CompView Users Guide

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Introduction

The CompView utility was written to allow users to view the contents of machine error map files for their CMM's. The data is displayed numerically and graphically for standard compensation items and numerically for all other related data.

The CompView utility can display a variety of error map formats from various vendors. This utility is cross platform compatible and can be run on GNU/Linux, OSX, and Windows.

Overview

The CompView utility is a single dialog window with tabs assigned for each axis of the CMM, the squareness, and any associated compensation data. Files are loaded using either the Select option from the input view or by dragging the compensation file (or folder) onto the CompView window.

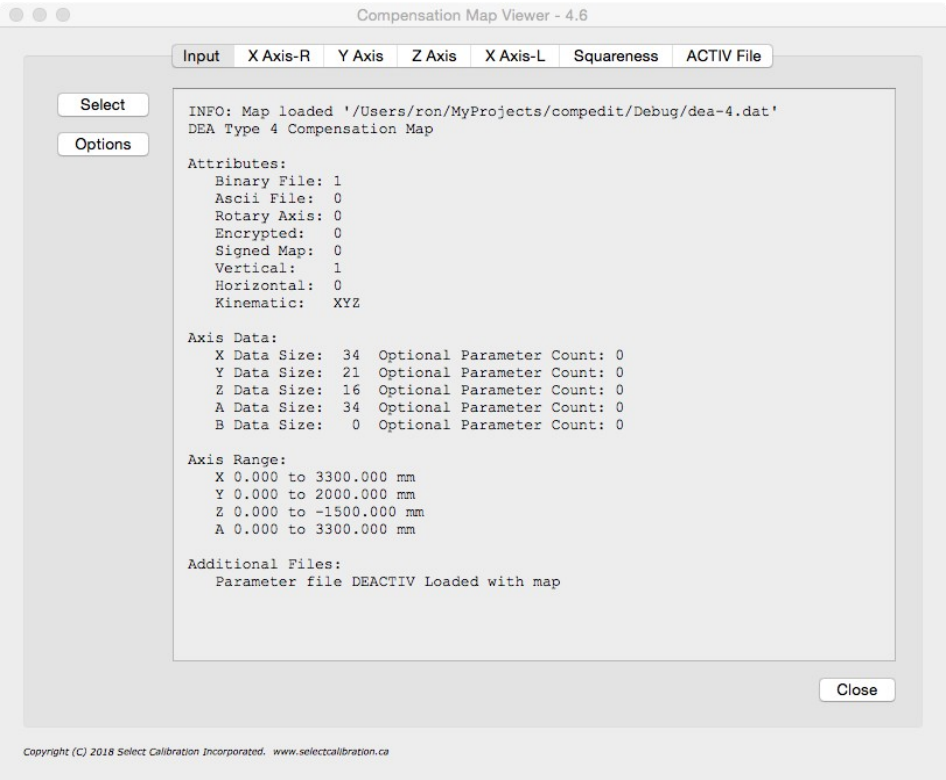

Illustration 1: Appearance of CompView with a compensation map loaded

Each axis contains a split view of the data with the numerical values displayed as text in the upper half and a 2D or 3D graphical view of selected data in the lower half. The type of display for the data can be set by toggling the button *Show 2D* or *Show 3D*.

