CompView Users Guide

Table of Contents

Introduction

The CompView utility allows users to view the contents of CMM compensation error map files. The data is displayed numerically and graphically for standard compensation data and numerically for all other related data.

The CompView utility can display a variety of error map formats from various vendors. The type of data displayed can be a standard compensation error map or a compensation error grid.

Overview

The *CompView* utility consists of a single window with tabs assigned to each CMM axis, grid data, and squareness data. Other compensation associated data such as deflection or temperature correction is displayed uninterpreted in separate tabs of the viewer.

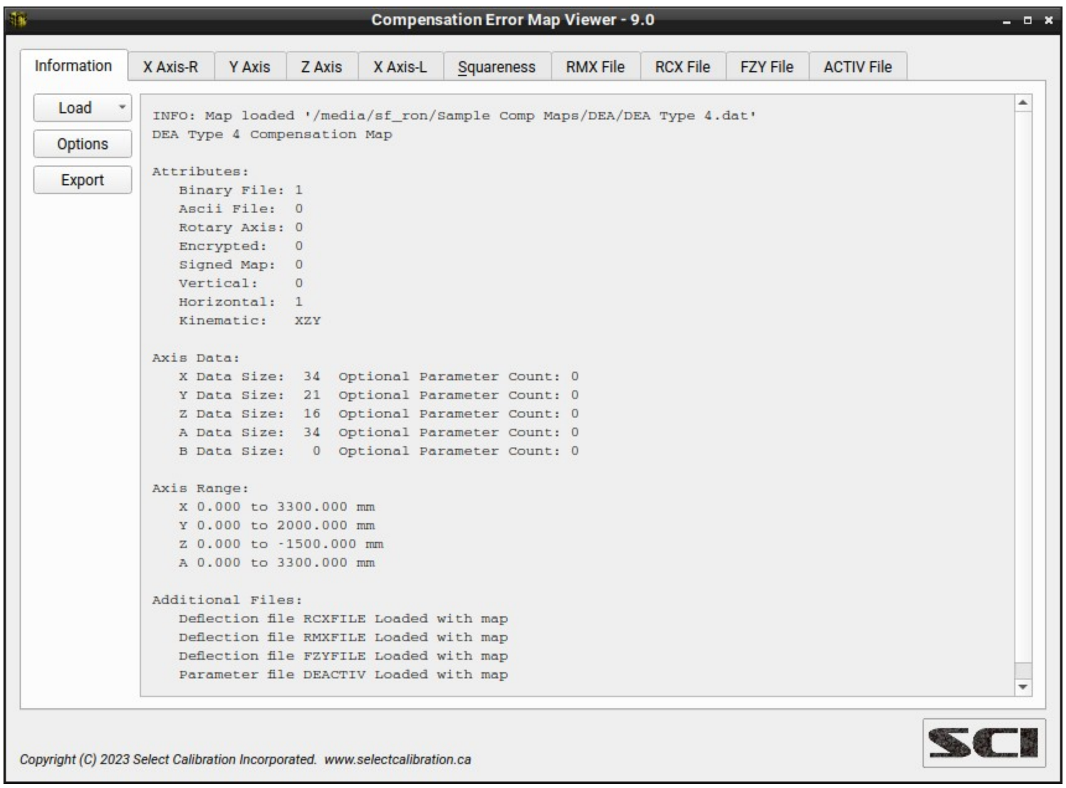


Illustration 1: Appearance of CompView with a compensation map loaded.

Options:

Option Name	*Description*
Load	Open a supported compensation error map or compensation error grid.
Options	Configuration of the data display options. See *Display Options* section.
Export	Output the active error map to a CSV file. See *Export Map Data* section.

Compensation files can be loaded using drag and drop.

Display Options

The names of the axis parameters and the units of the error data can be changed to suite the user. Clicking the *Options* button from the *Information* tab of *CompView* opens the option dialog as shown in illustration 2.

