment.

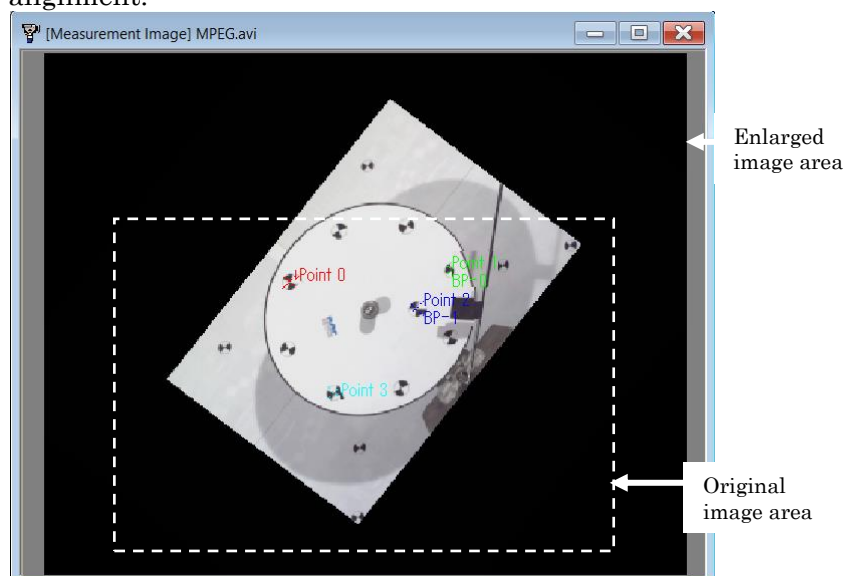
- **Image Area Enlargement Function**

Function to enlarge the image display area. The image is not enlarged or reduced and remains the original size.

The image alignment function performs rotation of images or changes the perspective, so part of the image is outside the display region, as shown in the figures below.




In this case, this function is used to enlarge the image area and display the entire image after alignment.



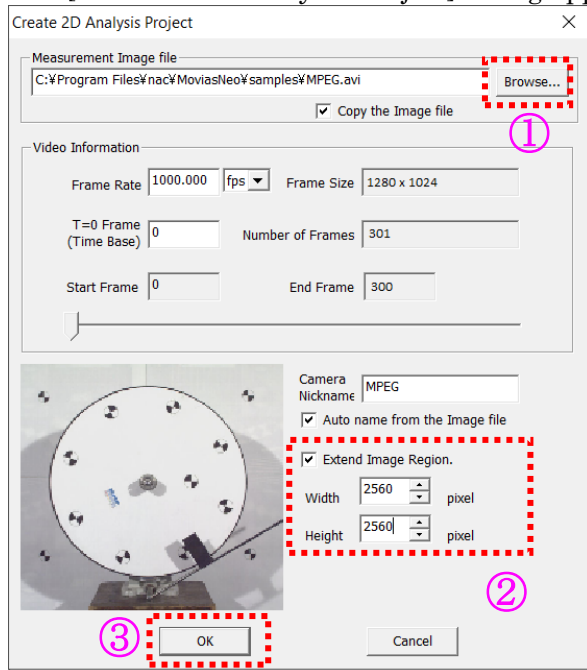
**Shows the Entire Image after Changing the Shape by Enlarging the Image Area**



Perform the following to enlarge the image area.

Click  on the main control bar with the [Image Alignment and Overlay Function] license key inserted.

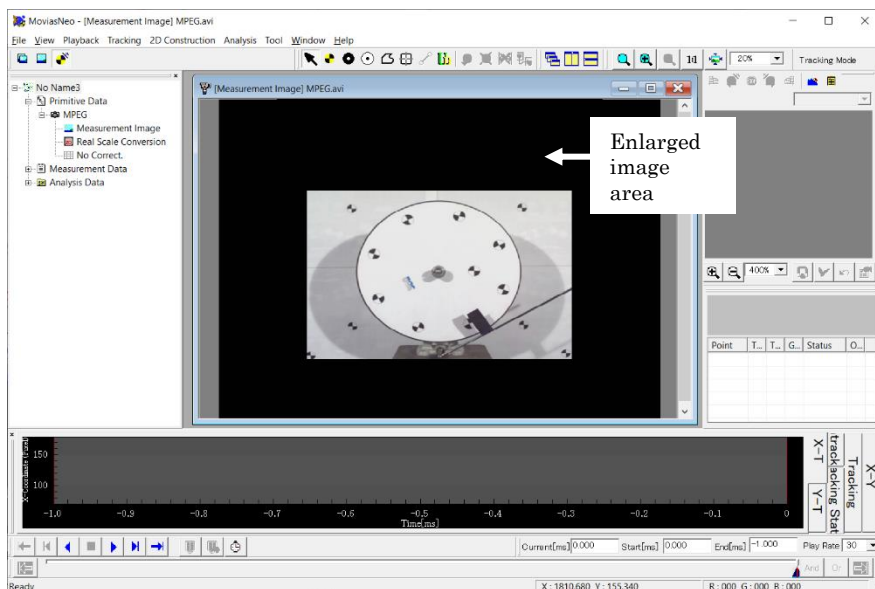
The [Create a 2D Analysis Project] dialog appears.



1. Click [Reference] to designate the measurement image file for analysis.

2. Check [Enlarge the Image Area] and input the enlarged area size.

3. Click [OK] to create a project with the image area enlarged.



After setting the enlarged image area, the operations using the image are processed with the enlarged size. Image area expansion can only be set during creation of a new 2D project. Changes to the image area cannot be made after a project is created. If changing the image area, create a new project.

## 10.1.5 Overlay Display

### ● Overlay Display

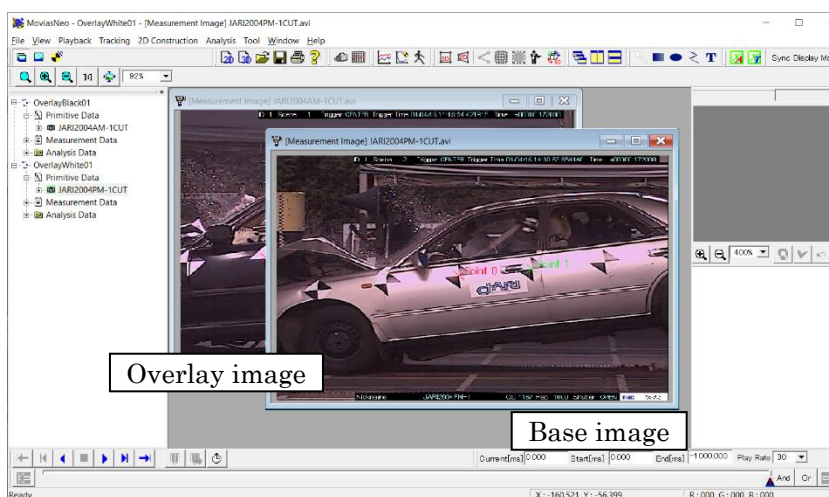
Overlay display is a function to superimpose the display of image files, showing the alignment of specified measurement points (reference points) is possible. Since MAX, MIN, RG channels can be selected as the method of creating images, match the superimposed images and use the appropriate method. Also, the image quality of both the base image and the overlay image can be adjusted.

[Copy to Clipboard], [Save Image File], [Print] and [Export AVI File] can be performed during overlay display. [Merged Export] is not available.

During overlay display, operation is only possible in the overlay image window. Switch to [Standard Display] or [Image Alignment] to use other windows

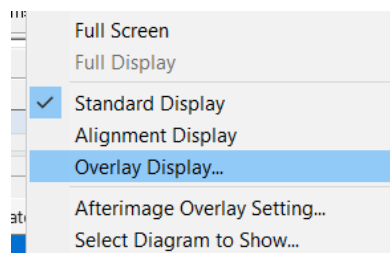
### ● Overlay Display Procedure

Open the image window for the overlay image before performing overlay display.

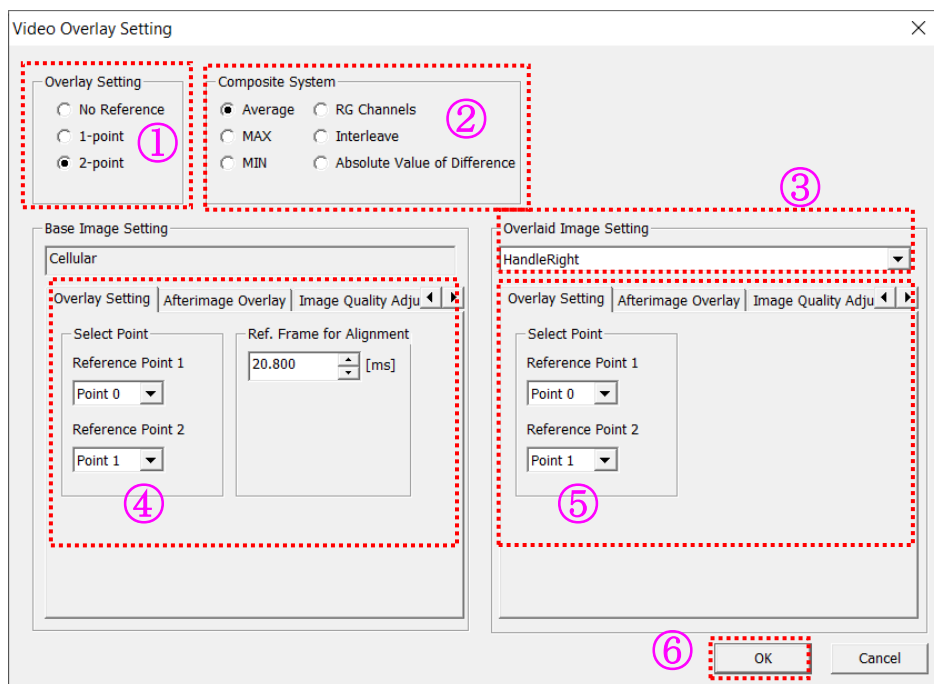


Overlay is possible with the [Measurement Image Window] and the [External Image Window].

Click [Overlay Display] on the right click menu of the image window used as the base and the [Video Overlay Settings] dialog will appear so you can make the overlay settings.



The procedure for making settings for the overlay display is as follows.

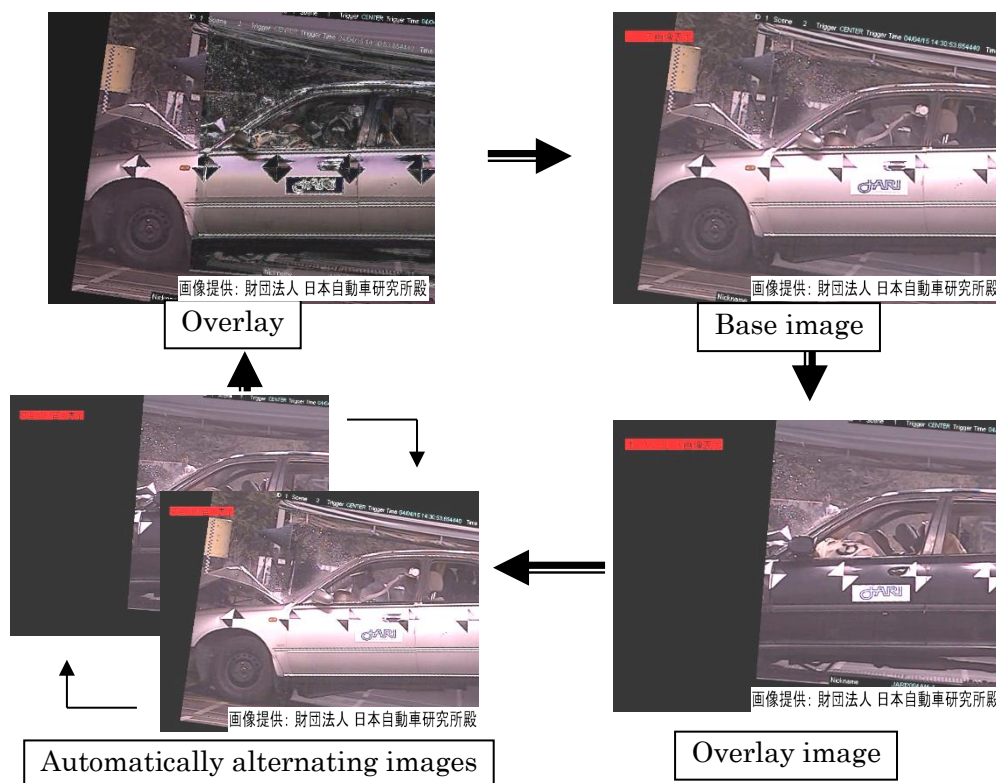


- ① Select the superimpose settings for the overlay.
- ② Select the overlay creation method.
- ③ Select the images to overlay from the [Overlay Image Settings] combination box.
- ④, ⑤ Make the settings for the method of superimposing the base image with the overlay image as well as for the afterimage and image quality adjustment. (Refer to p.エラー! ブックマークが定義されていません。 for details on each setting.)
- ⑥ Click [OK] to display the overlay image.

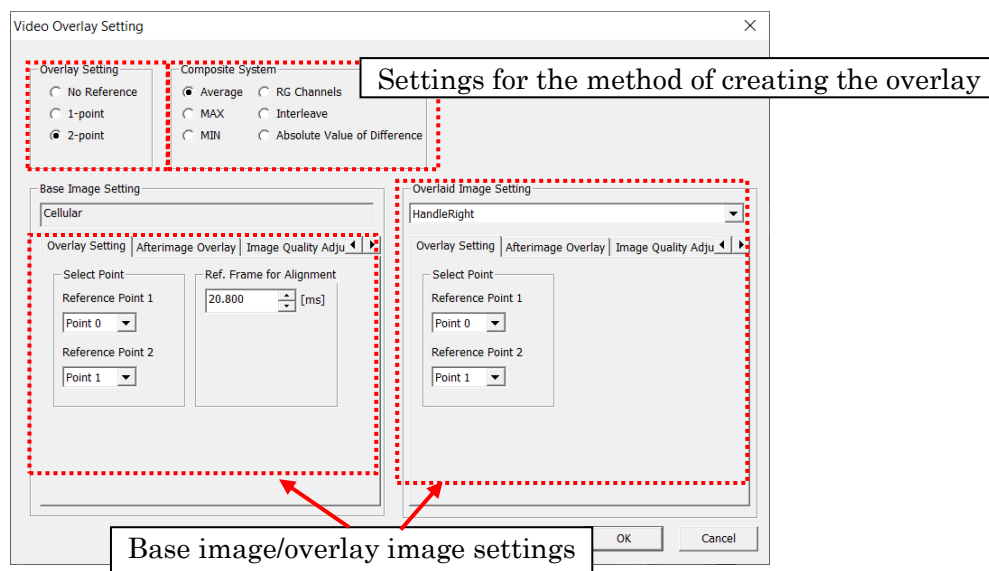
Click the image on the overlay display to switch the image display.

Switch in the order of create display → display base image → display overlay image → automatically alternate displays.

The automatically alternating display temporarily shows the [base image] then switches to the [overlay image].



## ● Overlay Display Settings



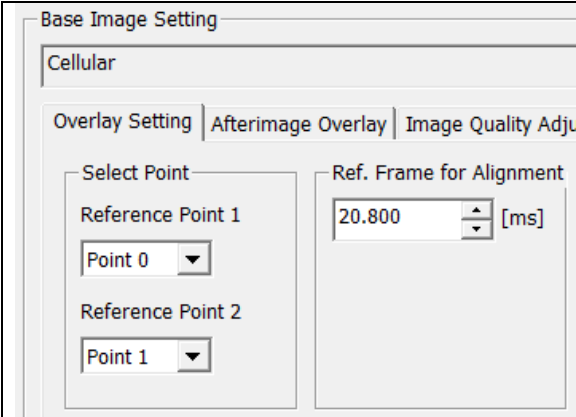
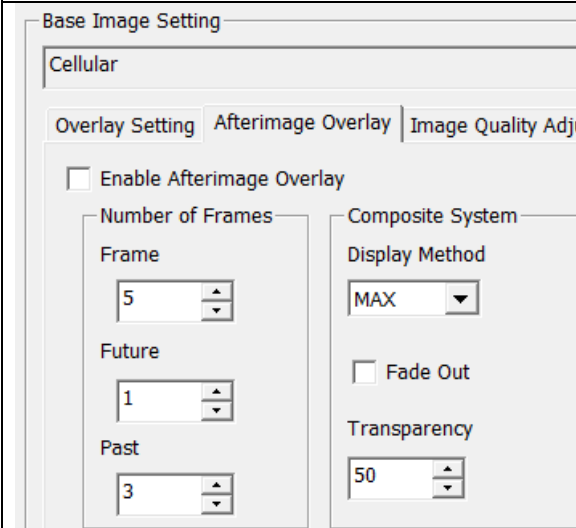
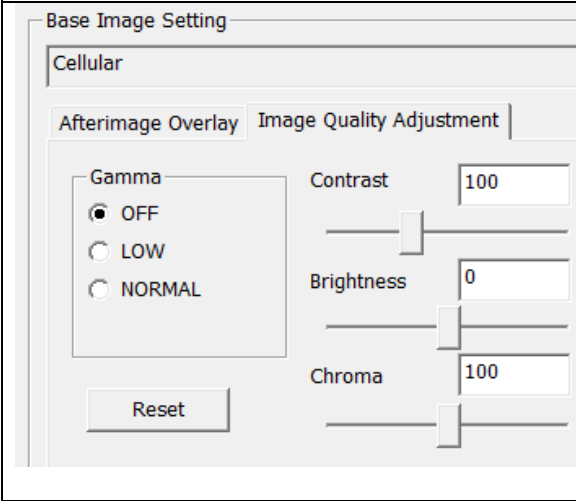
## Overlay Settings

No reference: Only displays superimposed images. Does not perform alignment.

1 reference point: Reference alignment with vertical and horizontal movement of the overlay image.

2 reference points: Reference alignment with similarity transformation of the overlay image

● Details of the Base Image / Overlay Image Settings

	<p>Overlay Settings</p> <p>Settings for reference points and reference frames.</p> <p>To superimpose one point, set reference point 1 and to superimpose two points, set reference points 1 and 2.</p> <p>Do not set reference points if you are not superimposing reference points.</p> <p>Align using the reference points for the alignment reference frames.</p>
	<p>Afterimage Display</p> <p>Make the settings for afterimage display when superimposing the base image or the overlay image.</p> <p>For details, refer to エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。).</p>
	<p>Image Quality Adjustment</p> <p>Adjust the image quality when overlaying.</p> <p>This is identical to the MOVIAS Neo [Correction of Displayed Images] function.</p>



- **Settings for the Method Creating the Overlay**

Select from average, MAX, MIN, RG channel, interleave, and the absolute value of the differences.

Examples creating each type using the base and overlay images are shown below.



Base Image



Overlay Image

### Example when [Average] is Selected



Displays the average of the color for each pixel from the base image and the overlay image.

Half of the brightness of both the base image and the overlay image is used.

### Example when [MAX] is Selected



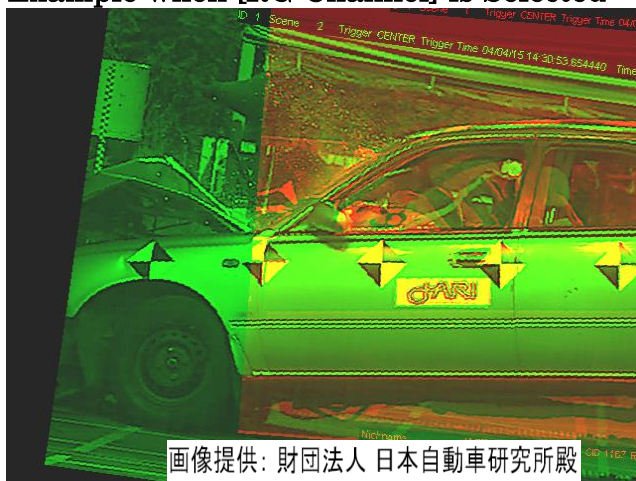
Shows each pixel with a brighter base image and overlay image.

Use this method to make images with dark backgrounds easier to see.

**Example when [MIN] is Selected**

Shows each pixel with a darker base image and overlay image.

Use this method to make images with bright backgrounds easier to see.

**Example when [RG Channel] is Selected**

Displays the brightness of the base image as R, the brightness of the overlay image as G, and B as 0.

Since the image is drawn in each color, the differences in images are easy to spot.

**Example when [Interleave] is Selected**

Displays an interleave of the base image and the overlay image.

A good quality video can be made because the images show each line.

To display properly, you must remove the image zoom and display it as 1: 1.

### Example when [Absolute Value of the Differences] is Selected



Displays the absolute value of the color differences between the base image and the overlay image.

The differences between the images can be checked.

### Right Click Menu of the Overlay Display

Switch from show or hide the display name for the superimposed reference points from the [Alignment Reference Points] on the right click menu.

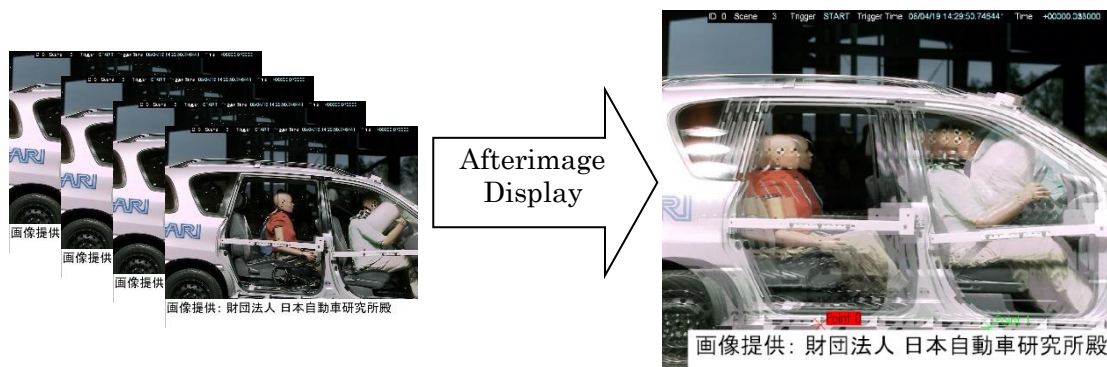
Annotation display is not available during the reference point alignment display.