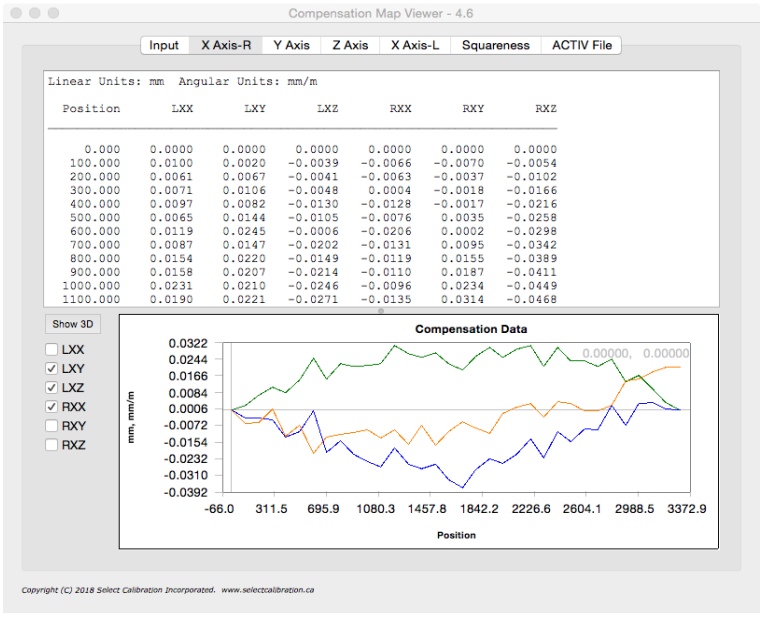

Illustration 2: Display of axis data in 2D mode

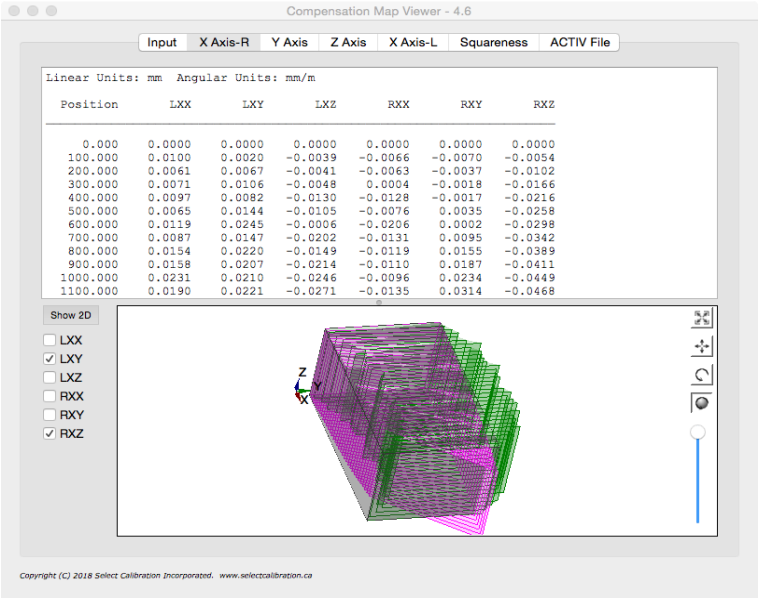

Illustration 3: Display of axis data in 3D mode. Display is showing an exaggeration of the X axis yaw and horizontal straightness.

Display 3D Controls

The 3D model display is not fixed and can be manipulated in a variety of ways. The model volume is based on the actual dimensions of the loaded compensation map and is displayed in the background as a grey cube. The model is displayed on the idea of a projection frustum to mimic the relative size of objects based on the distance away from the viewer to provide a slightly more realistic rendering of the volume of the data.

Image	*Description*
	Scale to fit. Adjusts the scale of the OpenGL Projection matrix to fit the visible data into the display viewport.
	Pan Mode. When enabled a right mouse button click and drag will move the position of the displayed model. For systems with a single mouse button use Ctrl + Mouse.
	Rotate 2D Mode. When enabled a right mouse button click and drag will rotate the model around the center of the viewport. For systems with a single mouse button use Ctrl + Mouse.
	Rotate 3D Mode. When enabled a right mouse button click and drag will rotate the model around the click position on the displayed model. For systems with a single mouse button use Ctrl + Mouse.
	Error Multiplier. The relative error of the data can be increased with this slider. *The error multiplier will allow errors to be exaggerated up to a maximum of 45 degrees for angular data and equal to the shortest volume axis length for linear. The limits are determined from all angular and linear data for each axis.*

In addition to the above controls areas of the displayed model can be zoomed into by drawing a box around any area of interest. The scale of the model can be increased or decreased using the mouse scroll button.

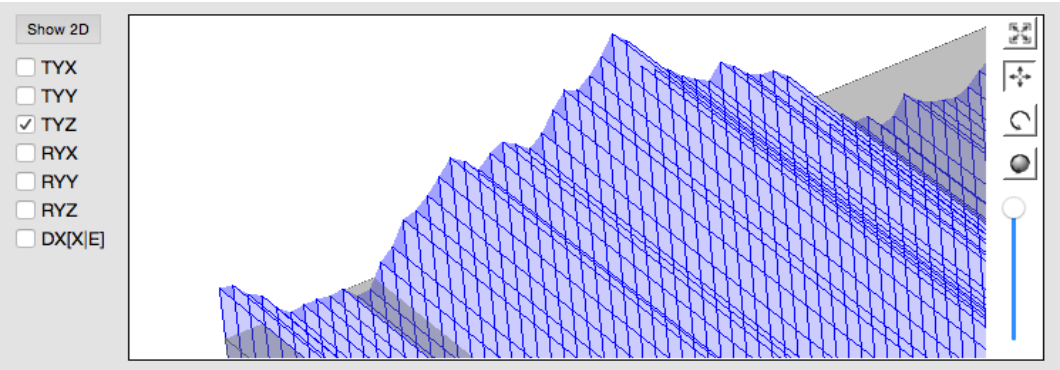

Illustration 4: Example showing relative errors for Y axis straightness in Z direction.

The method to display the error map data was chosen to generically represent what the data describes. The displayed simulation does not necessarily represent how the software interprets the compensation data.

Only the standard eighteen compensation parameters can be displayed using the 3D graphing option. Options that cannot be displayed can still be selected but will not appear in this view of the data.

OpenGL

The graphical view of the errormap data is drawn using OpenGL. Starting with version 4.0 of the CompView utility a newer base class for rendering 3D data is used. The computer must have at least OpenGL version 2.x or higher in order to run this utility program with a functional 3D view of the errormap data.

Using the newer base class solves a number of problems such as the opaque (or nonexistent) zoom window. The newer OpenGL widget is also more suitable for using modern features such as vertex shaders. The CompView utility will be eventually updated with the newer OpenGL features and methodologies and moving to the new widget is the first step.

The advantage of the older OpenGL base class was compatibility with legacy systems. Version 3.x and older of the CompView utility would work on computers that only supported OpenGL 1.x.

Running the CompView program on computers that only support OpenGL 1.x the 3D view is replaced with an information window. An example of this information window is shown in illustration 5.

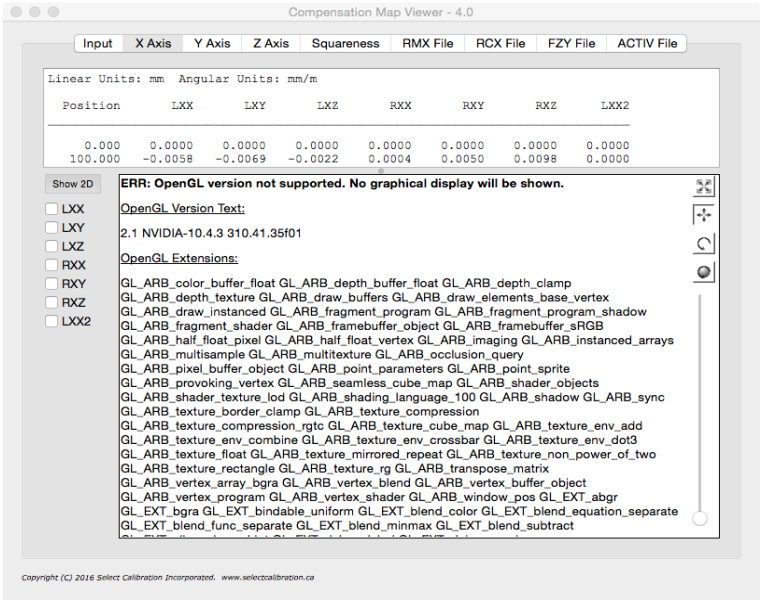

Illustration 5: Information screen that is displayed with unsupported OpenGL versions.