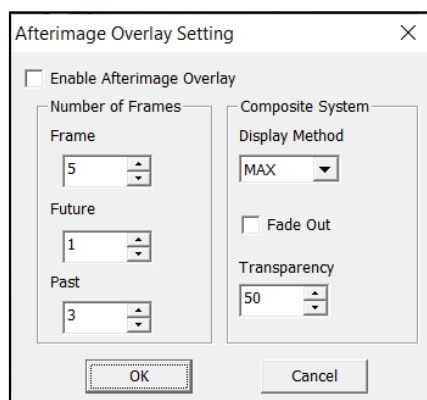
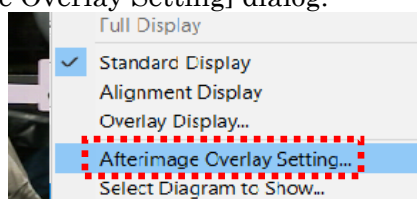
## 10.1.6 Afterimage Overlay Setting

This function superimposes image frames before and after the current frame for display. Scenes of the movement over multiple frames can be displayed on a single image. Afterimages can be created with [Image Alignment Display] or [Overlay Display].



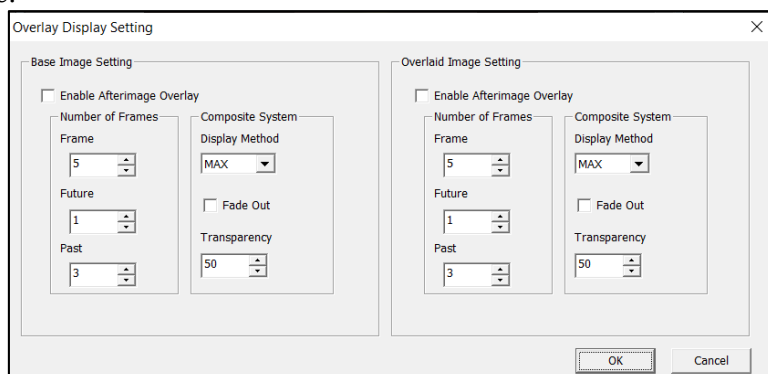
### ● Afterimage Overlay Setting Dialog

Click [Afterimage Overlay Setting] on the right click menu of the image window to display the [Afterimage Overlay Setting] dialog.



Afterimage Overlay Setting Dialog for Standard Display or Image Alignment Display

During overlay display, the afterimage display can be set for the base image and the overlay image.



**Afterimage Overlay Setting Dialog for Overlay Display**

### **Enable Afterimage Display**

Enables/disables afterimage display.

### **Number of Frames to Skip**

Sets the number of frames to jump among the surrounding frames for afterimage display. When 0, the subsequent image becomes the afterimage displayed.

### **Number of Frames Behind or Number of Frames Ahead**

Sets the number of images displayed before and after the current image. (0~9)

### **Method for Creating Afterimages**

Select [MAX] or [MIN]. Switch according to the image so the images are easy to see. This is identical to the [MAX] and [MIN] methods for creating overlay display.

**MAX:** Uses the brightest colored pixel in a series of afterimages.

Use this when the background is dark.

**MIN:** Uses the darkest colored pixel in a series of afterimages

Use this when the background is bright.

### **Fade Out**

The afterimage is shown fainter as time passes.

### **Afterimage Transparency**

Designate the transparency when creating afterimages with current images. The afterimage becomes fainter as it gets closer to 0, and brighter as it gets close to 100.

## 10.2 Frame Rate and Time Display for Time-Lapse Photography

[Frame Rate and Time Display for Time-Lapse Photography] is an optional function for MOVIAS Neo. It adds the units necessary for time-lapse photography.

The following environment is required to use this function.

- ✓ PC installed with MOVIAS Neo Ver2.21 or later
- ✓ MOVIAS license key with the license for this function

### 10.2.1 Basic Functions

The following are possible with this function.

- ✓ **Frame Rate for Time-Lapse Photography:**  
fpm and fph frame rates have been added for time-lapse photography.  
The following frame rates can be set with this function.
  - fps (frames per second)  
MOVIAS Neo standard unit for frame rate.
  - fpm (frames per minute = 1/60fps)
  - fph (frames per hour = 1/3600fps)
- ✓ **Display of Hours/Minutes/Seconds for Long Term Photography:**  
Adds a display of hours/minutes/seconds to show the time during long term photography.  
The following time displays are available with this function.
  - F (frames), sec (seconds), msec (milliseconds), usec (microseconds)  
MOVIAS Neo standard unit for time display.
  - hms (hours/minutes/seconds)

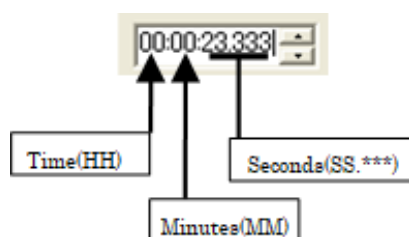
If hms (hours/minutes/seconds) is selected for the time display during long term photography, the display is “HH: MM: SS.\*\*\*”. If a negative, the display is “-HH: MM: SS.\*\*\*”.

HH and MM refer to hours and minutes.

“SS.\*\*\*” refers to seconds. \*\*\* refers to decimal places.

The number of columns is for the values set in [Number of Decimal Places] in [Time Units].

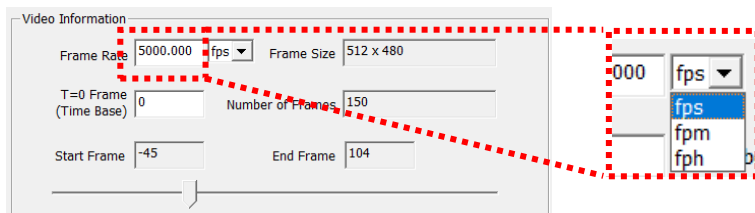
If [hours/minutes/seconds] is selected, input using the format of “HH: MM: SS.\*\*\*”.



## 10.2.2 Operation

### ● Frame Rate for Time-Lapse Photography

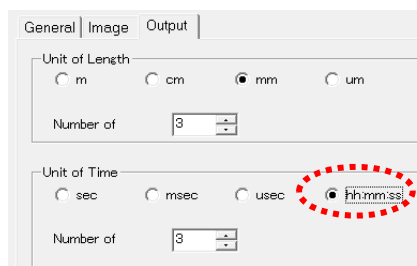
Select the frame rate unit when creating from new 2D projects, new 3D projects or project templates.



Select a frame rate in fps/fpm/fph. If creating a 3D project, you can set a frame rate for each camera.

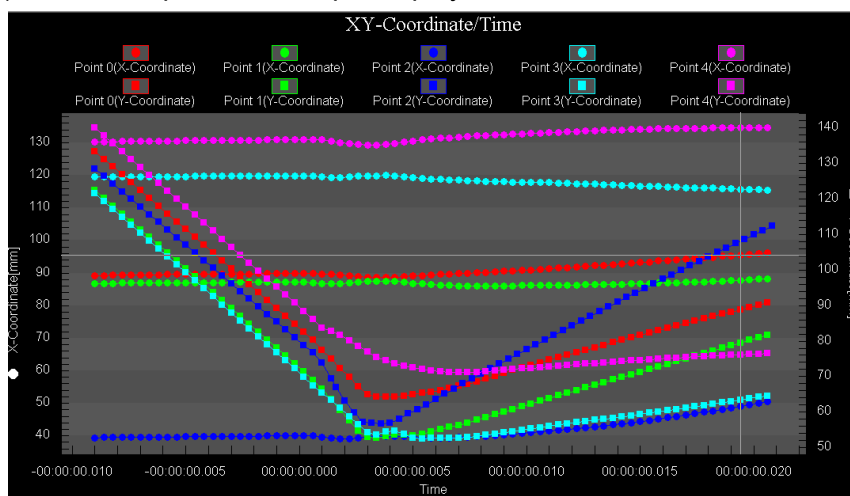
### ● Time Display for Extended Exposure Photography

To switch to the time display for extended exposure photography, select the [Export] tab when the [Project Information] dialog appears. Select [Hours/Minutes/Seconds] under [Time Units] and click OK to display the time using a format of “HH: MM: SS.\*\*\*”.



Example of the Hours, Minutes, or Seconds Display

(a) Example of the Graph Display



The graph time display is [Hours, Minutes, or Seconds].

(b) Example of the List Display

F-Seq	Graph_05 : Point 0 Position[mm]	Graph_05 : Point 1 Position[mm]	Graph_05 : Point 2 Position[mm]	Graph_05 : Point 4 Position[mm]
00:00:00.000	130.378	389.942	426.237	292.587
00:00:00.000	130.269	389.793	426.291	292.617
00:00:00.000	130.077	389.607	426.295	292.615
00:00:00.001	129.753	389.372	426.206	292.554
00:00:00.001	129.306	389.110	425.990	292.419
00:00:00.001	128.792	388.859	425.634	292.213
00:00:00.001	128.293	388.656	425.154	291.953
00:00:00.001	127.876	388.526	424.587	291.653
00:00:00.002	127.589	388.483	423.974	291.320
00:00:00.002	127.457	388.531	423.348	290.957
00:00:00.002	127.490	388.670	422.733	290.574
00:00:00.002	127.678	388.888	422.145	290.183
00:00:00.002	127.989	389.166	421.601	289.801
00:00:00.003	128.372	389.469	421.136	289.450
00:00:00.003	128.765	389.754	420.795	289.149
00:00:00.003	129.117	389.986	420.621	288.908

The time display for the first row is shown in [Hours], [Minutes], or [Seconds].

(c) Playback Bar Time Display

Current[hms]00:00:00.09 Start[hms]-00:00:00.0 End[hms]00:00:00.10

[Current], [Start] and [End] on the playback settings control bar refers to [Hours/Minutes/Seconds]. Input using the format of “HH: MM: SS.\*\*\*”.

(d) Select Time Units for Creating Graphs

Select “hms” when importing an analysis graph or waveform graph to display “Hours/Minutes/Seconds” separately from the project information.

New Graph

General Length Angle Area Point Angle Plane 6DOF

Measurement

Point 0  
Point 1  
Point 2  
Point 3  
Point 4

Vertical Axis

Physical

Position

Unit

mm

Component

☒ X

☐ Y

☐ Z

☐ Abs.

Offset

0.000

Details

Horizontal Axis

Physical

Time

Unit

hms

Sec

ms

us

hms

Component

☒ X

☐ Y

☐ Z

☐ Abs.

Details

## 10.3 MOVIAS Neo 2D-6DOF Measurement Functions

### 10.3.1 Basic Functions

The [MOVIAS Neo 2D-6DOF Measurement Function] is a functional expansion option for MOVIAS Neo that requires a license key. With this function, 6DOF measurements can be performed for 2D measurement projects.

- **Data required for 2D-6DOF measurements**

The following inputs and files are required to perform 2D-6DOF measurements.

**4 or more measurement points**

4 or more tracking points are required for 6DOF measurements on rigid bodies. If there are fewer than 4 tracking points for a rigid body in a specific time frame, 6DOF calculations cannot be performed for that time frame.

**Real scale or changing perspectives**

If performing 6DOF measurements using real scale conversion, you must set the true length of the reference line segment (refer to p. 5-5) and the reference plane depth (refer to p. エラー! ブックマークが定義されていません。 ).

If performing 6DOF measurements while changing perspectives, perform this in the same manner as when changing perspectives normally.

Refer to the figures on the following page for the relationship between conversion and 6DOF measurement values.

6DOF reference coordinates file (CSV format)	Designate a starting point (0.0, 0.0, 0.0) on a rigid body and create a file for the coordinates for each measurement point using the right hand coordinate system. Refer to 2D-6DOF Reference Coordinates File (p. F-1) for details on the creation methods.
--	--

- **6DOF Measurement Results**

The following is output as the 6DOF measurement results.

**6DOF Calculated Values**

Position and attitude of each frame for the starting points specified in the 6DOF reference coordinates file.

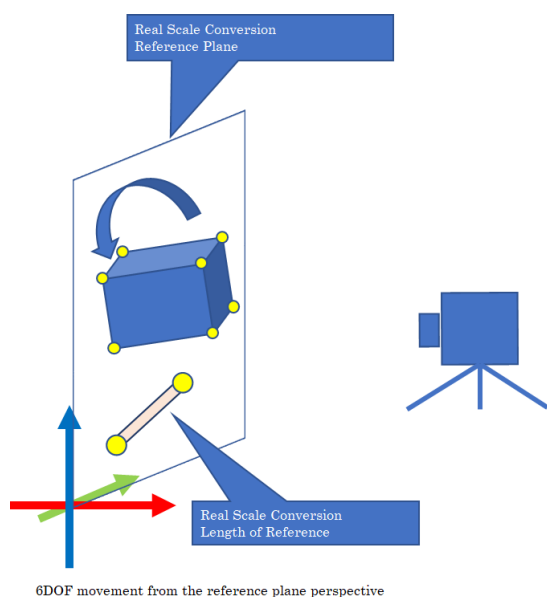
The 6DOF calculated values can be file outputs.

The direction of the X axis and the Y axis are set during 2D calibration. The Z axis is calculated in a direction toward the right hand coordinate system from the X axis and Y axis.

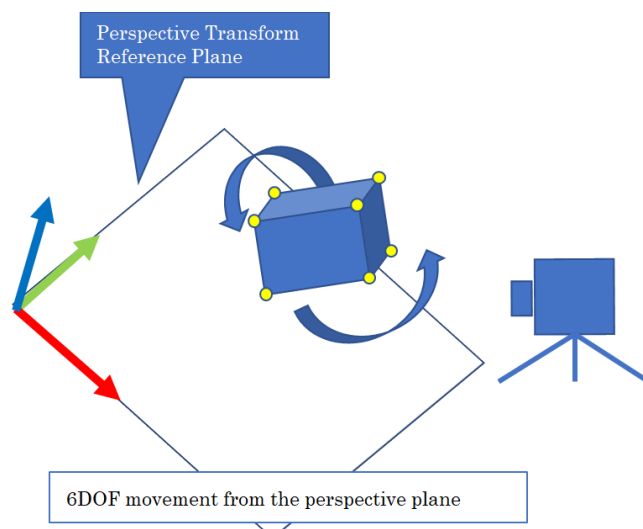
**3D Calculation Coordinates for Each Measurement Point**

3D coordinates calculated for each frame of each measurement point. Use with analysis graph calculations or stick display.

Calculate the coordinates while taking the X axis, Y axis and Z axis into consideration.



**2D-6DOF + real scale conversion.** Calculate the 6DOF movement from the reference plane perspective. The coordinate system follows that designated in the real scale dialog.



**2D-6DOF + changing perspectives.** Calculate the 6DOF movement from the perspective plane. The coordinate system follows that designated in the perspectives transform dialog.

- **2D-6DOF Quick Start**

The procedure for calculating 2D-6DOF is as follows.

(a) **Photographic Phase**

(1) **Position Coordinate Measurement for Target Points**

Measure the position coordinates for the target points on the rigid body for the 6DOF measurement. Use the right-hand coordinate system. Specify positions where the positional relationship on the target points is unknown. We recommend places on the image that are easy to identify (locations with angles or well-defined shapes).

We do not recommend areas that are poorly lighted or that are hard to see due to noise. Also, we do not recommend reflective areas such as metallic surfaces or overexposed areas because they are hard to see.

(2) **Create a 6DOF reference coordinate file (refer to p. エラー! ブックマークが定義されていません。)**

Enter the coordinate values for the measured target points to the file and create a 6DOF reference coordinates file. Use the target names given here and match them with the tracking points.

(3) **Filming**

Film so that there are 4 or more target points filmed. If there aren't enough, add target points or change the camera setup. If using real scale conversion to perform 2D-6DOF measurement, don't forget to measure the true length of the reference line segments (refer to p. 5-5) and the reference plane depth (refer to p. エラー! ブックマークが定義されていません。).

(b) **Analysis Phase**

(1) **Create a 2D project**

(2) **Track each measurement point**

If setting up tracking points on target points, change the name of the target points assigned during filming. Perform 6DOF calculations for the points corresponding to the names. It is not necessary to track all of the target points but 6DOF calculations cannot be performed on frames with fewer than 4 tracked points.

(3) **2D calibration**

(3-1) **Real Scale Conversion**

Set the true length, the axis and the starting point in the same manner as with standard real scale conversion.

With 6DOF measurements, make sure to also set the reference plane depth (refer to p. エラー! ブックマークが定義されていません。).

(3-2) **Changing Perspectives**

Perform in the same manner as when changing perspectives normally (p. エラー! ブックマークが定義されていません。).

(c) **File Output**

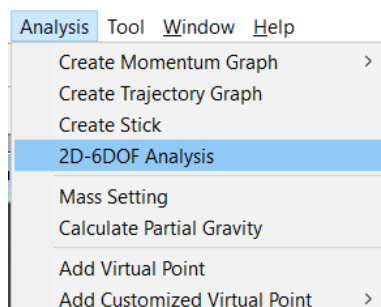
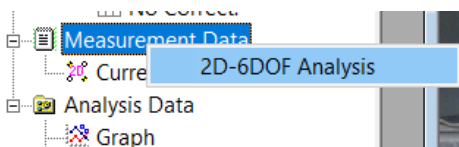
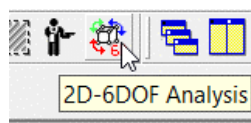
(1) **Show measurement results**

(2) **Output file of 2D-6DOF calculated values.**

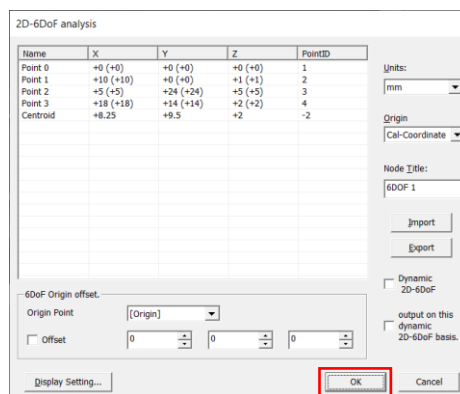
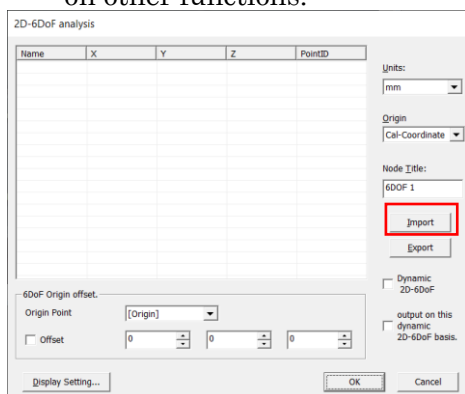


#### (d) Create 6DOF Node

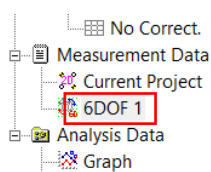
Use any of the following and the 2D-6DOF analysis dialog will appear.



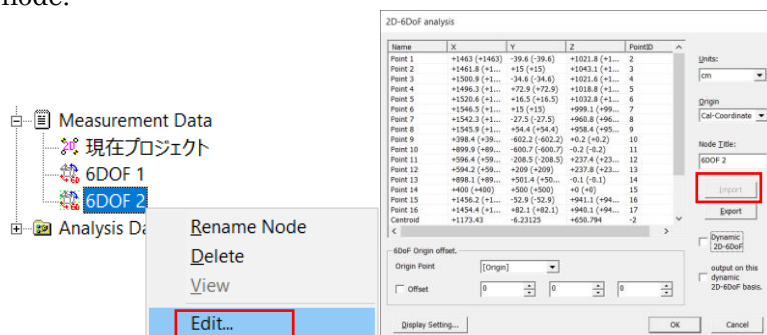
Import the 6DOF reference coordinates file created in the filming phase (a) - (2) with the [2D-6DOF analysis] dialog. Set the units in import. Refer to p. 10—45 for details on other functions.



Click OK once the import is done and a 6DOF node will be created under the measurement node.



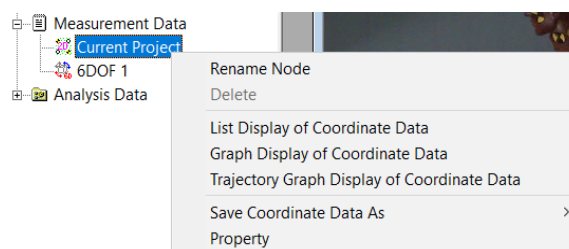
Note: After creating a 6DOF node, when you right-click and select Edit to open the 2D-6DOF analysis dialog, the [Import] button will be disabled, and you will not be able to re-import the reference coordinate file and re-analyze. To re-import, create a new 6DOF node.



## (e) 6DOF Analysis

Once the 6DOF calculations here have been completed properly, the 6DOF measurement results can be used.

The 6DOF list display, graph display and trajectory display are available with the right click menu of the [Current Project] node.



## (5-1) List Display of the Coordinate Data

Displays the 6 elements of the rigid body with the 6DOF analysis as well as the 3D calculated coordinates for each measurement point.

The 6DOF measurement results can be saved to a file from a CSV export or from saved 6DOF measurement results.

## (5-2) Graph Display of the Coordinate Data

Displays the analysis graph dialog. Displays the 3D calculated coordinates for each measurement point. Calculates the 3D acceleration for each measurement point so the physical quantities (length/angle etc.) combined with the normal measurement points can be calculated.

## (5-3) Display of the Trajectory Figure

Displays a 3D trajectory figure for each measurement point. Also, the position and attitude of the 6DOF measurement results can be displayed on the trajectory figure (ver. 3.13 or later).

## ● Dynamic 2D-6DOF [ver3.12 or later]

Performs 2D-6DOF while calibrating. 2D calibration has functions for dynamic origin and axis in the 2D-6DOF version.

Note: Since only these 2D-6DOF results can be calculated with this coordinate system, please use caution when comparing with other tracking results.

### (a) Use

#### 1. Filming

When photographing 2D-6DOF measurements, the reference coordinate system with 6 or more points is simultaneously photographed.

Note: Processing is performed in the same manner as with 3D calibration. Calculations for only points on a plane or straight-line fail. Use points positioned three-dimensionally. If arranged with a 3D calibration chart, it is easy to film these together Refer to the figure on the next page.

#### 2. Tracking

Create a project and all the 6DOF targets and dynamic 2D-6DOF reference points are tracked.

Don't forget to track all frames of the dynamic 2D-6DOF reference points.

#### 3. Calculations by MOVIAS Neo

##### (3-1)

Loads 6DOF measurement targets and coordinates for the reference points to a single file as the reference coordinate system.

##### (3-2)

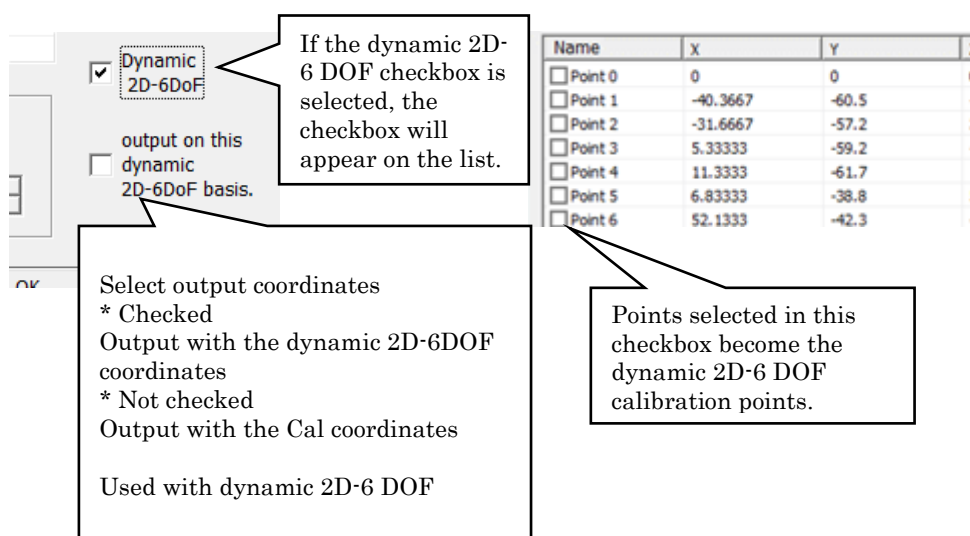
Check [Dynamic 2D-6DOF] in the [2D-6DOF Analysis Dialog] to display the checkbox in the list. Check the points in the list to be used as reference points. Select 6 or more points.

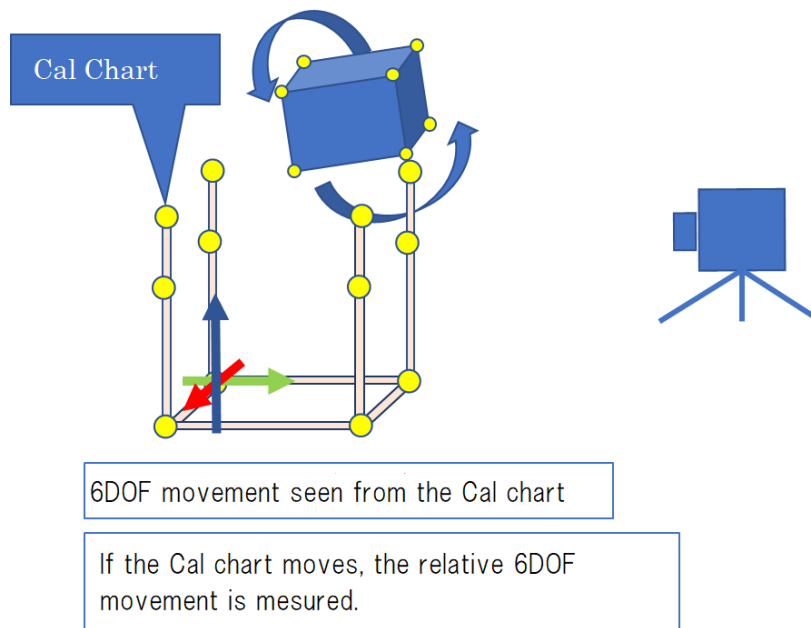
Check [output on this dynamic 2D-6DOF basis.] (Select Coordinates)

Select the output coordinates. If not checked, the 2D calibration coordinates are output. If checked, calculations are made with the calibration coordinates used for dynamic 2D-6DOF.

Compared to output with other devices, it is convenient to check this.

The dynamic 2D-6DOF results can be used now.





**Dynamic 2D-6DOF.** 6DOF movement seen from the Cal chart is measured. If the Cal chart moves, the relative 6DOF movement is measured. This is used for 6DOF measurements in oscillating environments.

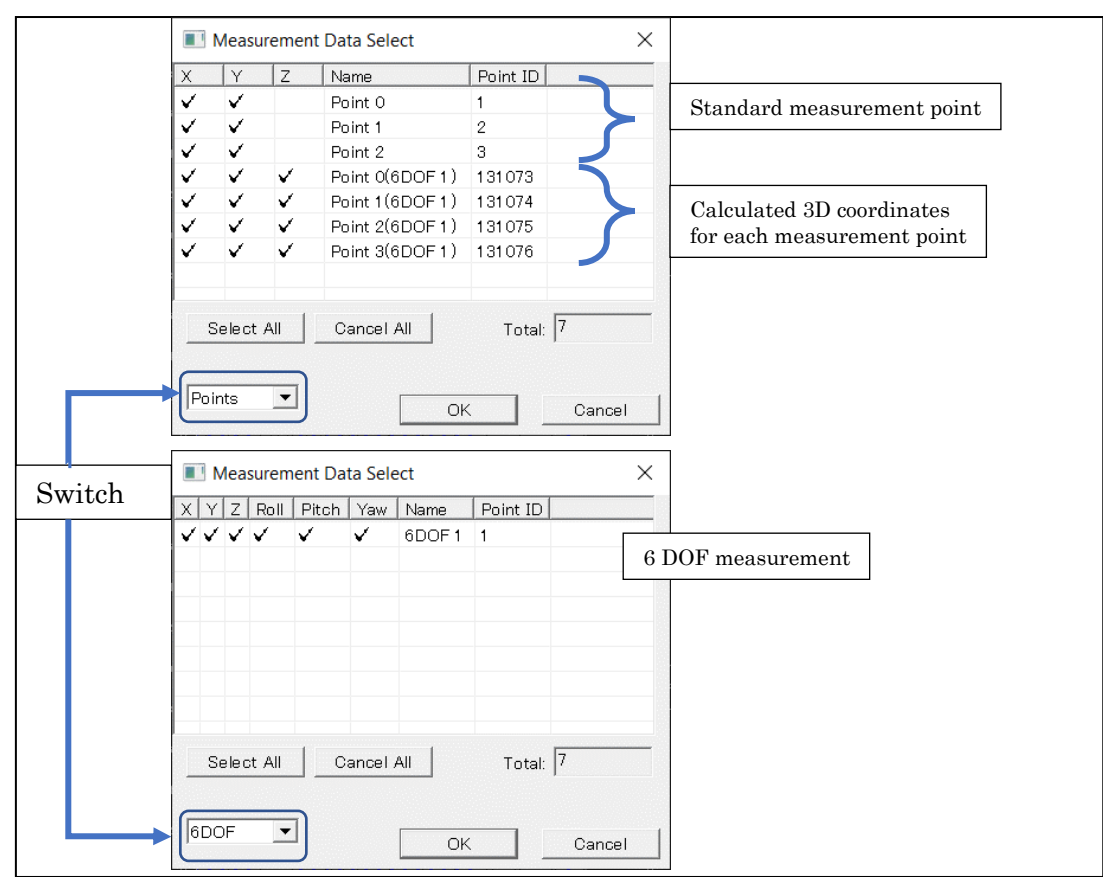
10.3.2 2D-6DOF Data Operation Method

● 6DOF Measurement Results

6DOF analysis is possible on multiple rigid bodies. The measurement results (6DOF measurement values, calculated 3D coordinates for each measurement point) are added to the measurement data.

(a) Confirming the Measurement Results

Displayed on the list of measurement data or on a graph.  
Displayed under the standard measurement points on the selection dialog. Points where a name has been assigned as the 2D-6DOF object name are calculated 3D coordinates for each measurement point.



The figure above shows the [Measurement Point Selection Dialog] for 6DOF measurements. You can set it to switch between the measurement points and the 6DOF coordinates. If the combo box [6DOF] is selected, you can set it to switch the display for each 6DOF measurement results.

(i) List Display for the 6DOF Measurement Results

Measurement Points				6 DOF Measurement Points						Calculated 3D coordinates for each measurement point		
F-Seq	Point 3 X(mm)	Point 3 Y(mm)	Point 3 Z(mm)	6DoF 1 6DoF-Roll	6DoF 1 6DoF-Pitch	6DoF 1 6DoF-Yaw	6DoF 1 6DoF-X	6DoF 1 6DoF-Y	6DoF 1 6DoF-Z	Point 3(6DoF 1) X(mm)	Point 3(6DoF 1) Y(mm)	Point 3(6DoF 1) Z(mm)
-2.000	-165.958	578.433	0.000	-1.048	1.410	-1.677	0.000	0.000	2225.626	-61.346	-70.958	2241.349
-1.000	-148.803	578.333	0.000	-1.045	1.404	-1.681	0.000	0.000	2487.379	-61.387	-70.935	2503.044
0.000	-131.593	578.236	0.000	-1.025	1.373	-1.705	0.000	0.000	2773.409	-61.852	-70.675	2788.408
1.000	-114.273	578.193	0.000	-1.017	1.361	-1.714	0.000	0.000	3080.721	-62.010	-70.593	3095.451
2.000	-97.267	578.090	0.000	-1.019	1.363	-1.711	0.000	0.000	3406.403	-61.937	-70.650	3421.168
3.000	-80.109	577.998	0.000	-1.020	1.365	-1.708	0.000	0.000	3753.737	-61.834	-70.739	3768.505
4.000	-62.655	577.842	0.000	-1.025	1.366	-1.706	0.000	0.000	4126.280	-61.645	-70.857	4141.272
5.000	-45.661	577.685	0.000	-1.022	1.363	-1.705	0.000	0.000	4529.620	-61.618	-70.939	4544.333
6.000	-28.440	577.704	0.000	-1.003	1.333	-1.729	0.000	0.000	5010.342	-62.061	-70.658	5024.532

The figure above shows the measurement list for [6DOF measurement results]. The standard measurement points, 6DOF measurement results, and the calculated 3D coordinates for each measurement point are all displayed.

6 DOF measurement results, 6 elements for a single 6 DOF measurement target								
Point 3 X(mm)	Point 3 Z(mm)	6DoF 1 6DoF-Roll	6DoF 1 6DoF-Pitch	6DoF 1 6DoF-Yaw	6DoF 1 6DoF-X	6DoF 1 6DoF-Y	6DoF 1 6DoF-Z	Point 3(6DoF 1) X(mm)
433	0.000	-1.048	1.410	-1.677	0.000	0.000	2225.626	-61.346
333	0.000	-1.045	1.404	-1.681	0.000	0.000	2487.379	-61.387
236	0.000	-1.025	1.373	-1.705	0.000	0.000	2773.409	-61.852
193	0.000	-1.017	1.361	-1.714	0.000	0.000	3080.721	-62.010
090	0.000	-1.019	1.363	-1.711	0.000	0.000	3406.403	-61.937
998	0.000	-1.020	1.365	-1.708	0.000	0.000	3753.737	-61.834
842	0.000	-1.025	1.366	-1.706	0.000	0.000	4126.280	-61.645
685	0.000	-1.022	1.363	-1.705	0.000	0.000	4529.620	-61.618
704	0.000	-1.003	1.333	-1.729	0.000	0.000	5010.342	-62.061

6 DOF measurement results rotation elements (Roll, Pitch, Yaw)

6 DOF measurement results movement elements (X, Y, Z)

The figure above shows the 6DOF measurements on the measurement list. 6 elements are shown for a single measurement target. With 3 rotation elements and 3 movement elements, they total 6 elements.

6 DOF measurement coordinates

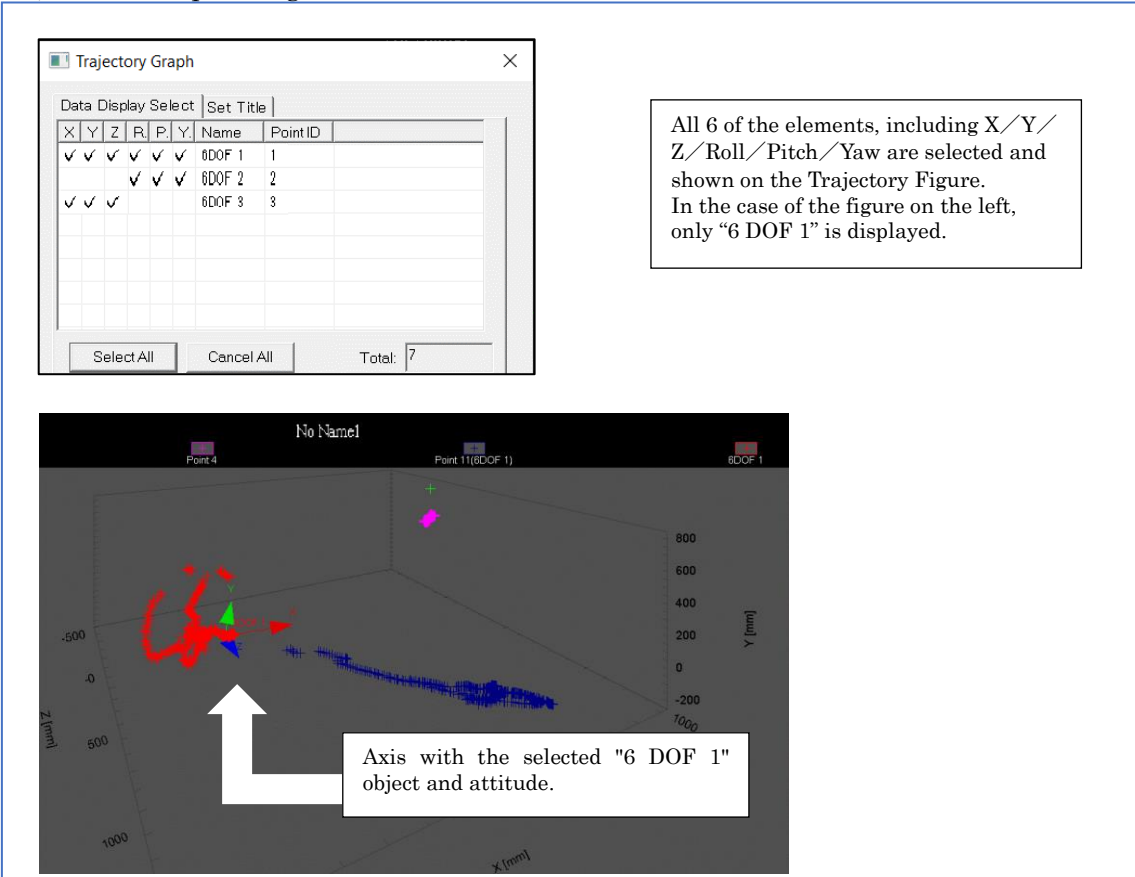
Point 3(6DOF 1) X(mm)	Point 3(6DOF 1) Y(mm)	Point 3(6DOF 1) Z(mm)
-61.346	-70.958	2241.349
-61.387	-70.935	2503.044
-61.852	-70.675	2788.408
-62.010	-70.593	3095.451
-61.937	-70.650	3421.168
-61.834	-70.739	3768.505
-61.645	-70.857	4141.272
-61.618	-70.939	4544.333
-62.061	-70.658	5024.532

6 DOF node name assigned to the point.

The figure above shows the calculated 3D coordinates for each measurement point on the measurement list. The 2D coordinates can be differentiated by the 2D-6DOF object name.

**(ii) Show Trajectory Figure of the 6DOF Measurement Results**

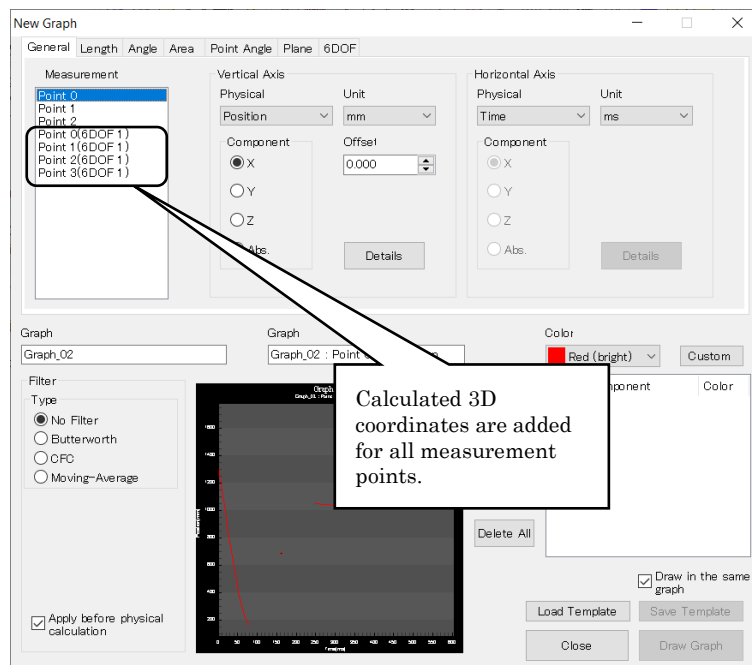
Use the create trajectory figure dialog to select the 6DOF measurements to be displayed on the trajectory figure. If the 2D-6DOF object trajectory is selected on the trajectory figure, the axis expressing the attitude is shown.



On the 6DOF page of the [Create Trajectory Figure Dialog], the 6DOF objects checked for all elements (XYZ, roll, pitch, and yaw) are displayed on the trajectory figure. When the trajectory figure is drawn, if the 6DOF objects are selected, the axis expressing the attitude is also shown (ver. 3.13 or later).

## (b) Use for Analysis Results

Calculated 3D coordinates for each measurement point are added to the create new graph dialog. An analysis graph using these points can be created.



Calculated 3D coordinates for each measurement point are added to the list of measurement points for the analysis (general, length, angle, and area) using the measurement points from the create new graph dialog.

Analysis can also be performed combining the standard measurement points with the calculated 3D coordinates for each measurement point.

Note: Different from the standard measurement points.

Standard measurement points are the coordinates from subjecting the tracking results to real scale conversion or changing perspectives. On the other hand, the calculated 3D coordinates for each measurement point are the coordinates calculated from the rigid body motion, and the length, angle and area of a single body are constant.

Note: The calculated 3D coordinates for each measurement point are 3D coordinates while the standard measurement points are 2D coordinates. If angles are compared or distances calculated, there may be differences in the distances or angles seen on the image.

Note: 6DOF calculations can be made using the 2D calibration movement origin and axis. However, tracking is possible on the XY plane, but tracking is not possible for the movement in the Z direction. If performing 6DOF measurements combining these, be careful of the activity. This is not a perfect relative coordinate system.

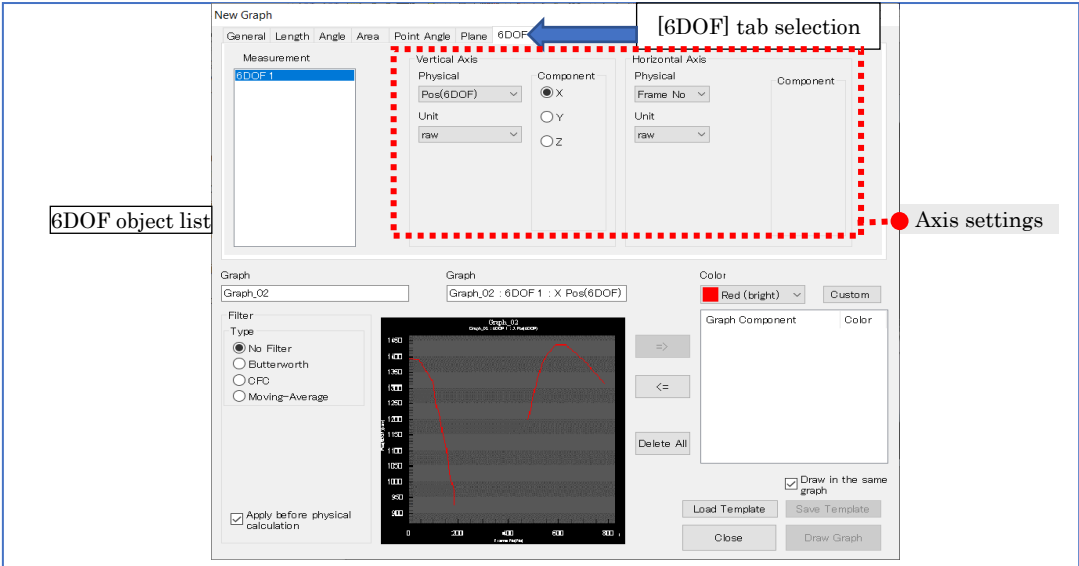


(i) 6DOF Analysis Graphs [ver.3.13 or later]

An analysis graph can be displayed of the XYZ, roll, pitch, and yaw values from the 6DOF measurement results.

● [6DOF] Tab

(a) Basic Operation



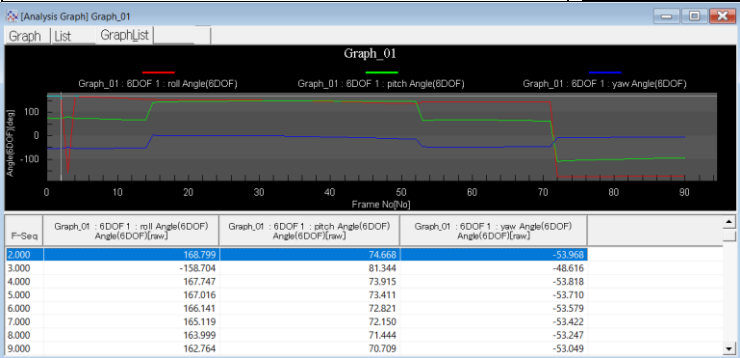
List of measurement points: Select the 6DOF object to be used for calculations.  
Graph horizontal axis and Graph vertical axis: Graph settings.

Create a graph showing the 6DOF calculation results. The units are only raw (units for 6DOF calculations).

(b) Physical Quantities

(i) POS (6DOF)

Create a graph of the location elements (X, Y, and Z) for the 6DOF measurement results.	Physical Quantities	POS (6DOF)
	Units	raw
	Elements	X, Y, Z



(ii) ANGLE (6DOF)

Create a graph of the attitude elements (roll, pitch, and yaw) for the 6DOF measurement results.