Display Units and Titles

The options button from the input tab of the CompView utility allows the user to customize the labeling of the error map data. The customization includes the data labels, display units, and display precision.

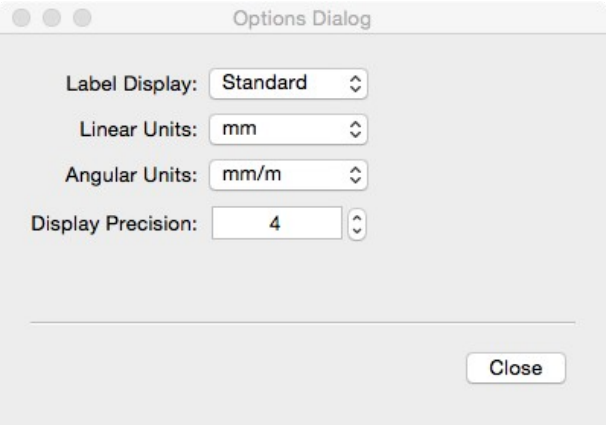

Illustration 6: Options dialog

These options do not affect any supplemental data loaded with the error map such as deflection or parametric files. These options only affect the display of the compensation data for each axis of the CMM and the squareness values.

Option Name	*Description*
Label Display	Method used to identify the displayed data. This option can be set to DEA, Standard, ISO 230, or VDI 2617. *The definition of the Z axis pitch and yaw errors when using the Standard labels has changed starting with version 3.0 of the error map viewer. Refer to the Z Axis Standard Naming Convention section.*
Linear Units	Display units for all linear parameters. The default is micrometers (um) but the data can also be displayed in millimeters (mm).
Angular Units	Display units for all angular parameters. The default is micrometers per meter (um/m) but millimeters per meter (mm/m) and arc-seconds are available as options.
Display Precision	The number of decimal places to show of the data. This option must be set appropriately to the selected display units of the data. For example, if the linear display units is set to mm and the angular display units is mm/m then the display precision should be no less than 3.

Z Axis Standard Naming Convention

The standard naming convention of pitch and yaw for the Z axis can be ambiguous. Starting with CompView 3.0 the naming convention for Z axis pitch and yaw has been defined is as shown in illustration 7. Prior versions of CompView labeled the Z axis pitch as the rotation of the Z axis around the X axis of the machine.

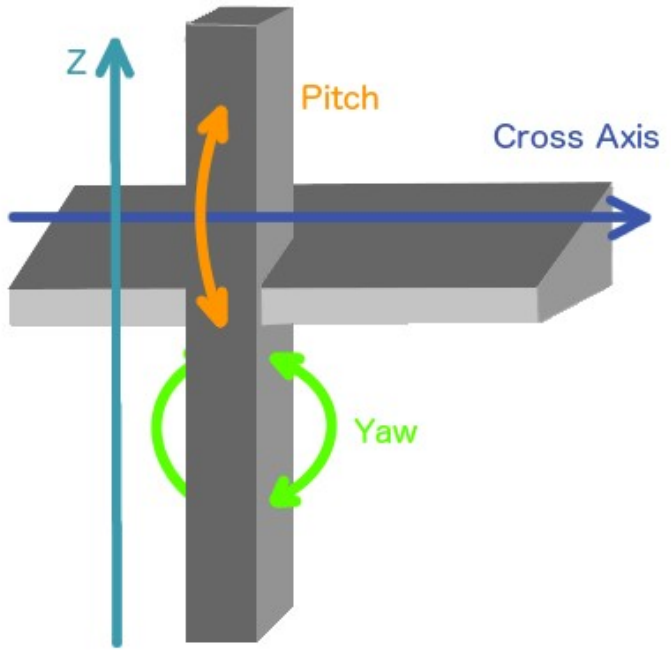

Illustration 7: Naming convention for Z axis pitch and yaw.