Physical Quantities

Unitsraw

Elementsroll, pitch, yaw

[Analysis Graph] Graph\_01

Graph | List | GraphList

Graph\_01

Graph\_01 : 6DOF 1 : roll Angle(6DOF)

Graph\_01 : 6DOF 1 : pitch Angle(6DOF)

Graph\_01 : 6DOF 1 : yaw Angle(6DOF)

Angle(6DOF)[raw]

Frame No[10]

F-Seq	Graph_01 : 6DOF 1 : roll Angle(6DOF) Angle(6DOF)[raw]	Graph_01 : 6DOF 1 : pitch Angle(6DOF) Angle(6DOF)[raw]	Graph_01 : 6DOF 1 : yaw Angle(6DOF) Angle(6DOF)[raw]
2,000	168.799	74.668	-53.968
3,000	-158.704	81.344	-48.616
4,000	167.747	73.915	-53.818
5,000	167.016	73.411	-53.710
6,000	166.141	72.821	-53.579
7,000	165.119	72.150	-53.422
8,000	163.999	71.444	-53.247
9,000	162.764	70.709	-53.049

ANGLE (6DOF)

Elements are sorted and displayed depending on setting of deconstruction method for 3D angles (Euler).

Example: YXZ

Component

☒ pitch

☐ yaw

☐ roll

ZXY

Component

☒ yaw

☐ roll

☐ pitch

[v3.13 or later] The analysis graph series is displayed in the order in which the components are selected/added.

Example:

XYZ

roll(red), pitch(green), yaw(blue)

[Analysis Graph] Graph\_02

Graph | List | GraphList

Graph\_02

Graph\_02 : 6DOF 1 : roll Angle(6DOF)

Graph\_02 : 6DOF 1 : pitch Angle(6DOF)

Graph\_02 : 6DOF 1 : yaw Angle(6DOF)

Angle(6DOF)[raw]

Frame No[10]

ZXY

yaw(red), roll(green), pitch(blue)

[Analysis Graph] Graph\_03

Graph | List | GraphList

Graph\_03

Graph\_03 : 6DOF 1 : yaw Angle(6DOF)

Graph\_03 : 6DOF 1 : roll Angle(6DOF)

Graph\_03 : 6DOF 1 : pitch Angle(6DOF)

Angle(6DOF)[raw]

Frame No[10]

Note: After creating a graph using analysis data, set the 3D angle decomposition method (XYZ, XZY, ...). If you change the 3D angle decomposition method, the series name of analysis graph remains the same as when it was created. It is recommended to recreate the analysis graph.

Example: List of Analysis Graphs

When created with "YZX" settings After that, when changed to "XYZ" settings

[Analysis Graph] Graph\_07

Graph | List | GraphList

Graph\_07

Graph\_07 : 6DOF 1 : roll Angle(6DOF) Angle(6DOF)[raw]

Graph\_07 : 6DOF 1 : pitch Angle(6DOF) Angle(6DOF)[raw]

Graph\_07 : 6DOF 1 : yaw Angle(6DOF) Angle(6DOF)[raw]

F-Seq	Graph_07 : 6DOF 1 : roll Angle(6DOF) Angle(6DOF)[raw]	Graph_07 : 6DOF 1 : pitch Angle(6DOF) Angle(6DOF)[raw]	Graph_07 : 6DOF 1 : yaw Angle(6DOF) Angle(6DOF)[raw]
2,000	-168.562	140.216	-20.932
3,000	-168.483	140.178	-20.970
4,000	-168.333	140.115	-21.030
5,000	-168.147	140.014	-21.110

[Analysis Graph] Graph\_08

Graph | List | GraphList

Graph\_08

Graph\_08 : 6DOF 1 : roll Angle(6DOF) Angle(6DOF)[raw]

Graph\_08 : 6DOF 1 : pitch Angle(6DOF) Angle(6DOF)[raw]

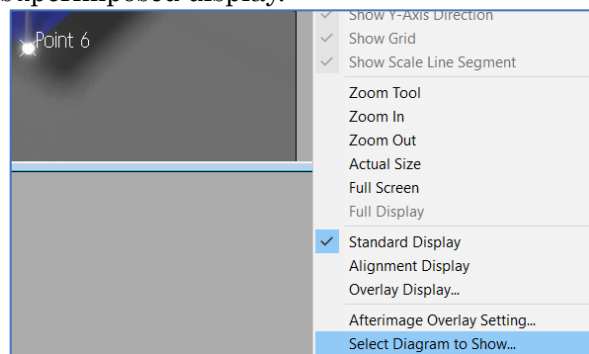
Graph\_08 : 6DOF 1 : yaw Angle(6DOF) Angle(6DOF)[raw]

F-Seq	Graph_08 : 6DOF 1 : roll Angle(6DOF) Angle(6DOF)[raw]	Graph_08 : 6DOF 1 : pitch Angle(6DOF) Angle(6DOF)[raw]	Graph_08 : 6DOF 1 : yaw Angle(6DOF) Angle(6DOF)[raw]
2,000	-14.653	-43.930	-168.799
3,000	-14.776	-43.930	-168.841
4,000	-14.989	-43.132	-168.939
5,000	-15.261	-43.281	-169.067

## (c) Superimposed Display of the 2D-6DOF Results

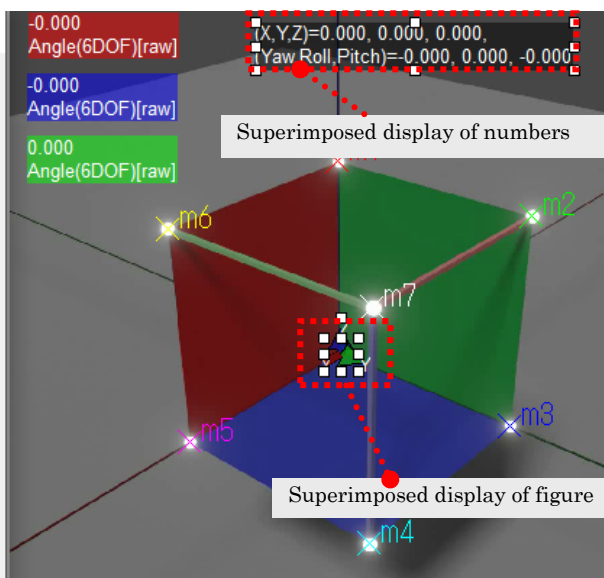
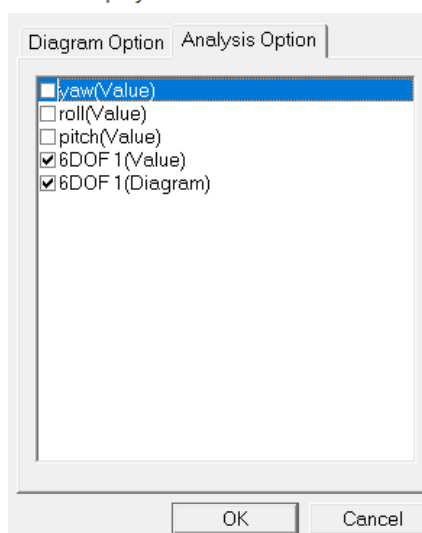
The 2D-6DOF results can be displayed as part of an annotation figure.

Select [Select Diagram to Show] from the right click menu for the image to open the select display dialog. Select the 6DOF number or figure from the select analysis tab for superimposed display.



[Select Diagram to Show] menu

Select Display



Select superimposed display for 6DOF results.

With a numerical superimposed display, the 6 elements (X, Y, Z, Roll, Pitch, and Yaw) of the 2D-6DOF calculations are displayed.

(X,Y,Z)=X value, Y value, Z value

(Roll,Pitch,Yaw)=Roll value, Pitch value, Yaw value

Note: The order of (Roll,Pitch,Yaw) values differs depending on the version of MOVIAS Neo. [v3.24 or later] Automatically sorted by current settings of 3D angle decomposition method (XYZ, XZY, ...) can be obtained. [v3.13~v3.23] The order of Roll, Pitch, Yaw is fixed.

With a diagram superimposed display, the arrows for the 3 axes are shown superimposed on the starting point location (0.0,0.0,0.0) of the rigid body subject to 6DOF measurements. The red arrow is the X axis direction, the green arrow is the Y axis, the blue arrow is the Z axis, and the attitude for each of the 6DOF measurement targets is expressed. Also, the movement trajectory of the rigid body is displayed.

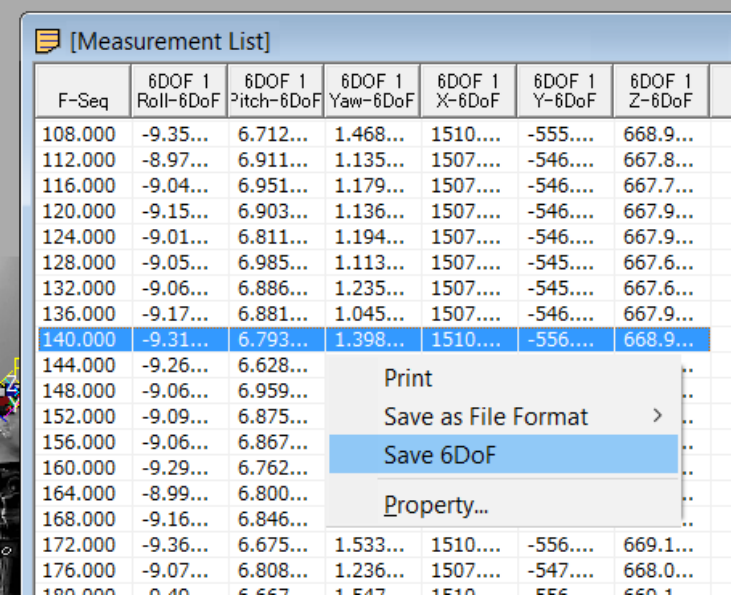
Note: The superimposed display of 3-axis arrow shapes is not reflected even if the 3D angle resolution method (XYZ, XZY, ...) is changed.

(d) Export File

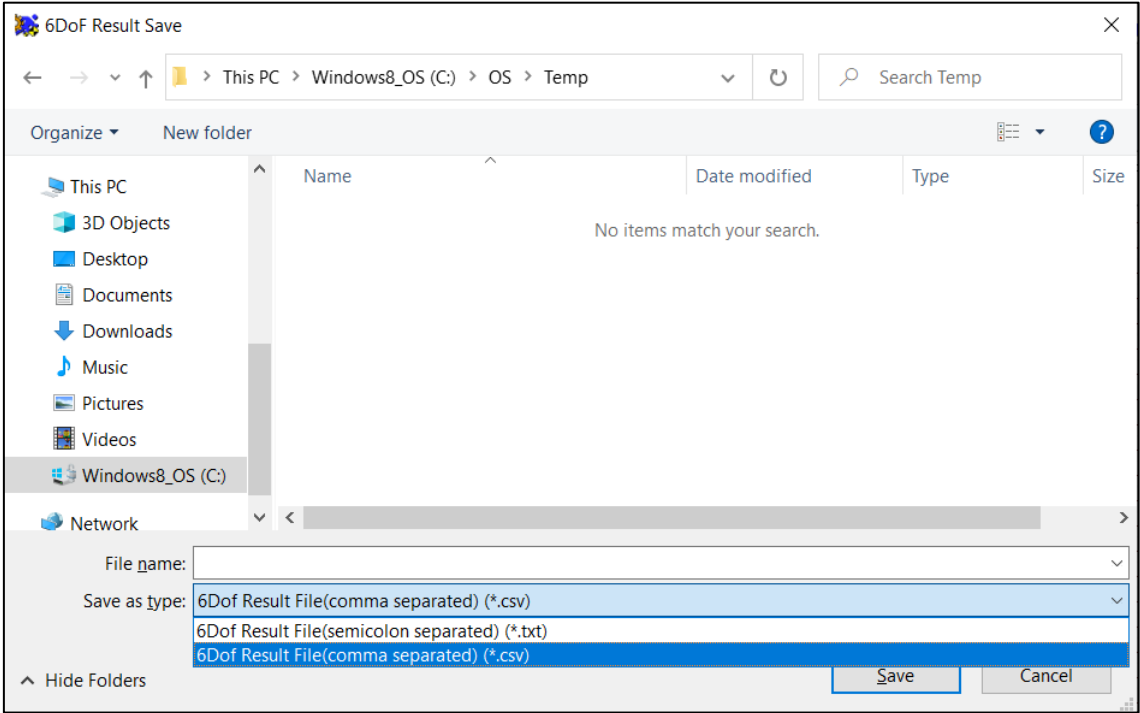
(i) Export File of the2D-6DOF Calculations.

First, access [Display List of 6DOF Measurement Results] to display the contents to be exported.

Select [Save 6DOF] from the right click menu on the list. The save dialog will appear so select the destination and save. Select a semicolon (;) or comma (,).



[Save 6DOF] menu



[6DOF Result Save] dialog

## (ii) Contents of the Export File for 2D-6DOF Calculations

CSV file constructed from 1 header row + data. Select a semicolon (;) or comma (,).

\$ Header Part

The first row of the file is fixed at

#Time;X;Y;Z;Roll;Pitch;Yaw;m00;m01;m02;m10;m11;m12;m20;m21;m22.

Since v3.24, depending on the setting of 3D angle decompose (XYZ, XZY, ...) in the angle unit of the output tab of the project information, the part of "Roll;Pitch;Yaw" sorted and output. Fixed to "Roll;Pitch;Yaw;" from v3.13 to v3.23.

Example: Since v3.24, for ZXY setting

#Time;X;Y;Z;Yaw;Roll;Pitch;m00;m01;m02;m10;m11;m12;m20;m21;m22

\$ Data Part

\$ \$ The first row is time. Milliseconds.

\$ \$ Subsequent rows are the data for each of the 6DOF objects.

There are 15 values for a single object.

The order from the left is (X coordinate, Y coordinate, and Z coordinate), (Roll value, Pitch value, and Yaw value), (with 3x3 rotation matrix shown, there are 9 elements).

The units for angles are as set. (ex. degree or radian)

### Roll, Pitch, Yaw:

The ranges for Roll, Pitch, Yaw are as follows.

$$-180^\circ < \theta_{\text{roll}} \leq 180^\circ, -90^\circ \leq \theta_{\text{pitch}} \leq 90^\circ, -180^\circ < \theta_{\text{yaw}} \leq 180^\circ$$

The final attitude is calculated as  $\mathbf{R} = \mathbf{R}_x(\theta_{\text{roll}})\mathbf{R}_y(\theta_{\text{pitch}})\mathbf{R}_z(\theta_{\text{yaw}})$ .

The rotation matrix is as follows.

$$\mathbf{R}_x(\theta) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{pmatrix}$$

$$\mathbf{R}_y(\theta) = \begin{pmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{pmatrix}$$

$$\mathbf{R}_z(\theta) = \begin{pmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Note: This is the same format as the simple 6DOF measurement results.

m00;m01;m02;m10;m11;m12;m20;m21;m22 part

Each element for a matrix of 3 rows and 3 columns.

$$\text{Rotation Matrix} = \begin{bmatrix} m00 & m01 & m02 \\ m10 & m11 & m12 \\ m20 & m21 & m22 \end{bmatrix}$$

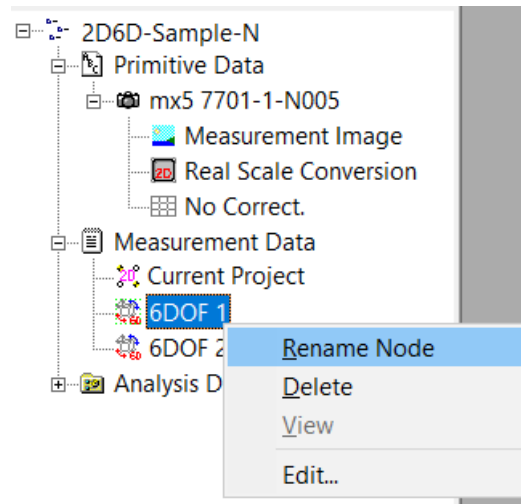
has this arrangement.

### 10.3.3 2D-6DOF GUI

- **Right Click Menu**

Perform the following using the right click menu (figure on the right) of the 2D-6DOF object node.

- **Change Node Name**  
Changes the name of the 2D-6DOF object.
- **Delete**  
Deletes the selected graph node and its 6DOF analysis results.
- **Edit**  
Displays the [2D-6DOF Analysis Dialog p. 10–45] so the settings can be edited.



## 2D-6DOF Analysis Dialog

Make the 6DOF settings and the graph settings using this dialog.  
Set the following items.

- ✓ Load and edit [Reference Points]
- ✓ 6DOF node name
- ✓ Coordinate units (mm/cm/m)
- ✓ 6DOF starting point settings
  - Reference points
  - Offset
- ✓ Drawing settings
- ✓ (Dynamic2D-6DOF)

After finishing, the 6DOF node is added at the bottom of the [Current Project] node.

2D-6DoF analysis

Name	X	Y	Z	PointID
<input type="checkbox"/> Point 0	-2.27043 (+0)	-162.606 (+0)	+33.1125 (+0)	-1
<input type="checkbox"/> Point 3	+55.0062 (+...	+19.3903 (+...	+52.5082 (+...	4
<input type="checkbox"/> Point 4	-0.133757 (+...	+44.345 (+2...	+61.7947 (+...	-1
<input type="checkbox"/> Point 5	-55.5735 (-5...	+20.9123 (+...	+52.4144 (+...	11
<input type="checkbox"/> Point 7	+72.9333 (+...	-76.8853 (+8...	-6.50323 (-3...	-1
<input type="checkbox"/> Point 8	+81.6334 (+...	-34.4969 (+1...	+14.4346 (-1...	1
<input type="checkbox"/> Point 9	+74.6365 (+...	+14.1495 (+...	+10.6584 (-2...	2
<input type="checkbox"/> Point 10	+27.5599 (+...	+62.3717 (+...	+8.94793 (-2...	6
<input type="checkbox"/> Point 11	-26.9378 (-2...	+62.9753 (+...	+8.9145 (-24...	8
<input type="checkbox"/> Point 12	-70.0134 (-6...	+25.0973 (+...	-0.849734 (-...	10
<input type="checkbox"/> Point 13	-83.7609 (-8...	-32.3714 (+1...	+14.3075 (-1...	-1
<input type="checkbox"/> Point 14	-72.5444 (-7...	-87.0624 (+7...	-1.95657 (-3...	-1
<input type="checkbox"/> Point 15	+71.24 (+73...	+1.17986 (+...	-47.8941 (-8...	3
<input type="checkbox"/> Point 16	+47.5087 (+...	+40.4886 (+...	-49.8403 (-8...	5
<input type="checkbox"/> Point 17	+0.289051 (...)	+57.9136 (+...	-52.143 (-85...	7

Units: mm

Origin: Cal-Coordinate

Node Title: 6DOF 1

Import

Export

☒ Dynamic 2D-6DoF

☒ output on this dynamic 2D-6DoF basis.

6DoF Origin offset.

Origin Point: [Centroid]

☐ Offset: 32 0 0

Display Setting...

OK Cancel

2D-6DOF dialog. Click OK to create.

- [Units] combo box  
Select the units for the coordinates.
- [Reference] combo box  
Set the standards for the 6DOF results to be calculated.  
[Cal coordinate system]: Calculate the position • attitude viewed from the calibration coordinate system.  
[Top frame]: Calculate the relative position • attitude from the position and attitude of the top frame.  
[T0 frame]: Calculate the relative position • attitude from the position and attitude of the T0 frame.
- [Node name] edit box  
Set the name of the 6DOF node. Use a unique name.
- [Import] button  
Select the 6DOF reference coordinate file to load those coordinates.

- [Export] button  
Save the currently displayed coordinates to a 6DOF reference coordinates file.
- [Draw Settings] button  
Switch the trajectory display for the starting point of the rigid body with 6DOF measurements ON/OFF and set the colors of the trajectory lines and the trajectory display range (around a certain frame).
- [Dynamic 2D-6DOF] checkbox  
Enables 2D-6DOF. If checked, a check will appear in the [Reference Point List]. Points checked here will be used as calibration points for the dynamic 2D-6DOF.
- [output on this dynamic 2D-6DoF basis.] checkbox (Select Coordinates)  
Select the output coordinates. If not checked, the 2D calibration coordinates are output. If checked, calculations are made with the calibration coordinates used for dynamic 2D-6DOF.  
Compared to output with other devices, it is convenient to check this.

If the dynamic 2D-6 DOF box is checked, the checkbox appears on the list.

Select output coordinates  
\* Checked  
Output with the dynamic 2D-6DOF coordinates  
\* Not checked  
Output with the Cal coordinates  
Used with dynamic 2D-6DOF

Name	X	Y	Z
<input type="checkbox"/> Point 0	-2.27043 (+0)	-162.606 (+0)	
<input type="checkbox"/> Point 3	+55.0062 (+...	+19.3903 (+...	
<input type="checkbox"/> Point 4	-0.133757 (+...	+44.345 (+2...	
<input type="checkbox"/> Point 5	-55.5735 (-5...	+20.9123 (+...	
<input type="checkbox"/> Point 7	+72.9333 (+...	-76.8853 (+8...	
<input type="checkbox"/> Point 8	+81.6334 (+...	-34.4969 (+1...	

Points selected with this checkbox become the dynamic 2D-6 DOF calibration points.

- 6DOF Starting Point  
Input auxiliary function for the reference coordinates. This is a function to apply the offset batch to the 2D-6DOF reference coordinates.

2D-6DoF analysis

Name	X	Y	Z	PointID
<input type="checkbox"/> Point 0	-2.27043 (+0)	-162.606 (+0)	+33.1125 (+0)	-1
<input type="checkbox"/> Point 3	+55.0062 (+...	+19.3903 (+...	+52.5082 (+...	4
<input type="checkbox"/> Point 4	-0.133757 (+...	+44.345 (+2...	+61.7947 (+...	-1
<input type="checkbox"/> Point 5	-55.5735 (-5...	+20.9123 (+...	+52.4144 (+...	11
<input type="checkbox"/> Point 7	+72.9333 (+...	-76.8853 (+8...	-6.50323 (-3...	-1
<input type="checkbox"/> Point 8	+81.6334 (+...	-34.4969 (+1...	+14.4346 (-1...	1
<input type="checkbox"/> Point 9	+74.6365 (+...	+14.1495 (+...	+10.6584 (-2...	2
<input type="checkbox"/> Point 10	+27.5599 (+...	+62.3717 (+...	+8.94793 (-2...	6
<input type="checkbox"/> Point 11	-26.9378 (-2...	+62.9753 (+...	+8.9145 (-24...	8

Units: mm

Origin: Cal-Coordinate

Node Title: none 1

Original coordinates and offset coordinates

6DOF origin point settings area

6DOF Origin offset

Origin Point: [Centroid]

Select reference points combo box

Specify the Offset

Offset: 32 0 0

Display Setting...

OK Cancel

The [6DOF starting point] area is below the list. The settings for the starting point offset are made here. The value after applying the offset and the original value is shown on the list.



## ● [Contents of the List Display]

Two numbers are shown in a single cell. The [import] value is shown in parenthesis and the value is that input by manually editing the CELL. The value on the left side is the value after offset application.

When manually editing the value, the value in parenthesis is editing.

The value for the [centroid] is shown at the very bottom. These coordinate values are the values that are used when the centroid is selected in the combo box as the reference point.

Values on the left are the values are being offset

Values in parenthesis are the originals

Name	X	Y	Z	
<input type="checkbox"/> Point 0	-2.27043 (+0)	-162.606 (+0)	+33.1125 (+0)	Units: mm  Origin
<input type="checkbox"/> Point 3	+55.0062 (-57.2767)	+19.3903 (+181.996)	+52.5002 (+19.3958)	
<input type="checkbox"/> Point 4	-0.133757 (-2.136...)	+44.345 (+206.951)	+61.7947 (+28.6822)	
<input type="checkbox"/> Point 5	-55.5735 (-3.3031)	+20.9123 (+183.518)	+52.4144 (+19.3019)	
<input checked="" type="checkbox"/> Point 16	+49.7792	+203.094	-82.9527	6DOF 1  Imp  Exp
<input checked="" type="checkbox"/> Point 17	+2.55949	+220.52	-85.2555	
<input checked="" type="checkbox"/> Point 18	-45.1166	+204.309	-83.0252	
<input checked="" type="checkbox"/> Point 19	-69.9156	+165.502	-81.1057	
<input type="checkbox"/> Centroid	+8.91404	+157.413	-10.4089	

Coordinates for the center of gravity are shown at the very bottom of the list

Values shown on the list. Both the value after offset and the original values are shown. Coordinates for the [centroid] are shown at the very bottom.

Select reference points combo box

- ✓ Reference Coordinates System
  - The reference coordinates input is used without being changed.
- ✓ Centroid
  - Parallel transport of all points so the center of gravity of the input reference coordinates is (0,0,0).
  - With [dynamic 2D-6DOF], the center of gravity for the measurement points (the center of gravity for the points not checked on the list) is used. To check the current coordinates for the center of gravity, look at the [Centroid] coordinates at the very bottom of the list.
- ✓ Select Measurement Points
  - Parallel transport of all points so the coordinate of the designated point is (0,0,0).

Specify the Offset

If [Offset] is checked, the coordinates specified are calculated with the coordinate system added. If not checked, these offset values are not used.

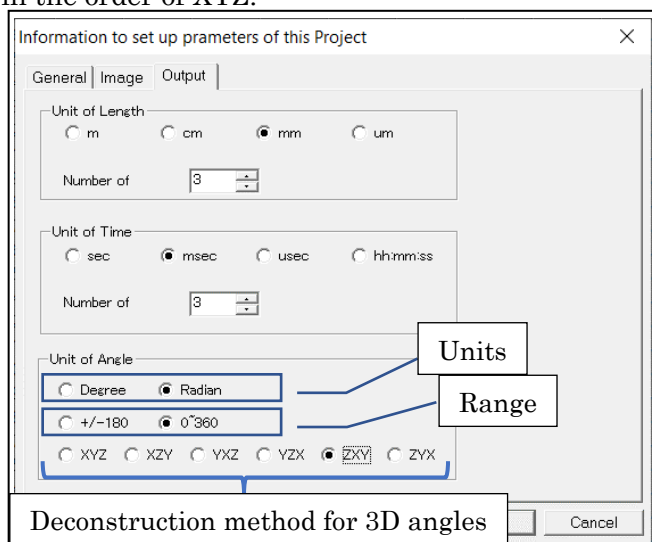
## ● [Display Settings]

Make the 6DOF display settings from the [Output] tab in the [Information to set up parameters of this Project] dialog.

Range: Display in a range of  $\pm 180^\circ$  (Default) or display in angles from  $0 \sim 360^\circ$ .

Units: Radian display or displayed in degrees (Default).

XYZ~ZYX: Deconstruction method for 3D angles. (Euler) The default is deconstruction in the order of XYZ.



Setting for displaying angles. Set the unit, range, and deconstruction method.

Note: [Since v3.24] After changing for Deconstruction method for 3D angles, the value may not match the existing series (item name) in the analysis trajectory diagram. It is recommended to recreate the analysis graph.

Example: List of analysis trajectory graph

Example: Create graph with ZYX -> Update to XYZ

[Analysis Trajectory Graph] No Name1						[Analysis Trajectory Graph] No Name1					
6DOF 1 Yaw-6DoF	6DOF 1 Pitch-6DoF	6DOF 1 Roll-6DoF	6DOF 1 X-6DoF	6DOF 1 Y-6DoF	6DOF 1 Z-6DoF	6DOF 1 Yaw-6DoF	6DOF 1 Pitch-6DoF	6DOF 1 Roll-6DoF	6DOF 1 X-6DoF	6DOF 1 Y-6DoF	6DOF 1 Z-6DoF
1.952	0.022	0.003	0.462	0.734	0.942	-0.000	0.000	-0.000	0.000	0.000	0.000
2.982	-0.015	0.011	0.920	0.803	0.207	-0.015	-0.020	0.140	0.499	0.096	0.033
4.172	-0.030	0.004	0.744	0.319	-0.147	-0.010	-0.008	0.522	0.292	-0.058	-0.061
5.542	-0.025	-0.009	0.819	0.193	0.091	0.008	-0.003	1.137	0.321	0.172	0.202

The timing at which the arrangement is reflected by the setting of the decomposition method of the 3D angle is as follows.

Item name in the measurement list: When changing the decomposition method of 3D angles

Analysis graph series (list item name): When creating an analysis graph

Analysis graph list value: When changing the decomposition method of 3D angles

Roll/Pitch/Yaw items in the analysis trajectory chart list: When creating an analysis trajectory graph

Values in the analysis trajectory chart list: When changing the decomposition method of 3D angles

Sorting and numbers of Annotations (Roll, Pitch, Yaw) on Measurement Images: When changing the decomposition method of 3D angles

Note: [v3.13-3.23] Measurement list, analysis graph/trajectory chart list, annotation (Roll, Pitch, Yaw) (old ROT=...) is a fixed arrangement of Roll/Pitch/Yaw. (No sorting)

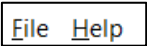
# 11. Appendix

## Appendix A GUI Overview

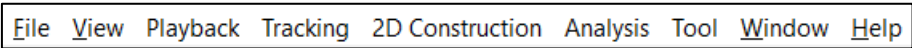
**(a) Menu**

All operations. Switch according to the project open. There are also menus that can only be used with specific modes.

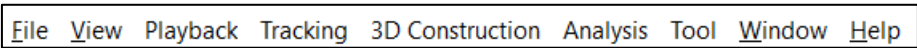
■ If a project is not open



■ While a 2D project is processing



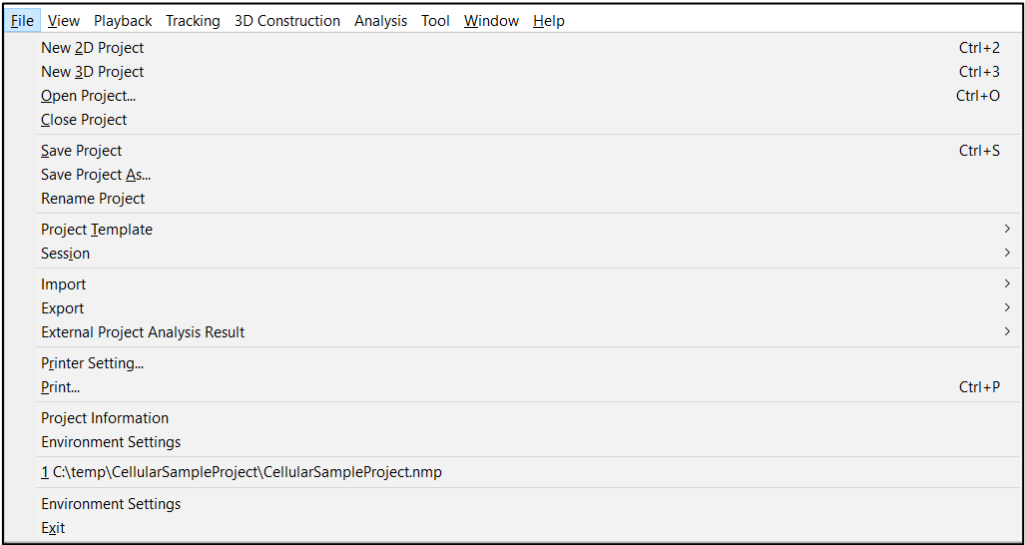
■ While a 3D project is processing



✓ **File**



(if a project isn’t created)



(if a project is open)

**New 2D Project**

Create a new 2D project.

Requires a MOVIAS license key for 2D analysis and 3D analysis.

**New 3D Project**

Create a new 2D project

Requires a MOVIAS license key for 3D analysis

エラー! 参照元が見つかりません。

Opens a specific project.

Requires the MOVIAS license key for the project.

**Close a Project**

Closes a project.

---

**Save a Project**

Saves a project.

**Save Project As**

Assigns a name to the current project to save it. Changes the name of the current project.

---

**Project Template**

Creates a project from a template or creates a template from the current project.

**Session**

Opens a session and performs processing to save and close.

---

エラー! 参照元が見つかりません。

Adds [Reference Image] or [Analog Waveform] to the project.

エラー! 参照元が見つかりません。

Exports project data to another file.

- ✓ CSV export of measurement coordinate data
- ✓ Export image to AVI • still image
- ✓ Merged export
- ✓ Excel export

**Remove External Project Analysis Results**

Deletes an external project linked to a project.

---

**Printer Settings**

Shows the printer settings dialog.

**Print**

Prints the current active window.

---

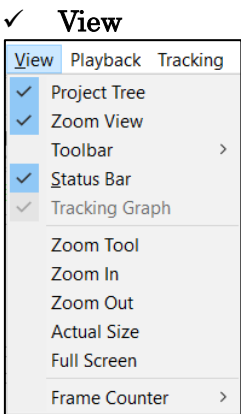
エラー! 参照元が見つかりません。

Displays or changes the project settings.

エラー! 参照元が見つかりません。  
Displays or changes the MOVIAS Neo settings.

---

**Exit the Application**  
Ends the MOVIAS Neo application.



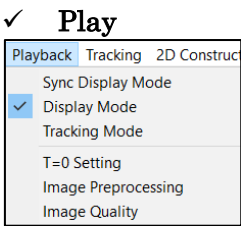
**Project Tree, Zoom View, Toolbar, Status Bar**  
Switch each tool control between show/hide.

---

**Zoom Tool, Zoom In, Zoom Out, Actual Size, Full Screen**  
Adjusts the size of the image displayed.

---

**Frame Display**  
Switches the frame units used for viewing between time and frame number.



**Synchronized Display Mode**  
Puts each window into the synchronized display mode.

**View Mode**  
Puts the active window into the view mode.

**Tracking Mode**  
Puts the measurement image into the tracking mode.

---

**Time Starting Point (T0) Settings**  
Sets the current frame to the time starting point (T0).

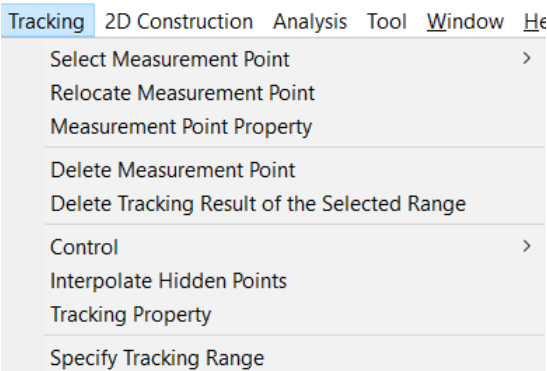
**Image Pre-Processing**

Performs image rotation, resizing, interlace removal and image quality adjustment for tracking.  
Adjusts the image quality for display with [Adjust the Window Image].

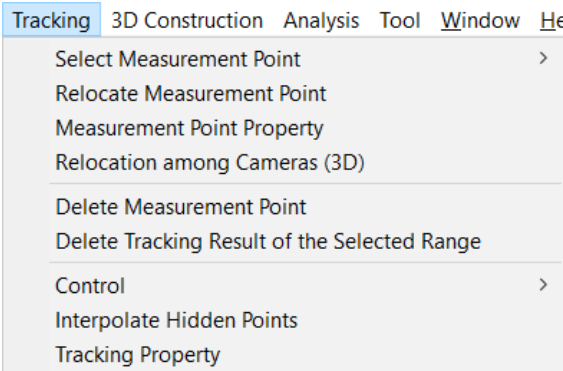
**Adjust the Window Image**

Adjusts the image for viewing.  
Image quality adjustment for tracking is performed with [Image Pre-processing].

✓ **Tracking**



(2D analysis project)



(3D analysis project)

**Specify Measurement Points**

Selects the target marker for the measurement points to be added.

**Rearrange Measurement Points**

Rearranges measurement points.

**Measurement Point Properties**

Sets the properties for the measurement points selected.

**Rearrangement between Cameras (3D only)**

Camera mapping. Used when setting measurement points for 3D analysis.

**Delete Measurement Points**

Removes the selected measurement points.

**Delete the Tracking Results for a Specified Range**

Deletes the tracking results for the selected measurement points.

**Operation**

Performs tracking operations.  
Select from Step Backward, Reverse, Stop, Forward and Step Forward.

**Interpolate Hidden Points**

Shows the interpolation dialog for function fitting.

**Tracking Properties**

Displays the tracking settings dialog.

**Specify Tracking Area (2D only)**

Switches to the mode to specify the tracking area.

✓ **2D Construction, 3D Construction**

2D Construction

Analysis

Tool

Window

Help

Calibration Status Setting

Lens Distortion Correction

Extended Lens Distortion Correction

2D Construction Status Display

(2D analysis project)

3D Construction

Analysis

Tool

Window

Help

Calibration

Lens Distortion Correction

Extended Lens Distortion Correction

Create 3D Measurement Data

Evaluate 3D Construction Error

3D Construction Status Display

(3D analysis project)

**Calibration Status Settings (2D only)**

Performs real scale or changing perspectives.

**Calibration (3D only)**

Switch to the 3D calibration mode.

**Optical Distortion Correction**

Uses the optical distortion correction chart to perform optical distortion correction.

**Expanded Optical Distortion Correction**

Performs expanded optical distortion correction. (improved method of calculating distortion correction, chessboard, and qualitative correction without a chart)

**Create 3D Measurement Data (3D only)**

Creates 3D analysis data.

**Evaluate 3D Construction Error (3D only)**

Shows the construction error for the 3D analysis data.

**Display Measurement Data Construction Status**

Shows the error status for data construction.  
Cannot be used when the data construction is successful.

✓ **Analysis**

<div><div>AnalysisToolWindowHelp</div><div>Create Momentum Graph &gt;Create Trajectory GraphCreate Stick2D-6DOF Analysis</div><div>Mass SettingCalculate Partial Gravity</div><div>Add Virtual PointAdd Customized Virtual Point &gt;</div></div> <div>(2D Analysis Project)</div>	<div><div>AnalysisToolWindowHelp</div><div>Create Momentum Graph &gt;Create Trajectory GraphCreate Stick6DOF Analysis</div><div>Mass SettingCalculate Partial Gravity</div><div>Add Virtual PointAdd Customized Virtual Point &gt;</div></div> <div>(3D Analysis Project)</div>
--	---

**Create a Graph of the Momentum**  
Displays the create graph dialog.

**Create Trajectory Figure**  
Displays the create trajectory figure dialog.

**Create Sticks**  
Creates and displays sticks.

**2D-6DOF Analysis (2D only)**  
Displays the 2D-6DOF analysis dialog.

**6DOF Analysis (3D only)**  
Displays the 6DOF analysis dialog.

---

**Mass Settings**  
Displays the mass settings dialog.

**Partial Center of Gravity Calculations**  
Displays the partial center of gravity calculations.

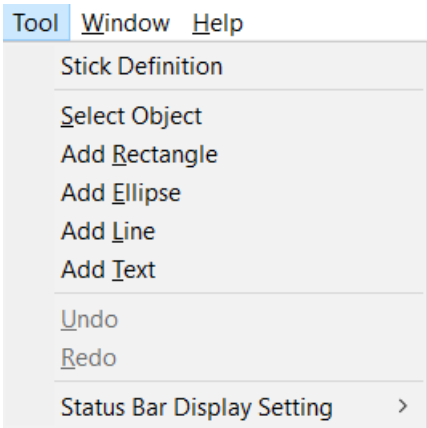
---

**Add Common Virtual Points**  
Displays the dialog for creating common virtual points.

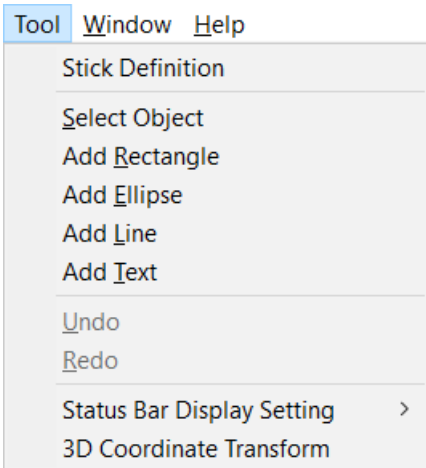
**Add Custom Virtual Points**  
Displays the dialog for creating custom virtual points



✓ **Tool**



(2D Analysis Project)



(3D Analysis Project)

**Stick Definition**  
Defines sticks

---

**Select Object**  
Selects the figure created on the image.

**Add Rectangle**  
Adds a rectangle on the image.

**Add Ellipse**  
Adds an oval on the image.

**Add Line**  
Adds a line on the image.

**Add Text**  
Adds text to the image.

---

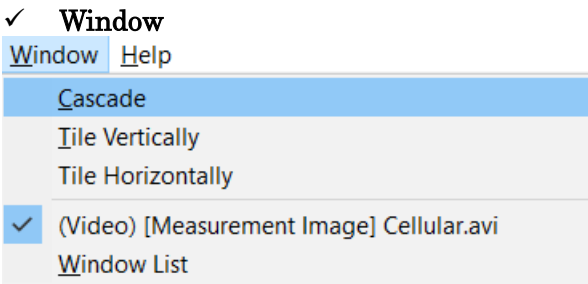
**Undo**  
Returns to the operation previously performed on the figure.

**Redo**  
Corrects the previous operation.

---

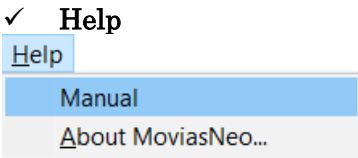
**Status Bar Display Settings**  
Selects the items displayed on the status bar (coordinates, RGB values, brightness values)

**3D Coordinate Transform (3D only)**  
Displays the 3D coordinate conversion dialog.



**Cascade, Tile Horizontally, Tile Vertically**  
Rearranges the window according to the method specified.

**Window List**  
Shows a list of the windows currently displayed.



**Manual**  
Shows the MOVIAS Neo manual (pdf file).

**About MOVIAS Neo**  
Shows the version of the MOVIAS Neo application.

**(b) Status Bar**  
Displays the image coordinates and brightness or RGB values for image windows. Displays the graph coordinates for graph windows.  
Select the items to display with [Tool] → [Status Bar Display Settings] on the menu.