For the new naming convention the pitch is always around the cross axis. A CMM with a kinematic axis order of YXZ the Z axis pitch would be the same as RZX (rotation of Z axis around the X). For a kinematic axis order of XYZ the Z axis pitch would be the same as RZY (rotation of Z axis around Y).

When using the standard naming convention the Z axis horizontal straightness would always refer to the error parallel to the cross axis and the vertical straightness would be perpendicular to the cross axis.

LK Compensation Maps

The LK compensation map data is stored in a series of files inside a folder commonly called 'Errc'. In order to load one of these compensation folders the file 'LASERDAT.PRG' is used as the identifying file when using the File Selection dialog. If the folder or the identifying file 'LASERDAT.PRG' is dragged into the viewer the data will be recognized an an LK compensation file.

In the event the actual compensation data size does not agree with what is expected from what is described in the file LASERDAT.PRG a warning message is displayed. The files LASERDAT.PRG and XYZ.DAT should be checked for entry errors relative to the actual data size. Different compensation parameter's that have different entry sizes will always generate a warning message.

DEVA Compensation Maps

The DEVA compensation map data is stored in a series of files with a common name. The extension of the individual files is used to identify the contents of the data. In order to load one of these compensation maps the compiled errormap matrix and all parameter files must exist in the same directory (with the same base file name). These maps can be loaded by selecting any of the required files or by dragging the folder containing these files into the compensation viewer program. A complete set of compensation files will include files for all linear, straightness, and angular corrections along with the compiled map file (nineteen files in total).

In the event there are multiple compensation files in the same folder, and the folder was used as the input, the first minimal compensation set is loaded.
Files that are missing from a complete map set will display zero values inside the compensation viewer.
DEVA compensation maps that do not include a configuration file will default to a kinematic order of YXZ. This does not alter the contents of the data but it will show this configuration in the information page of the compensation viewer program.

OpenDMIS Compensation Map

The OpenDMIS compensation map data can have the data arranged in a variable order with a random spacing of the data. These formats are automatically interpolated down to the minimum data step found in the data to a minimum of 5 mm.

Verisurf Segment Axis Compensation Map

Verisurf uses two known types of 3D compensation maps for their machines. The first format, called *Segment Axis*, contains information similar to what would normally be contained in a typical compensation map. The second format, called *Grid Table*, is a collection of nominal and actual measurement points throughout the measurement volume of the CMM.

The compensation viewer utility can only load the *Segment Axis* version of this file. It is possible to extract the compensation map data from the grid table version but this process is complex and beyond the scope of this program.

Both the *Segment Axis* and *Grid Table* compensation maps use the same file extension of V3D so to determine the file type it is necessary to open it with a text editor and review the header data section.

```
CALTYPE=SEG_AXIS_TABLE
```

```
CALTYPE=3D_GRID_TABLE
```

Changing the CALTYPE parameter from 3D_GRID_TABLE to SEG_AXIS_TABLE will not make the file readable or usable unless the contents of the file is also changed to suite the CALTYPE parameter option.

DEA Dual Scale Compensation Map

DEA machines that have two scales along the X axis have special compensation to deal with the extra information available to the software. The first option is to have a second scale parameter file outside of the standard compensation error map containing corrections for the second scale. The second method is to have a single compensation file that contains two sets of X axis data for the left and right side of the machine. The second method allows for a more complete description of the X axis of a machine where changes in the center of gravity for the bridge has subtle effects on the X axis characteristics.