**(c) Right Click Menu**  
(i) Measurement Image (Display Mode, Sync Display Mode)

**Change to Tracking Mode**  
Switches to the tracking mode

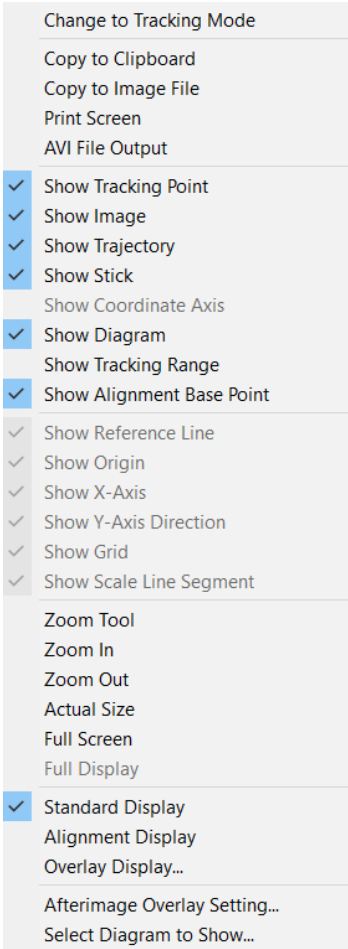
**Copy to Clipboard**  
Copies the displayed image to the clipboard

**Copy to Image File**  
Outputs the displayed image to the file

**Print Screen**  
Prints the screen displayed

**Output AVI File**  
Outputs the image to an AVI file

**Display Tracking Points**



Switches between show • hide for all tracking points

**Show Image**

Switches the image between show or hide

**Show Trajectory**

Switches all the tracking points between show or hide

**Show Sticks**

Switches all the sticks between show or hide

**Show Figure**

Switches all the figures between show or hide

**Show Tracking Range (2D only)**

Switches the tracking range between show or hide

**Alignment Reference Points**

Switches alignment reference points between show or hide

---

**Show Reference Lines (Real Scale Conversion, Changing Perspectives Only)**

Switches the reference lines between show or hide

**Show Starting Point (Real Scale Conversion, Changing Perspectives Only)**

Switches the starting point between show or hide

**Show X Axis (Real Scale Conversion, Changing Perspectives Only)**

Switches the X axis between show or hide

**Show Y Axis Direction (Real Scale Conversion, Changing Perspectives Only)**

Switches the Y axis between show or hide

**Show the Grid (Real Scale Conversion, Changing Perspectives Only)**

Switches the grid between show or hide

**Show the Scale Lines (Real Scale Conversion Only)**

Switches the scale lines between show or hide

---

**Zoom Tool**

Enables the zoom tool

**Zoom In**

Zooms in the image

**Zoom Out**

Zooms out the image

**Actual Size**

Displays the image as actual size

**Full Screen**

Displays the image fit to the size of the window

---

**Standard Display**

Standard display of the image

**Alignment Display (option sold separately)**

Displays the alignment of the image

**Overlay Display (option sold separately)**

Shows the overlay settings dialog

---

**Afterimage Overlay Setting**

Displays the afterimage overlay setting dialog if the afterimage overlay setting (option sold separately) are enabled

Switches the afterimage between show or hide if the afterimage overlay setting are disabled

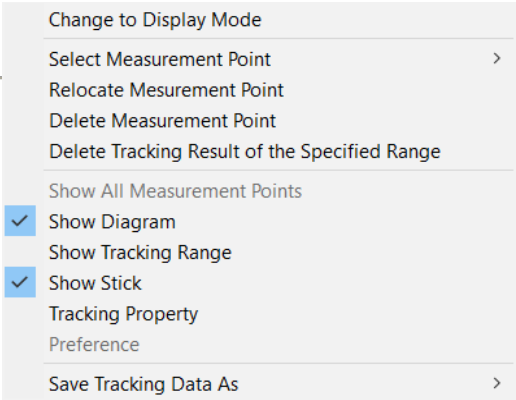
**Select Diagram to Show**

Displays the select diagram to show dialog

(ii) Measurement Image (During Tracking Mode)

**Change to Display Mode**

Switches to the display mode



**Specify Measurement Points**

Specifies the measurement points  
(selected measurement point, quadrant, white dot, black dot, feature point, fixed point)

**Rearrange Measurement Points**

Rearranges the selected measurement points

**Delete Measurement Points**

Deletes the selected measurement points

**Delete the Tracking Results for the Specified Range**

Displays the [Delete Tracking Results for the Specified Range] dialog

**Show Figures**

Switches between show or hide all the figures

**Show Tracking Range (2D only)**

Switches between show or hide the tracking range

**Show Sticks**

Switches between show or hide the sticks

**Tracking Properties**

Shows the [Tracking Properties] dialog

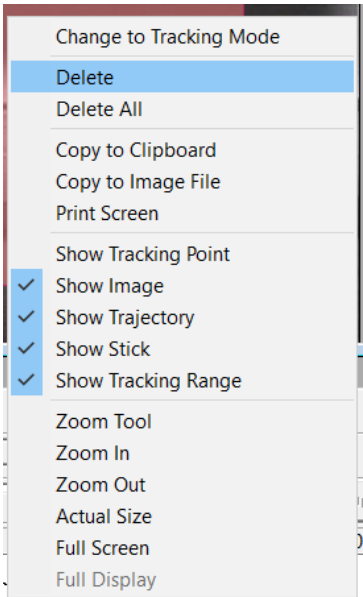
**Save Tracking Data as**

Saves the tracking data to a CSV file

(iii) Measurement Image (During Specify Tracking Range Mode)

**Change to the Tracking Mode**

Switches to the tracking mode



**Delete**

Deletes the selected tracking range

**Delete All**

Deletes all of the tracking range

**Copy to Clipboard**

Copies the image displayed to the clipboard

**Copy to Image File**

Exports the image displayed to the file

**Print Screen**

Prints the screen displayed

**Show the Tracking Points**

Switches between show or hide all the tracking points

**Show Image**

- Switches between show or hide the image
- Show Trajectory**
  - Switches between show or hide the trajectory of all tracking points.
- Show Sticks**
  - Switches between show or hide all the sticks
- Show Figures**
  - Switches between show or hide all the figures
- Show Tracking Range**
  - Switches between show or hide the tracking range

- 
- Zoom Tool**
    - Enables the zoom tool
  - Zoom In**
    - Zooms in the image
  - Zoom Out**
    - Zooms out the image
  - Actual Size**
    - Displays the image as actual sized
  - Full Screen**
    - Displays the image fit to the size of the window

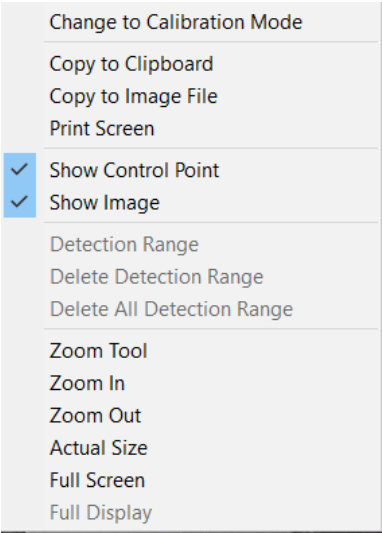
- (iv) Calibration Image (3D)
- Switch to the calibration mode**
  - Switches to the calibration mode (3D)

- 
- Copy to Clipboard**
    - Copies the displayed image to the clipboard
  - Copy to Image File**
    - Outputs the displayed image to the file
  - Print Screen**
    - Prints the screen displayed

- 
- Show the Control Points**
    - Switches between show and hide the control points
  - Show Image**
    - Switches the image between show and hide

- 
- Detection Range**
    - Sets the detection range for the auto detection of white dots
  - Delete the Detection Range**
    - Deletes the detection range for the auto detection of the selected white dots
  - Delete All of the Detection Range**
    - Deletes all of the detection ranges for the auto detection of white dots

- 
- Zoom Tool**
    - Enables the zoom tool
  - Zoom In**
    - Zooms in the image
  - Zoom Out**
    - Zooms out the image



**Actual Size**

Displays the image as actual sized

**Full Screen**

Displays the image fit to the size of the window

(v) Distortion Correction Chart Image

**Switch to the Optical Distortion Correction Mode**

Switches to the optical distortion correction mode

**Copy to Clipboard**

Copies the image displayed to the clipboard

**Copy to Image File**

Exports the image displayed to the file

**Print Screen**

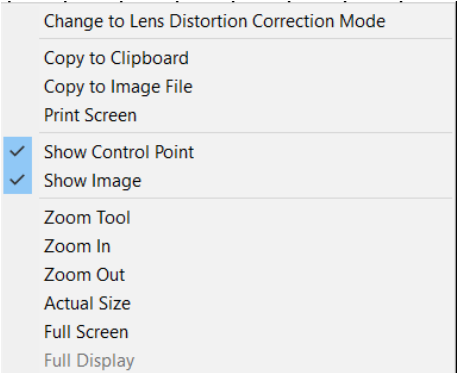
Prints the screen displayed

**Show the Control Points**

Switches between show and hide the control points

**Show Image**

Switches the image between show and hide



**Zoom Tool**

Enables the zoom tool

**Zoom In**

Zooms in the image

**Zoom Out**

Zooms out the image

**Actual Size**

Displays the image as actual sized

**Full Screen**

Displays the image fit to the size of the window

**(d) Toolbars**

(i) Project Toolbar

Performs project operations.



New 2D project



New 3D project



Open project



Save project



Print



Help

## (ii) Import Toolbar

Imports external data. Imports image and waveform data.



**Import external image:** Imports image data.



**Import external waveform data:** Imports waveform data.

## (iii) Operation Mode Toolbar

Tool bar to switch operating modes. The tracking mode can only be used when the measurement window is active.



**Synchronized Display Mode:** Accesses the synchronized display mode.



**Display Mode:** Accesses the display mode.



**Tracking Mode:** Accesses the tracking mode.

## (iv) Settings Toolbar

Tool bar to perform the following processing on tracking and measurement data. Different for 2D and 3D analysis.



(2D analysis)



(3D analysis)



**Real Scale Conversion:** Performs real scale conversion.  
Enabled during measurement image display for 2D analysis.



**Changing Perspectives:** Changes perspectives.  
Enabled during measurement image display for 2D analysis.



**3D Calibration:**  
Performs 3D calibration.



**Add Virtual Point:** Switches to the virtual point input mode.  
Enabled when measurement data exists.



**Optical Distortion Correction:** Switches to the optical distortion correction mode.  
Enabled when the optical distortion correction window is displayed.



**Specify Tracking Range:** Switches to the specify tracking range mode.


**Define Sticks:**

Enabled when the 2D analysis measurement image window is active.

Shows the settings dialog for stick definitions.  
Enabled when measurement data exists.


**2D-6DOF Analysis:** Performs 2D-6DOF analysis.

**3D Coordinate Conversion:** Performs 3D coordinate conversion.

## (v) Analysis Toolbar

Tool bar to create analysis data based on measurement data.  
Enabled when measurement data exists.

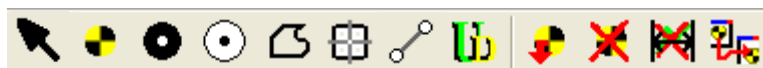

**Create Graphs:** Displays the create a graph dialog.

**Create Trajectory Figures:** Displays the create a trajectory figure dialog.

**Create Sticks:** Creates a stick item node from a stick definition.

## (vi) Specify Measurement Points Toolbar

Selects the input method for the tracking points. Displayed during the tracking and calibration modes.


**Select Measurement Point:** Setting for the measurement point selection.

**Add Quadrant:** Setting for adding quadrants.

**Add White Dot:** Setting for adding white dots.

**Add Black Dot:** Setting for adding black dots.

**Add Feature Point:** Setting for adding feature points.

**Add Fixed Point:** Setting for adding fixed points.

**Input Line Segment:** Used during 2D calibration.  
The starting point and the ending point can be input once when the axis and line is input. Drag to input.

**Add User Defined Point:** Setting for adding user defined points.

**Rearrange Tracking Points:** Setting for rearranging tracking points.

**Delete Measurement Points:** Deletes the specified measurement points.  
Processing for everything selected on the measurement



point list.



**Delete Tracking Results:** Deletes the results within a specified range. Processing for everything selected on the measurement point list.



**Camera Mapping:** Used during 3D analysis. Mode for adding the measurement points added with another camera to the current camera.

#### (vii) Window Toolbar

Sorts the currently displayed windows. The sorting order depends on the order the windows were activated.



**Cascade**



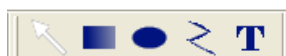
**Tile Vertically**



**Tile Horizontally**

#### (viii) Figures Toolbar

Draws a figure on the currently displayed measurement image.



Selects the figure to be drawn.



Draws a rectangle.



Draws an oval.



Draws a line group.



Draws text.

#### (ix) Excel Export Toolbar

Performs either [Group Export of Graphs to Excel] or [Export Graphs to Excel Template].



Performs [Group Export of Graphs to Excel].



Performs [Export Graphs to Excel Template].

#### (x) Tracking Control Toolbar

Shown on the top of the zoom view while in the tracking mode. Tracks and makes the settings for stopping and tracking.



Tracks the current frame and jumps to the frame in the specified direction.



Starts auto tracking in the specified direction.



Stops auto tracking.



Interpolates for function fitting.



Shows the tracking properties.

**(e) Zoom Control Bar**

Zoom settings in the video display window.



**Zoom Tool:** Switches the zoom tool between show • hide.



**Zoom In:** Enlarges the display.



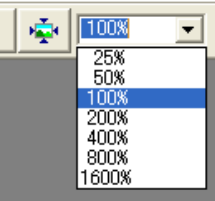
**Zoom Out:** Shrinks the display.



**Remove Zoom:** Displays the image as actual size.



**Fit to Screen:** Displays the image fit to the size of the window.



**Set Image Size:** Specifies the zoom rate selected from a list or manually input.

**(i) Playback Control Bar**

Performs playback, stop and jump. Also sets the index frame.





**Jump to starting frame or to the previous frame**




**Frame by frame forward, jump to the ending frame**




**Play (loop play)**




Reverse playback (reverse loop play)




Stop



Jump to T0



Jump to the next index frame



Add or delete the index frame

(ii) Playback Settings Control Bar

Displays the numbers for the current playback settings. Click [View] → [Toolbars] → [Playback Settings Control Bar] on the menu to show/hide.

Current[ms]20800

Start[ms]-398.750

End[ms]20800

Play Rate30

Current:

Current frame number. Manually input a number to jump.

Start:

Start of the playback range. Manually input numbers to set the range.

End:

End of the playback range. Manually input numbers to set the range.

Frame Rate:

Sets the frame rate. Either manually input a number or select from the combo box.

1

2

3

4

5

6

7

8

9

10

15

20

25

30

60

120

240

480

960

1920

Play Rate30

(iii) Playback Slider Bar

The slider bar shows the current playback settings. Click [View] → [Toolbars] → [Playback Slider Bar] on the menu to show/hide.

Set the playback start frame, playback end frame, current frame on the slider.

While in the synchronized playback mode, you can set [Common Range] · [Combined Range] for the window displayed.

Top frame

Current frame

End frame

Playback range

And


Or

Playback start frame

Index frame

Playback end frame

T0 frame



Sets the current frame to the playback start frame.



Sets the current frame to the playback end frame.



Sets the synchronized playback range to a range where the playback range for all of the windows displayed is an overlapping range (only in the sync playback mode)



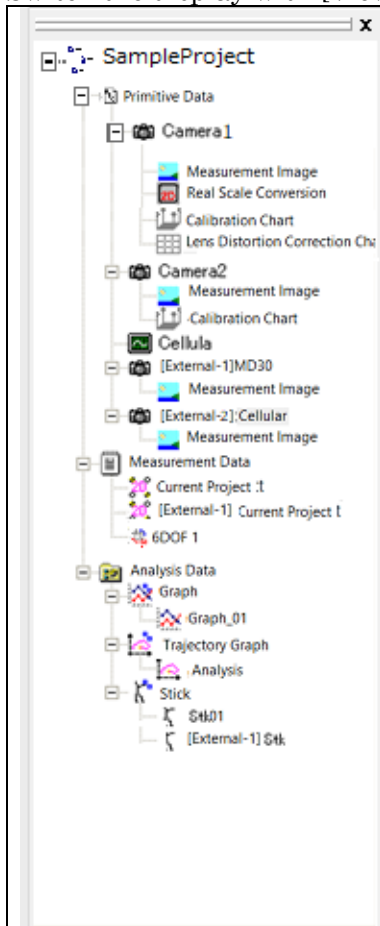
Sets the synchronized playback range to a range that includes the playback range for all of the windows displayed (only in the sync playback mode)

### (f) Dialog Bar

#### (i) Project Tree

Shows the current project structure. Not displayed if a project isn't open.

Switch the display with [View] → [Project Tree] on the menu.



The name of each node is as follows. Each node can be edited using the right click menu for that node.

- Project Node
  - Primitive Node
    - Camera Node
    - Measurement Image Node
    - Calibration Mode Node (2D)
    - Calibration Node (3D)
    - Optical Distortion Correction Node
  - Waveform Data Node
  - External Image Node
  - External Image Item Node
- Measurement Data Node
  - Measurement Data Item
  - External Measurement Data Item
- 6DOF Node
- Analysis Data Node
  - Graph Node
  - Graph Item Node
  - Trajectory Figure Node
  - Trajectory Figure Item Node
  - Stick Node
  - Stick Item Node

To display data corresponding to a node, double click on a node or use the right click menu.

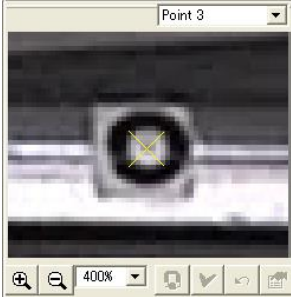
Set and operate each node from the right click menu of that node.

Change the name of the project node to change the name of the project file.

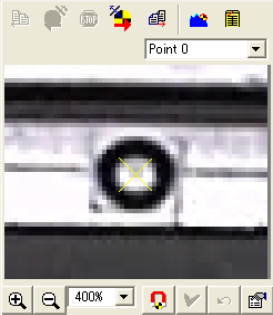
(ii) Zoom View

Zooms the area clicked. Zooms points if selected.  
Click [View] → [Zoom View] on the menu to switch between show/hide the zoom view.


When the measurement image window, calibration image window or optical distortion correction window is activated, they can be viewed.




Not in tracking mode




In tracking mode




Zoom In, Zoom Out




Auto Detect



Confirm (the space bar can be used as a shortcut)



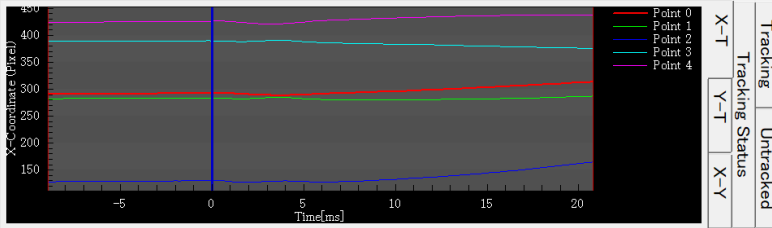
Undo (returns to previous state)



Measurement Point Properties

(iii) Tracking Dialog Bar

Shows the tracking status and coordinates. Displayed only in the tracking mode. The display cannot be switched.

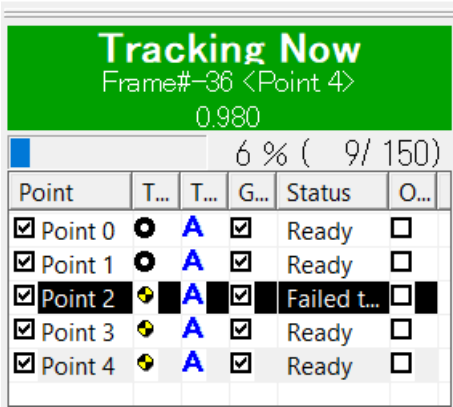


Displays the X-T graph, the Y-T graph and the X-Y graph. Also displays the tracking completed/tracking not completed frames and the tracking status (regardless of interpolation).

Shows when the box next to the graph on the measurement point list is checked.

(iv) Measurement Point List

Shows the status of the measurement points in the current frame.



Performs the following on points selected on the list

- ✓ Deletes measurement points
- ✓ Deletes tracking results in the specified range
- ✓ Sorts measurement points

Appendix B Description of 3D Coordinate Conversion

(a) 3-2-1 Conversion

Specifies the 3 types, specifically coordinate plane, axis, point, and performs coordinate conversion into that coordinate system.

If xxx-yy-z is specified, the six points of  $x_1, x_2, x_3, y_1, y_2, z_1$  are input.

Coordinate conversion is performed so the X coordinates of  $x_1, x_2, x_3$  become 0, the Y coordinates of  $y_1, y_2$  become 0, and the Z coordinates of  $z_1$  become 0.

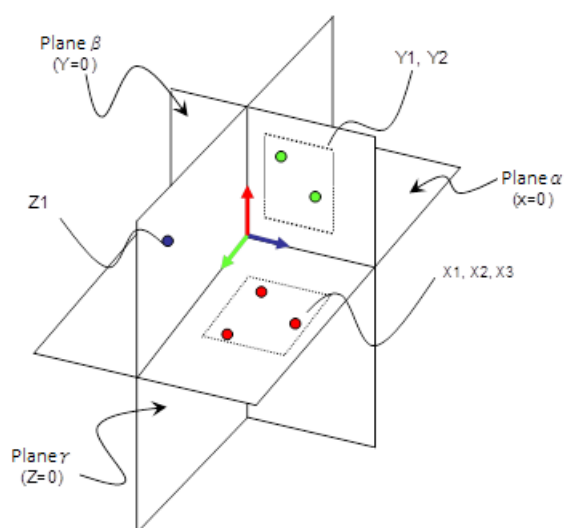
First, plane ( $\alpha$ ) is determined so  $X=0$  from  $x_1, x_2, x_3$ .

Next, plane ( $\beta$ ) is determined so  $Y=0$  from  $y_1, y_2$  and plane ( $\alpha$ ) previously calculated.

Finally, plane ( $\gamma$ ) is determined so  $Z=0$  from  $z_1$  and plane ( $\alpha, \beta$ ).

The rotation matrix R and the parallel transport vector t are calculated from planes  $\alpha, \beta, \gamma$ .

Perform coordinate conversion using this R and t.

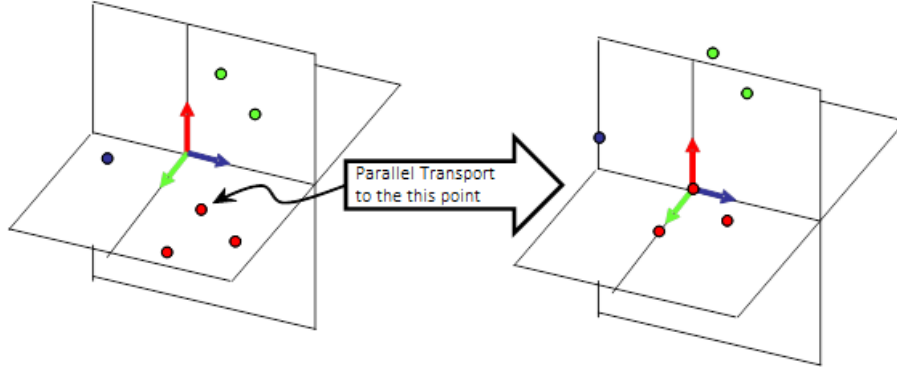


### Overview of 3-2-1 Conversion

Conversion is performed in the same manner as other types of conversion, including yyy-xx-z.

## (b) Parallel Transport

Parallel transport coordinate conversion is performed for only the number specified from the calibration coordinate starting point.



### Overview of Parallel Transport

Real calculations use the following formula for coordinate conversion.

$$\mathbf{x}' = \mathbf{x} - \mathbf{t} \text{ (where } \mathbf{t} \text{ refers to specified measurement points or coordinates)}$$

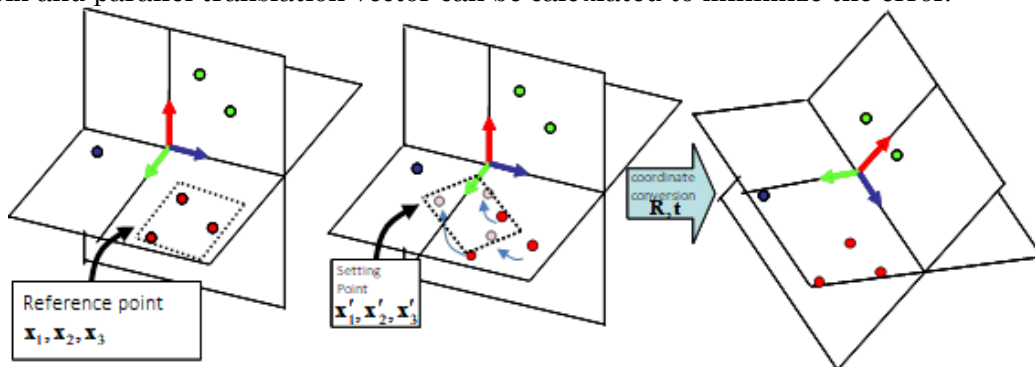
## (c) Reference Points Best Fit

Designate the three points of  $\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3$  as the reference points for coordinate conversion. After coordinate conversion, the coordinates are  $\mathbf{x}'_1, \mathbf{x}'_2, \mathbf{x}'_3$ . With  $\mathbf{R}$  as the rotation matrix and  $\mathbf{t}$  as the extent of parallel transport,  $\mathbf{R}$  and  $\mathbf{t}$  are calculated from  $\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3, \mathbf{x}'_1, \mathbf{x}'_2, \mathbf{x}'_3$  according to the following formulas.

$$\begin{aligned} \mathbf{R}\mathbf{x}_1 + \mathbf{t} - \mathbf{x}'_1 &= 0 \\ \mathbf{R}\mathbf{x}_2 + \mathbf{t} - \mathbf{x}'_2 &= 0 \\ \mathbf{R}\mathbf{x}_3 + \mathbf{t} - \mathbf{x}'_3 &= 0 \end{aligned}$$

The rotation matrix and parallel transport obtained from these equations are used for coordinate conversion.