LXXD1

For earlier versions of DEA dual scale compensation a separate data file called LXXD1.DAT was expected to contain the corrections for the second scale of the CMM's X axis. This is the method used for DEA map types 1-3. One confusing point is that the second scale file LXXD1.DAT compensates along the primary scale of the CMM.

TD Maps

The DEA type 4 compensation error map includes a second set of data for the X axis of the coordinate measuring machine. The two sets of X axis data are shown as *X Axis-L* and *X Axis-R* by compensation viewer program.

DEA maps with dual scale or dual axis data do not apply compensation parameter RXZ in the same way as the single axis counterpart. Correction for RXZ data is based only on the probe offset for these dual axis maps.

Squareness

The squareness entries for XY, YZ, and ZX may be actual values stored inside the compensation data or extracted from the compensation data when these entries do not exist. As an example the Brown and Sharpe CTx and Zeiss maps do not have separate squareness entries in their compensation data so values are extracted from the standard 18 compensation parameters.

Additional Compensation Files

Some vendors store information in supplemental files that are related to the compensation map but not part of the standard compensation parameters. This includes table compensation, deflection files, and parametric compensation files among other things. When loading a compensation map the supplemental files will be displayed as part of the regular compensation axis parameters or in separate tabs depending on the nature of the data.

Revision History

Date	*Version*	*Changes*
Jan 24, 2016	1.0	New Program
Feb 28, 2016	1.1	Added more extensive testing of binary map types. Previous version may crash with unrecognized input files instead of returning an error message.
Mar 27, 2016	1.2	Added Capps compensation files. Added CT1 files configured for horizontal arm CMM. Added display for LK deflection data. Added support for LK subdivided map increment steps. Added warning messages for LK maps when conflicting information exists. Set minimum graph display resolution to value suitable for displayed data.
Apr 6, 2016	1.3	Added additional LK validity checks and warning messages.
Apr 11, 2016	1.4	Information section from input tab is now scrollable to keep window geometry size reasonable.
Apr 25, 2016	1.5	Added Renishaw compensation map formats. Added output for signed map formats.
June 12, 2016	2.0	Updated Qt version to 5.6.0. Added option to display compensation data in 3D.
June 25, 2016	3.0	Fixed problem where re-loading maps may crash the software. Added support for label naming conventions ISO 230 and VDI 2617. Standardized naming convention of pitch and yaw for Z axis.
Aug 3, 2016	3.1	Added DEVA compensation map formats.
Sept 11, 2016	3.2	Added OpenDMIS compensation map formats.
Oct 6, 2016	3.3	Added support for LK maps with dual scales.
Oct 20, 2016	3.4	Added OpenDMIS text map formats. Fixed a problem where OpenDMIS map formats were in the wrong units.
Nov 30 2016	3.5	Added Leitz map formats.
Dec 14, 2016	4.0	Switched to newer OpenGL base class. Added option to detect minimum usable OpenGL version and disable sections of the program that are not compatible. Added splitter for axis data. Size of text vs graphical data can be adjusted as needed.
Feb 14, 2017	4.1	Added Verisurf Segment Axis compensation map format.
Mar 18, 2017	4.2	Changes for interpretation of Sheffield configuration data.
Jul 3, 2017	4.3	Fixed problem loading Leitz compensation maps with empty data

Date	*Version*	*Changes*
		sections
Nov 3, 2017	4.4	Fixed problem loading DEA type 4 maps with empty fourth axis header.
Apr 25, 2018	4.5	Added VDMIS compensation map format.
July 11, 2018	4.6	Fixed problem loading Virtual DMIS maps with Y2 Data. Fixed problem with interpretation of Sheffield Z Scale Factor. Prevent DEVA maps from opening if parameter files missing. Report Sheffield MEA sphere position when loading map. Added custom axis names to data. Added custom axis parameter names. Changed rotary table position to degrees instead of radians.
Oct 24, 2018	4.7	Added Zeiss Guideway/Square compensation map format
Jan 28, 2019	4.8	Added Mycrona map format Added Visio map format