The formulas will not be correct if there is any measurement error. Using the distance between the specified coordinates and the converted coordinates as the error, the rotation matrix and parallel translation vector can be calculated to minimize the error.



### Overview of Reference Points Best Fit



## Appendix C Description of Calculations

### (a) Calibration

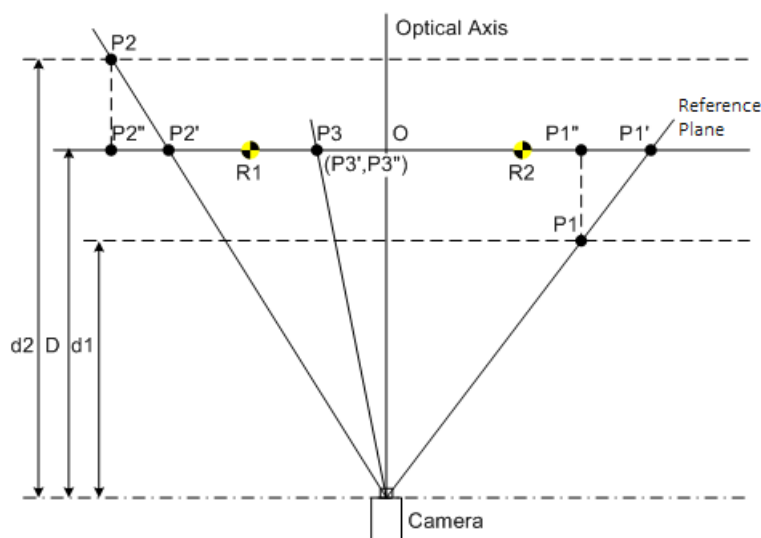
#### (i) Depth Correction

Basically, during 2D analysis, the camera considers the movement of the object as movement on the same perpendicular plane, and analysis is performed on that plane.

If filming objects with depth, objects close to the camera seem larger than objects farther away. On the other hand, objects far away appear smaller than those nearby.

Therefore, to perform analysis on the motion on multiple planes of varying distances, it is necessary to correct for the differences in size and position due to this photographic distance (distance from the camera to the object). This is called **depth correction**.

MOVIAS Neo has a depth correction function for 2D analysis and can perform quantitative motion analysis on multiple planes that taken into account the differences in depth. (However, correction is not possible if there are constant changes in the photographic distance, and this is limited to when there is movement within a plane perpendicular to the optical axis of the camera.)



Descriptive Figure of Depth Correction

In the descriptive figure of depth correction, with

O: Center of the screen

d1: Distance from the camera on a plane containing point P1

d2: Distance from the camera on a plane containing point P2

D: Distance from the camera on a plane (reference plane) containing real scale conversion standard points (R1, R2), with point P3 also on the reference plane

P1, P2, P3: Actual positions of measurement points P1, P2, P3

P1', P2', P3': Apparent positions of measurement points P1, P2, P3

P1'', P2'', P3'': Position of measurement points P1, P2, P3 after depth correction

Therefore,

the depth correction coefficient for point P1 is  $\frac{d1}{D}$

the depth correction coefficient for point P2 is  $\frac{d2}{D}$

the depth correction coefficient for point P3 is  $\frac{D}{D} = 1$

The specific calculation uses (  $x$  ,  $y$  ) as the coordinates of the measurement point before correction,  $\alpha$  as the depth correction coefficient of this measurement point, (  $cx$  ,  $cy$  ) as the coordinates of the center of the screen, and (  $X$  ,  $Y$  ) as the coordinates of the measurement point after depth correction to get

$$X = cx + (x - cx) \times \alpha$$

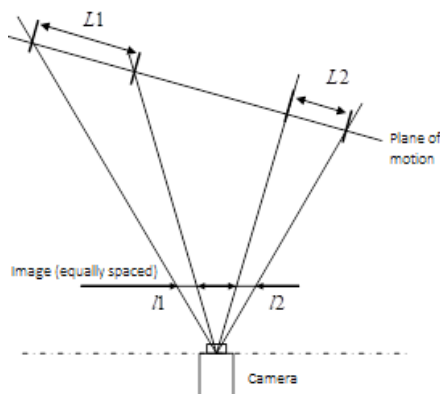
$$Y = cy + (y - cy) \times \alpha$$

As is clear from this equation, for measurement point P2 that appears smaller because it is farther away from the reference plane,  $\frac{d2}{D} = \alpha$  is a value greater than 1 so is calculated to be larger. On the other hand, for measurement point P1 that appears larger because it is closer to the reference plane,  $\frac{d1}{D} = \alpha$  is a value less than 1 so is calculated to be smaller.

## (ii) Changing Perspectives

Filming with cameras may be difficult if the motion of the object is positioned perpendicular to the camera. If the plane of motion is not perpendicular to the camera, the actual scale may vary even if the distance on the image is the same

As a result, correction for differences in size and position may not be possible with just depth correction.



**Figure Showing the Positional Relationship for Changing Perspectives**

In the figure of the positional relationship for changing perspectives,

$L1, L2$ : actual length along the plane of movement

$l1, l2$ : length that can be verified on the image

Even if the distance on the image is equivalent, we understand that the width on the plane of movement differs. This cannot be corrected with simple depth correction alone. As a result, correction of the size and position must take place by changing perspectives.

MOVIAS Neo 2D analysis has a change perspective function with a level of freedom for the positional relationship of the plane on which the object moves relative to the camera, and quantitative motion analysis can be performed on that plane

(However, this correction is limited to when the relationship between the camera and the plane of motion is constant.)

## (b) Physical Quantities when Creating Graphs

This describes the physical quantities calculated during graph creation.

### (i) Position

Calculates the positions of specified points or the relative position to particular points.  $p_i(X_i \ Y_i \ Z_i)$  are the coordinates for frame i of the specified point, and  $p_{0i}(X_{0i} \ Y_{0i} \ Z_{0i})$  are the coordinates for frame i of the reference point for calculating the relative position. At this point, position  $P_i(P_{Xi} \ P_{Yi} \ P_{Zi})$  and the absolute value  $P_{Ai}$  are calculated as follows.

$$\begin{aligned} P_{Xi} &= X_i - X_{0i} \\ P_{Yi} &= Y_i - Y_{0i} \\ P_{Zi} &= Z_i - Z_{0i} \\ P_{Ai} &= \sqrt{P_{Xi}^2 + P_{Yi}^2 + P_{Zi}^2} \end{aligned}$$

If the relative position is not specified, it is calculated as  $p_0(X_0 \ Y_0 \ Z_0) = (0 \ 0 \ 0)$ .

### (ii) Velocity

Calculates the velocity of a specified point. There are two equations for calculating speed.  $p_i(X_i \ Y_i \ Z_i)$  are the coordinates for frame i of the specified point and  $T_i$  is that time. At this point, the velocity  $V_i(VX_i \ \vec{V}Y_i \ VZ_i)$  and the absolute value  $VA_i$  are calculated as follows.

#### Formula 1 – Forward Difference

$$\begin{aligned} VX_i &= \frac{X_{i+1} - X_i}{T_{i+1} - T_i} \quad VY_i = \frac{Y_{i+1} - Y_i}{T_{i+1} - T_i} \quad VZ_i = \frac{Z_{i+1} - Z_i}{T_{i+1} - T_i} \\ VA_i &= \sqrt{VX_i^2 + VY_i^2 + VZ_i^2} \end{aligned}$$

#### Formula 2 – Central Difference

$$\begin{aligned} VX_i &= \frac{X_{i+1} - X_{i-1}}{T_{i+1} - T_{i-1}} \quad VY_i = \frac{Y_{i+1} - Y_{i-1}}{T_{i+1} - T_{i-1}} \quad VZ_i = \frac{Z_{i+1} - Z_{i-1}}{T_{i+1} - T_{i-1}} \\ VA_i &= \sqrt{VX_i^2 + VY_i^2 + VZ_i^2} \end{aligned}$$

**(iii) Acceleration**

Calculates the acceleration of a specified point. There are two equations for calculating acceleration.

$V_i(VX_i \quad VY_i \quad VZ_i)$  is the velocity for frame  $i$  of the specified point and  $T_i$  is the time at that point. Here, the acceleration  $A_i(AX_i \quad AY_i \quad AZ_i)$  and the absolute value  $AA_i$  are calculated as follows.

**Formula 1 – Forward Difference**

$$AX_i = \frac{VX_{i+1} - VX_i}{T_{i+1} - T_i} \quad AY_i = \frac{VY_{i+1} - VY_i}{T_{i+1} - T_i} \quad AZ_i = \frac{VZ_{i+1} - VZ_i}{T_{i+1} - T_i}$$

$$AA_i = \sqrt{AX_i^2 + AY_i^2 + AZ_i^2}$$

**Formula 2 – Central Difference**

$$AX_i = \frac{VX_{i+1} - VX_{i-1}}{T_{i+1} - T_{i-1}} \quad AY_i = \frac{VY_{i+1} - VY_{i-1}}{T_{i+1} - T_{i-1}} \quad AZ_i = \frac{VZ_{i+1} - VZ_{i-1}}{T_{i+1} - T_{i-1}}$$

$$AA_i = \sqrt{AX_i^2 + AY_i^2 + AZ_i^2}$$

**(iv) Displacement**

Calculates the amount of displacement from a particular frame of a specified point.

$p_i(X_i \quad Y_i \quad Z_i)$  are the coordinates for frame  $i$  of the specified point,  $j$  is the reference frame for calculating the displacement and  $p_{0j}(X_{0j} \quad Y_{0j} \quad Z_{0j})$  are the coordinates for that frame. At this point, the amount of displacement  $D_i(D_{Xi} \quad D_{Yi} \quad D_{Zi})$  and the absolute value  $D_{Ai}$  are calculated as follows.

$$D_{Xi} = X_i - X_{0j}$$

$$D_{Yi} = Y_i - Y_{0j}$$

$$D_{Zi} = Z_i - Z_{0j}$$

$$D_{Ai} = \sqrt{D_{Xi}^2 + D_{Yi}^2 + D_{Zi}^2}$$

**(v) Movement**

Calculates the amount of accumulative movement from a reference frame “ $Nrf$ ”. Negative values are before the reference frame and positive values are after. The value of the reference frame is “0”.

The amount of movement  $Travel_i$  is calculated as follows.

$$Travel_{nFrm} = \begin{cases} \sum_{k=Nrf}^{nFrm} \text{dist}(P_i, P_{i-1}) & , \quad Nrf < nFrm \\ 0 & , \quad nFrm \equiv Nrf \\ - \sum_{k=Nrf}^{nFrm} \text{dist}(P_i, P_{i+1}) & , \quad nFrm < Nrf \end{cases}$$

Here,  $\text{dist}(P_i, Q_i)$  is the function that calculates the distance between 2 points  $P_i, Q_i$ . If processing elements, the function returns absolute values for the differences of each element. If processing for “absolute value”, the function returns the Euclidian distance.

**(vi) Length**

Calculates the distance formed by multiple designated points. With N number of points,  $(x_i \ y_i \ z_i)$  are the coordinates for point i.

At this point, the length  $L_{abs}$  and the projection length  $L_x, L_y, L_z$  are calculated as follows.

$$L_x = \sum_{i=0}^N \sqrt{(y_i - y_{i+1})^2 + (z_i - z_{i+1})^2}$$

$$L_y = \sum_{i=0}^N \sqrt{(x_i - x_{i+1})^2 + (z_i - z_{i+1})^2}$$

$$L_z = \sum_{i=0}^N \sqrt{(x_i - x_{i+1})^2 + (y_i - y_{i+1})^2}$$

$$L_{abs} = \sum_{i=0}^N \sqrt{(x_i - x_{i+1})^2 + (y_i - y_{i+1})^2 + (z_i - z_{i+1})^2}$$

Projection length  $L_x$  expresses the length projected on plane y-z,  $L_y$  expresses the length projected on plane z-x and  $L_z$  expresses the length projected on plane x-y.

**(vii) Angle**

Calculates the angle between specific vectors. Consider vectors  $\mathbf{V}_1(V_{1x} \ V_{1y} \ V_{1z})$  and  $\mathbf{V}_2(V_{2x} \ V_{2y} \ V_{2z})$ . There are three methods of calculating angles, and the method of calculating each vector  $\mathbf{V}_1, \mathbf{V}_2$  is different. Angle  $\theta$  is calculated as follows.

$$\theta = \tan^{-1} \frac{\sin \alpha}{\cos \alpha} \quad : \cos \alpha \neq 0$$

$$\theta = \frac{\pi}{2} \quad : \cos \alpha = 0$$

$$\text{with} \quad \cos \alpha = \frac{\mathbf{V}_1 \bullet \mathbf{V}_2}{|\mathbf{V}_1| |\mathbf{V}_2|}$$

$$\sin \alpha = \sqrt{1 - \cos^2 \alpha}$$

**Method 1 4 Points**

Calculates the angle created by the vectors from 4 points. If the four points of  $P_1(X_1 \ Y_1 \ Z_1), P_2(X_2 \ Y_2 \ Z_2), P_3(X_3 \ Y_3 \ Z_3), P_4(X_4 \ Y_4 \ Z_4)$  are specified, vectors  $\mathbf{V}_1, \mathbf{V}_2$  are calculated as follows.

$$\mathbf{V}_1 = \mathbf{P}_2 - \mathbf{P}_1$$

$$\mathbf{V}_2 = \mathbf{P}_4 - \mathbf{P}_3$$

$\mathbf{V}_1, \mathbf{V}_2$  are applied to the abovementioned angle calculations to calculate the angle.

**Method 2 3 Points**

Calculates the angle created by the vectors from 3 points. If given the three points of  $P_1(X_1 \ Y_1 \ Z_1), P_2(X_2 \ Y_2 \ Z_2), P_3(X_3 \ Y_3 \ Z_3)$ , vectors  $\mathbf{V}_1, \mathbf{V}_2$  are calculated as follows.

$$\mathbf{V}_1 = \mathbf{P}_2 - \mathbf{P}_1$$

$$\mathbf{V}_2 = \mathbf{P}_3 - \mathbf{P}_1$$

$\mathbf{V}_1, \mathbf{V}_2$  are applied to the abovementioned angle calculations to calculate the angle.

### Method 3 2 Points

Calculates the angle created by the vectors from 2 points. If given the two points of  $P_1(X_1 \ Y_1 \ Z_1)$ ,  $P_2(X_2 \ Y_2 \ Z_2)$ , vectors  $\mathbf{V}_1$ ,  $\mathbf{V}_2$  are calculated as follows.

$$\mathbf{V}_1 = \mathbf{e}$$

$$\mathbf{V}_2 = \mathbf{P}_2 - \mathbf{P}_1$$

$\mathbf{e}$  denotes the unit vector for the selected coordinate axis.  $\mathbf{V}_1$ ,  $\mathbf{V}_2$  are applied to the abovementioned angle calculations to calculate the angle.

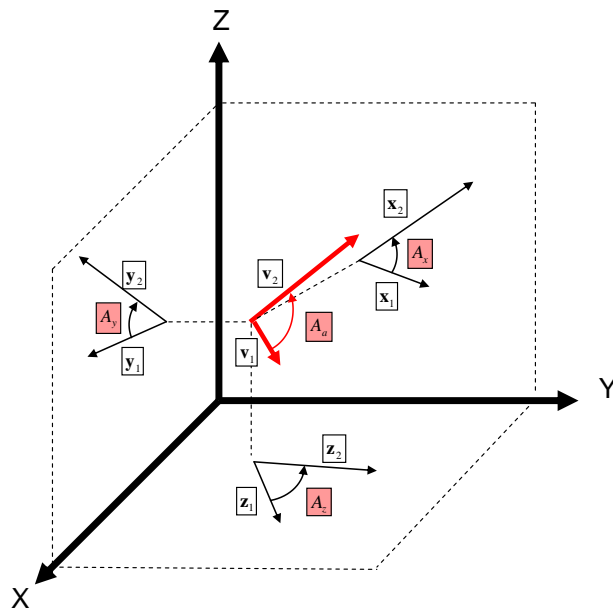
### (viii) 3D Angles

Calculates the angle from 3D measurement data. The projection planes include "Standard", X projection plane ( $A_x$ ), Y projection plane ( $A_y$ ), Z projection plane ( $A_z$ ) and absolute value ( $A_a$ ).

$A_x$ ,  $A_y$ ,  $A_z$  and  $A_a$  are used as vectors ( $\mathbf{x}_1, \mathbf{x}_2$ ), ( $\mathbf{y}_1, \mathbf{y}_2$ ), ( $\mathbf{z}_1, \mathbf{z}_2$ ) projected on the x plane ( $\mathbf{x}_1, \mathbf{x}_2$ ), the y plane ( $\mathbf{y}_1, \mathbf{y}_2$ ), and the z plane ( $\mathbf{z}_1, \mathbf{z}_2$ ) and are used for the calculations in the previous section (エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 ) for the 3D vector calculations ( $\mathbf{v}_1, \mathbf{v}_2$ ). The angle between the two vectors ( $\mathbf{v}_1, \mathbf{v}_2$ ) is calculated for the absolute value ( $A_a$ ).

"Standard" is used for angle calculations compatible with MOVIAS Neo Ver1, which takes into consideration the 3D coordinates and the orientation of the rotation angle to determine the agreement with the results of the calculations for  $A_a$ .

This positional relationship is shown in the following figure.



Positional relationship of 3D angle Calculation

$$A_a = \cos^{-1} \left( \frac{\mathbf{v}_1 \cdot \mathbf{v}_2}{\|\mathbf{v}_1\| \|\mathbf{v}_2\|} \right)$$

3D angle absolute value( $A_a$ ) formula

**(ix) Area**

Calculates the projection area  $S_x$ ,  $S_y$ ,  $S_z$  for the points when the group of input points are projected on the y-z plane, the z-x plane and the x-y plane. The number of input points is N. The coordinates for #i are  $(x_i \ y_i \ z_i)$ . At this point, the projection areas  $S_x$ ,  $S_y$ ,  $S_z$  are calculated as follows.

$$S_x = \frac{1}{2} \text{ABS} \left( \sum_{i=1}^{N-1} (z_{i+1} + z_i)(y_{i+1} - y_i) + (z_1 + z_N)(y_1 - y_N) \right)$$

$$S_y = \frac{1}{2} \text{ABS} \left( \sum_{i=1}^{N-1} (x_{i+1} + x_i)(z_{i+1} - z_i) + (x_1 + x_N)(z_1 - z_N) \right)$$

$$S_z = \frac{1}{2} \text{ABS} \left( \sum_{i=1}^{N-1} (y_{i+1} + y_i)(x_{i+1} - x_i) + (y_1 + y_N)(x_1 - x_N) \right)$$

Lines connecting points cannot intersect with other lines.

**(x) Momentum**

Calculates the momentum for a designated point.

$m$  is the mass for the specified point and  $V_i(VX_i \ \vec{\leftrightarrow} \ VY_i \ \ VZ_i)$  is the velocity of frame i. At this point, momentum  $M_i(MX_i \ \vec{\leftrightarrow} \ MY_i \ \ MZ_i)$  and the absolute value  $MA_i$  are calculated as follows.

$$MX_i = m \cdot VX_i \quad MY_i = m \cdot VY_i \quad MZ_i = \vec{\leftrightarrow} m \cdot VZ_i$$

$$MA_i = \sqrt{MX_i^2 + MY_i^2 + MZ_i^2}$$

**(xi) Force**

Calculates the force of a specified point.

$m$  is the mass of the specified point and  $A_i(AX_i \ \ AY_i \ \ AZ_i)$  is the acceleration of frame i. At this point, force  $F_i(FX_i \ \vec{\leftrightarrow} \ FY_i \ \ FZ_i)$  and the absolute value  $FA_i$  are calculated as follows.

$$FX_i = m \cdot AX_i \quad FY_i = m \cdot AY_i \quad FZ_i = \vec{\leftrightarrow} m \cdot AZ_i$$

$$FA_i = \sqrt{FX_i^2 + FY_i^2 + FZ_i^2}$$

**(xii) Power**

Calculates the power of a specified point.

$m$  is the mass of the specified point and  $V_i(VX_i \ \ VY_i \ \ VZ_i)$  is the velocity of frame I and  $A_i(AX_i \ \ AY_i \ \ AZ_i)$  is the acceleration of frame i. At this point, power  $PW_i(PWX_i \ \vec{\leftrightarrow} \ PWY_i \ \ PWZ_i)$  and the absolute value  $PWA_i$  are calculated as follows.

$$PWX_i = m \cdot VX_i \cdot AX_i \quad PWY_i = m \cdot VY_i \cdot AY_i \quad PWZ_i = \vec{\leftrightarrow} m \cdot VZ_i \cdot AZ_i$$

$$PWA_i = m \cdot (VX_i \cdot AX_i + VY_i \cdot AY_i + VZ_i \cdot AZ_i)$$



**(xiii) Energy**

Calculates the energy of a specified point.

$m$  is the mass for the specified point and  $V_i(VX_i \quad VY_i \quad VZ_i)$  is the velocity of frame  $i$ .

At this point, energy  $E_i(EX_i \quad EY_i \quad EZ_i)$  and the absolute value  $EA_i$  are calculated as follows.

$$EX_i = \frac{1}{2}m \cdot VX_i^2 \quad EY_i = \frac{1}{2}m \cdot VY_i^2 \quad EZ_i = \frac{1}{2}m \cdot VZ_i^2$$

$$EA_i = EX_i + EY_i + EZ_i$$

**(xiv) Calculating the Center of Gravity**

This describes the method of calculating the center of gravity.

The 3-point method of calculating the center of gravity is described below.

The center of gravity  $G(X \ Y \ Z)$  using the 3 points  $P_1(X_1 \ Y_1 \ Z_1)$ ,  $P_2(X_2 \ Y_2 \ Z_2)$ ,  $P_3(X_3 \ Y_3 \ Z_3)$  and the mass  $M_1, M_2, M_3$  are calculated as follows.

$$GX = \frac{M_1 \times P_{1X} + M_2 \times P_{2X} + M_3 \times P_{3X}}{M_1 + M_2 + M_3}$$

$$GY = \frac{M_1 \times P_{1Y} + M_2 \times P_{2Y} + M_3 \times P_{3Y}}{M_1 + M_2 + M_3}$$

$$GZ = \frac{M_1 \times P_{1Z} + M_2 \times P_{2Z} + M_3 \times P_{3Z}}{M_1 + M_2 + M_3}$$

## Appendix D CSV Format

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Graph data can be imported or exported with MOVIAS Neo as comma separated text data (CSV format). The file formats include the two types of time graphs (XT graphs) and correlation diagrams such as trajectory figures (XY graphs).

Imported graphs can be played back together with AVI images and graphs analyzed with MOVIAS Neo.

**File Format**

The format is comma separated text files (CSV format).

The files are constructed of the following 3 blocks.

- ✓ Header (fixed length)  
1~29 rows, containing information relating to the graphs.
- ✓ Data (variable length)  
From row 30 to "EOD", containing coordinate data.
- ✓ Comments (variable length)  
From "EOD" to the end of the file, containing comments (and calibration data).

For CSV output, the point displayed on the list is the one output.

CSV imports correspond to XT graphs.

**(a) Header**

The header is comprised of six parts, including the file identifier, graph settings, graph data information, horizontal axis settings, data channel settings, and channel data information.

**(i) File Identifier**

Row	Contents	Format
1	File format and version identifier	Movias**GraphV## (all single byte) **: Graph format XT with graphs of time, XY for graphs of correlation ##: 2 rows of single byte for version information of this format Ex) time graph, with Ver1.1 MoviasXTGraphV11
2	Reserved	

**(ii) Graph Settings**

Settings for the graphs, including title and data channel.

Note:

- The characters “\/: ?” cannot be used in the “Title”.
- About the “Creator”, indicates the creator of this file and the version.

Row	Item	Contents	Format
3	Title	Graph title	Text
4	SubTitle	Graph sub-title	Text
5	NDataCh	Number of data channels	Integer
6	Creator	Creator of this file	Text

**(iii) Graph Data Information**

Graph data information added with MOVIAS output.

Note: Ignore when importing.

Row	Item	Contents	Format
7	#NData	Number of data	Integer
8	#FrameInterval[ms]	Time interval between frames	Integer

**(iv) Horizontal Axis Settings**

Horizontal axis settings, including title of the horizontal axis and the scale.

Note: Ignore “XMin” and “XMax” when importing.

Row	Item	Contents	Format
9	XAxisCaption	X Axis Caption	Text
10	XUnit	X Axis Unit	Text
11	XMin	X Axis Minimum Value	Fixed at “Auto”
12	XMax	X Axis Maximum Value	Fixed at “Auto”
13	XChName	X Axis Data Channel Name	Text (used only with XT graphs)

**(v) Data Channel Settings**

Settings for each channel, including the titles for vertical lines and colors.

Note: Ignore “LineStyle”, “YMin”, and “YMax” when importing.

Row	Item	Contents	Format
16	ChNo	Channel number	Integers, 1,2,3,4...
17	ChName	Channel name	Text
18	Color	Line color	Color name or number Refer to the following chart for a list of color names
19	Line Style	Line type	Fixed at integers
20	YAxisCaption	Y axis caption	Text
21	YUnit	Y axis unit	Text
22	YMin	Y axis minimum value	Fixed at “Auto”
23	YMax	Y axis maximum value	Fixed at “Auto”
24	YChName	Y axis data channel name	Text
25	XChName	X axis data channel name	Text (used only for XY graphs)

**List of Colors**

Color Name	Color	Color Name	Color
Yellow	Yellow	Maroon	Maroon
Fuchsia	Magenta	Navy	Navy blue
Aqua	Cyan	Purple	Purple
Red	Red	Teal	Teal
Blue	Blue	Black	Black
Green	Green	Gray	Gray
Lime	Lime	Silver	Silver
Olive	Olive	White	White

Color Numbers: After “#”, base 16 with a sequence of blue, green, red, with a maximum of “FF”.

The format is #BBGGRR, with BB the brightness of blue, GG the brightness of green and RR the brightness of red.

**(vi) Channel Data Information**

Information on each channel added for MOVIAS Neo output.

Note: Ignore when importing.

Row	Item	Contents	Format
15	#ExcelRange	Range of cells for channel data on an Excel spreadsheet	Excel standards Ex) B12: C20
26	#Min	Minimum value for the channel data	Integers
27	#Max	Maximum value for the channel data	Integers
28	#MinTime	Time when the channel data is at a minimum [ms]	Integers
29	#MaxTime	Time when the channel data is at a maximum [ms]	Integers

**(b) Data**

Data for each channel in chronological order. Output involves the file for the channel shown on the list display.

Row	Contents	Format
30	Data item	(XT graph) Time[ms], Ch1Y, Ch2Y, Ch3Y, Ch4Y.... (XY graph) Time[ms], Ch1X, Ch1Y, Ch2X, Ch2Y, Ch3X, Ch3Y, Ch4X, Ch4Y....
31 ~ EOD	Time and channel data	(1 <sup>st</sup> row) Time data. Msec units, integers. Times all at even intervals. (2 <sup>nd</sup> row and after) Channel data. Integers. Data arranged identical to the 30 <sup>th</sup> row.

Untracked points and failed measurement points show “ ” in the column.

If comments or calibration data are continued below, “EOD” is inserted.

**(c) Comments**

From “EOD” to the end of the file. Includes comments. When exporting from measurement data, the calibration data (real scale conversion, changes in perspective, 3D calibration) can also be exported.

Ignore when importing.

**(i) Calibration Data**

If exporting from measurement data to a CSV file, calibration parameters are included after the “EOD” row. Depending on the calibration, the calibration parameters are included from the item “CalibPrmBeg” to the item “CalibPrmEnd”.

✓ Real Scale Conversion

If performing real scale conversion for calibration or if not calibrating, the following parameters are output.

Real scale conversion parameters consist of calibration parameters, axis and origin settings and depth planes

Row	Item	Contents
EOD next row	CalibPrmBeg	Mark for starting the calibration data
	#2D Calibration Parameter	
		Real scale conversion parameters Refer to the following table for details
(# of plane rows)		Depth plane parameters Refer to the following table for details
Next row after the entries for all the plane parameters	#End	
	CalibPrmEnd	Mark for ending the calibration data

**Details of the real scale conversion calibration parameters**

The following calibration parameter items are included in the row as CSV.

**Conversion Parameters**

Column	Item	Contents	Format
1	Type: scale	Calibration type Fixed at "scale"	Fixed text
2	Datum pnt1_x: (#)	Input reference length coordinates (X starting point)	Integers
3	Datum pnt1_y: (#)	Input reference length coordinates (Y starting point)	
4	Datum pnt2_x: (#)	Input reference length coordinates (X ending point)	
5	Datum pnt2_y: (#)	Input reference length coordinates (Y ending point)	
6	Segment length: (#)	Actual reference length	
7	Depth: (#)	Depth of reference plane	
8	Coefficient: (#)	Coefficient of calculated reference plane	

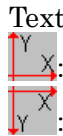
**Starting Point for Real Scale Conversion**

Exports the starting point settings for real scale conversion. Items vary according to the item selected.

Column	Item	Contents	Format
If [lower left corner of screen] or [fixed] is selected			
9	Origin_x: (#)	X coordinate for the starting point	Integer
10	Origin_y: (#)	Y coordinate for the starting point	
If [each frame] is selected			
9	Origin point: ( <i>Point name</i> )	Name of starting point	Text

**Axis Direction for Real Scale Conversion**

Exports the axis settings for real scale conversion. Items vary according to the item selected.

Column	Item	Contents	Format
If [horizontal right] is selected			
Next column from beginning point	Axis_x_direction: horizontal axis	Shows the X axis direction	Fixed text
If [fixed] is selected			
Next column from beginning point	Axis_x begin_x: (#) Axis_x begin_y: (#) Axis_x end_x: (#) Axis_x end_y: (#)	Input coordinates for X axis (X starting point) Input coordinates for X axis (Y starting point) Input coordinates for X axis (X ending point) Input coordinates for X axis (Y ending point)	Integer
If [every frame] is selected			
Next column from beginning point	Axis_x begin: ( <i>Point name</i> ) Axis_x end: ( <i>Point name</i> )	Name of X axis starting point Name of X axis ending point	Text (blank if not selected)
Y axis direction			
Next column from X axis	Axis_y: ( <i>characters</i> )	Characters set to indicate the Y axis direction	Text  : bottom-up : top-down



**Details of the Parameters for the Depth Plane**

The scale plane is shown after the depth plane.

Column	Item	Contents	Format
1	Depth plane: ( <i>characters</i> )	Depth plane name	Text
2	Depth: (#)	Depth of this plane	Numbers
3	Coefficient: (#)	Conversion coefficient of this plane	Numbers

✓ Changing perspectives

Exported to change perspectives.

Parameters for changing perspectives include conversion parameters and axis and origin settings.

Row	Item	Contents
EOD next row	CalibPrmBeg	Mark for starting the calibration data
	#2D Calibration Parameter	
		Parameters for changing perspectives Refer to the following table for details
	#End	
After entering all of the calibration data	CalibPrmEnd	Mark for ending the calibration data

**Calibration Parameters for Changing Perspectives**

The following items are included in the row as CSV.

**Conversion Parameters**

Column	Item	Contents	Format
1	Type: perspective	Calibration type Fixed at "perspective"	Fixed text
2	Point_UL_x: (#)	Input reference length coordinates (upper left of X)	Integer
3	Point_UL_y: (#)	Input reference length coordinates (upper left of Y)	
4	Point_UR_x: (#)	Input reference length coordinates (upper right of X)	
5	Point_UR_y: (#)	Input reference length coordinates (upper right of Y)	
6	Point_LR_x: (#)	Input reference length coordinates (lower right of X)	
7	Point_LR_y: (#)	Input reference length coordinates (lower right of Y)	
8	Point_LL_x: (#)	Input reference length coordinates (lower left of X)	
9	Point_LL_y: (#)	Input reference length coordinates (lower left of Y)	

**Conversion Parameters** (continued from previous page)

Column	Item	Contents	Format
10	Segment_UL_UR: (#)	Actual reference length (Upper left $\Leftrightarrow$ Upper right)	Integer
11	Segment_UR_LR: (#)	Actual reference length (Upper right $\Leftrightarrow$ Lower right)	
12	Segment_LL_LR: (#)	Actual reference length (Lower left $\Leftrightarrow$ Lower right)	
13	Segment_UL_LL: (#)	Actual reference length (Upper left $\Leftrightarrow$ Lower left)	
14	Segment_UL_LR: (#)	Actual reference length (Upper left $\Leftrightarrow$ Lower right)	
15	Segment_UR_LL: (#)	Actual reference length (Lower left $\Leftrightarrow$ Upper right)	

**Starting Point for Changing Perspectives and Axis Direction for Changing Perspectives**

Identical to real scale conversion. Enter on the same row as the calibration parameters for changing perspectives.

## ✓ 3D Calibration

Output during 3D calibration.

Outputs the calibration method and the calibration results.

Note: For “Repeat for each camera” repeats for all cameras.

Camera name → PrincipalDist → ... → CameraPosition → Camera name →

PrincipalDist→.....

Sequentially output for all the cameras.

Row	Item	Contents
EOD next row	CalibPrmBeg	Mark for starting the calibration data
	Type: ( <i>characters</i> )	With 3D calibration: “Type: 3D Calibration” With MDLT: “Type: MDLT”
Repeat for each camera	CameraName: ( <i>characters</i> )	Camera name
	PrincipalDist: (#), (#)	X, Y of the camera focal length
	PrincipalPnt: (#), (#)	X, Y of camera center position
	TransformR: (#), (#), (#) (#), (#), (#) (#), (#), (#)	Rotation matrix showing the camera positions
	CameraPosition: (#), (#), (#)	X, Y, Z of camera position
After including all of the calibration data	CalibPrmEnd	Mark for ending the calibration data

## (ii) Comments

If there are comments, enter the comments in the row after “#Comment”. If none, leave blank

Row	Contents
#Comment	Mark for starting comments
From #Comment next row to the end of the file	Comments

Appendix E Simple CSV Format

After Ver2.20, a simple CSV format has been added to the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) for importing waveform data. This streamlines the procedure for editing files.

(a) File Format

The format is comma separated text file (CSV format).  
The files are constructed of the following 2 blocks.

Data (variable length)  
Pairs of time and waveform data.  
Optional information (variable length)  
The names and colors of series information can be specified. If there isn’t any, the default value is set.

An example of a file is shown below. In this example, time data is entered in the first line but times can be set in other lines by specifying “Time” under [Title] of the optional information.

Time data (milliseconds)	Data			
1	0.188906	0.663756	0.308846	0.688181
2	0.571408	0.615731	0.267138	0.555397
3	0.943593	0.390421	0.064892	0.823087
		⋮		
99	0.986931	0.117127	0.487761	0.118405
100	0.514575	0.335635	0.758175	0.846427
Unit=msec	Meters	Meters	g	V
Color=0xffffffff	0xff00ff	0x00ff00	0x0000ff	0xff0000
Axis=Time	Position	Position	Acceleration	Sensor
Title=Time	Seq1	Seq2	Seq3	Seq4
FrameRate=10000				

Example of a Simple SCV File Format

**(i) Data**

Section to arrange time and waveform data in pairs.

Specify the time in milliseconds. The amount of data is determined by the number of rows in the top row of the data.

The default is the time data in the first column. If setting “Time” under [Title] in the optional information section, that column is specially imported as time.

**(ii) Optional Information**

If “Unit”, “Color”, “Axis”, “Title” or “FrameRate” are entered in the first column, the information noted in that row is used to import the optional information on the waveform data.

If there are multiple rows with the same item in the file, the contents of the first row found are reflected.

Series data with the same [Unit] and [Axis] are drawn to the same axis but if they are different, they are drawn to different axes.

**Unit**

Sets the units for the series. Used as the graph display units. The default is “V”.

**Color**

Sets the color for the series. The default is the registered color.

**Axis**

Sets the axis for the series. Paired with units for use. The same pair is shown on the same axis. The default is “voltage”.

**Title**

Series title. The default is sequential [Ch1], [Ch2].

If “Time” is specified, the column is treated separately as the time sequence, and a graph is drawn.

If not, the first column is imported as time.

**FrameRate**

Sampling frequency for the waveform data. This number is calculated when applying Filter Settings (p. 8–25). If not entered, it is calculated from the time series data.

The following is entered into the エラー! 参照元が見つかりません。 (p. エラー! ブックマークが定義されていません。 ) .

Series	Unit	Color	Axis Name
Time	msec	0xffffffff	Time
Seq1	meters	0xff00ff	Position
Seq2	meters	0x00ff00	Position
Seq3	g	0x0000ff	Acceleration
Seq4	V	0xff0000	Sensor

[Units] and [Axis] are only used for the graph display and identifier name. Unit conversion (milliseconds ⇔ seconds) is not supported

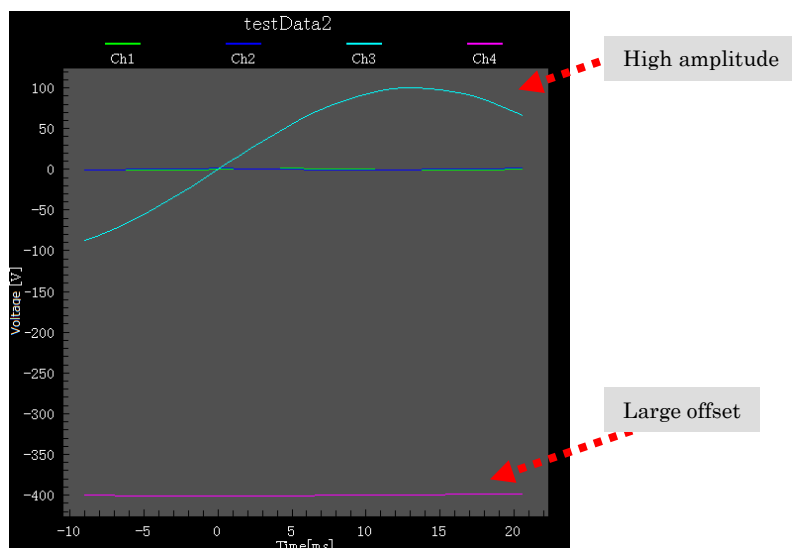
The first column in the エラー! 参照元が見つかりません。 is read as time.

“Seq1” and “Seq2” are drawn on the same axis since the [Unit] of “meter” and [Axis] of “position” match. “Seq3” and “Seq4” are drawn on different axes since the [Unit] and [Axis] combination does not match.

### (iii) [Unit] and [Axis] Optional Information

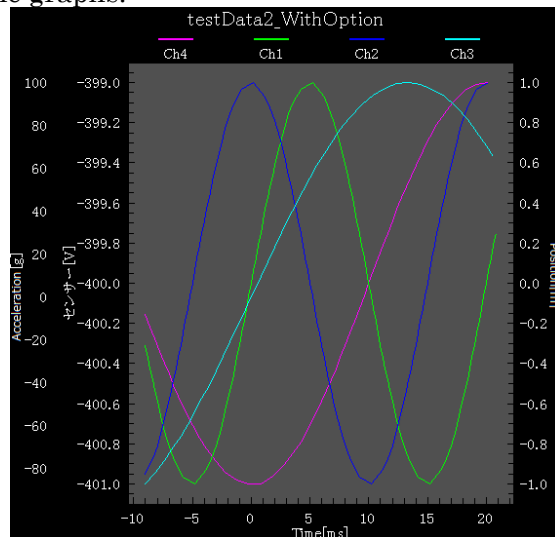
The [Unit] and [Axis] optional information are separated according to the axis displaying the series data.

Effective when comparing different data with high amplitude or large offset.



#### Example of Defaults (when optional items are not specified)

Ch3 has high amplitude compared to other series. Ch4 has low amplitude compared to other series but a large offset. If these series are imported unchanged, it will be a bit difficult to compare the graphs.



#### Example of when the axis is specified (when optional items are specified)

Loaded as unit + axis.

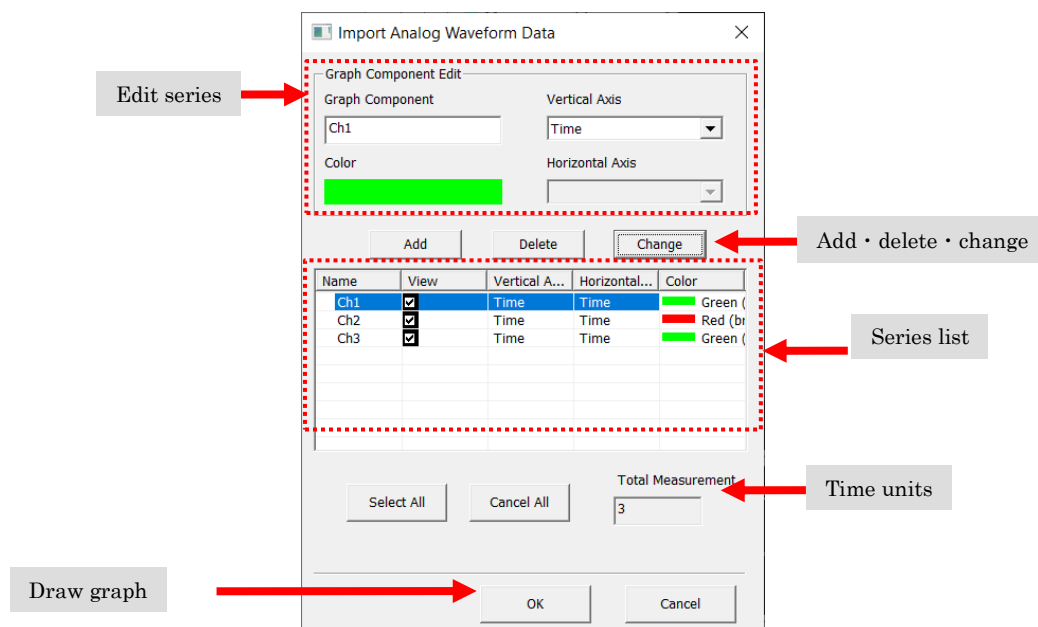
Ch1, Ch2 from the previous graph are on a single axis. Ch3 is on a single axis. Ch4 is drawn on a single axis.

Since vertical auto scaling is done for each axis, it is easy to compare each waveform.

Therefore, when importing waveforms, consider combining axes according to the scale of the data.

## (b) Importing Waveforms

When loading simple CSV formatted waveform files, the analog waveform data import dialog in the figure below is displayed. Create the series to import and press the draw graph button to draw a waveform graph. If necessary, add • delete series.



Double click [Name], [View], [Vertical Axis], [Horizontal Axis] or [Color] in the series list dialog to edit. Click the draw graph button and after creating a graph, use エラー! 参照元が見つかりません。 Properties( p. 8－26) to edit data not on the horizontal axis.

Use the [Add], [Delete], and [Change] button to add, remove or change the series.

### Add

Adds the series set in the edit series section to the series list.

### Delete

Deletes the series data selected in the series list from the list.

### Change

Changes the details of the series data selected in the series list that were set in the edit series section.

### Separate Graph for Each Channel

Create a graph for each series on the list.

### One Graph for Each Channel

Draws each group of waveform data with the same horizontal axis on a single graph. If there are multiple groups with the same horizontal axis, multiple graphs are drawn.

### Time Units

Select the units showing the time axis for the waveform graph.

Select from sec, msec or usec.

Appendix F 2D-6DOF Reference Coordinates File

The 2D-6DOF reference coordinates file specifies a desired starting point (0.0, 0.0, 0.0) to a rigid body in CSV format (comma separated values) so create a graph of coordinates for each measurement point with the coordinate system on the left. The values that must be input include, from the left, the name, X coordinate, Y coordinate and Z coordinate for each measurement point. The names of each measurement point must be the same name assigned to the target point assigned in MOVIAS Neo.

	Name of each measurement point	X Coordinates	Y Coordinates	Z Coordinates
	A	B	C	D
1	Point 0	81	0	0
2	Point 1	0	85	0
3	Point 2	0	0	77
4	Point 3	81	0	0
5	Point 4	22	45	66
6	Point 5	1	50	70
7	Point 6	0	0	44









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