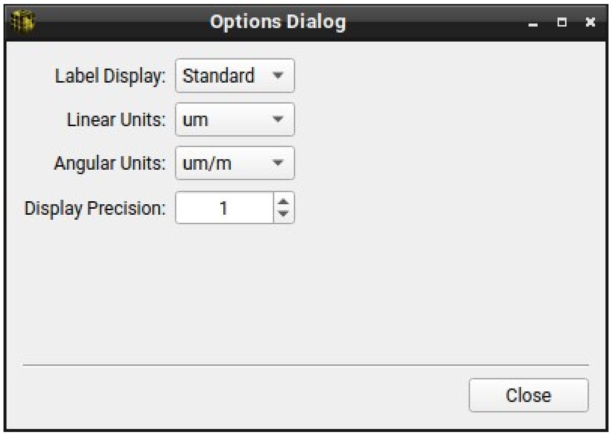


Illustration 2: Options dialog

Options:

Option Name	*Description*
Label Display	Method used to identify the displayed data. See *Label Display* section for more details.
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 data display units. 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.

The display options do not affect supplemental data loaded with the error map such as deflection or parametric files. Supplemental data is currently displayed without interpretation by CompView.

Label Display

The compensation data labels can be shown in one of four formats; DEA, Standard, ISO 230, and VDI 2617. The following table shows examples of the different formats with example names for the X axis scale, the Y axis vertical straightness, and the Z axis roll:

Label Name	*Examples*	*Description*
DEA	LXX, LYZ, RZZ	The first letter, L or R, indicates linear or angular parameter. The second letter is the moving axis and the

Label Name	*Examples*	*Description*
		third letter is the measuring axis.
Standard	Scale, Str Z, Roll	The display of the data using conventional names such as scale, straightness, roll, pitch, or yaw.
ISO 230	XX, ZY, CZ	The first letter is the measurement axis, the second is the axis. Letters A, B, and C represent the X, Y, and Z axis for angular data.
VDI 2617	XtX, YtZ, ZrZ	The first letter indicates the axis, the second (t or r) indicates linear or angular data and the third is the measurement axis.

Export Map Data

The Export option will save the currently loaded compensation error map to a CSV file. The CSV file can be opened with any spreadsheet software such as LibreOffice Calc or MS Excel. Illustration 3 shows the Export Map Data Dialog.

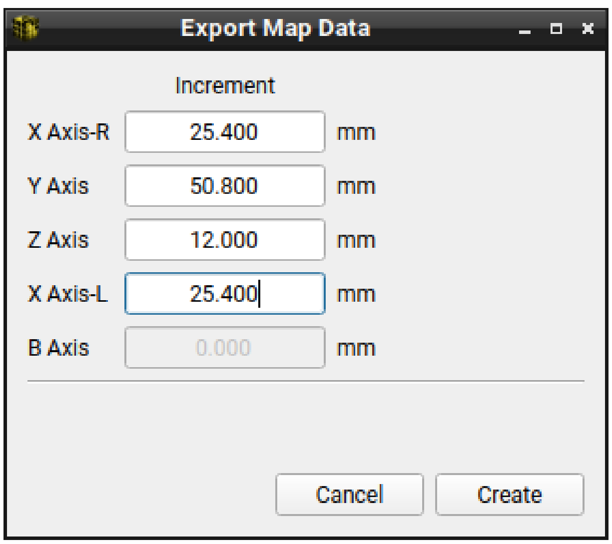


Illustration 3: Exporting the currently loaded compensation data with user defined increments.

The increment initially shown in the dialog is the nominal increment of the currently loaded map data. This increment can be changed to anything suitable for the desired output.

The minimum increment that can be used is 1 mm. The maximum increment is limited to the range of the axis so that 2 data points will always be created.

Option	*Description*
Increment	Desired increment for the data output. The sign of the increment is automatically determined based on the range of the axis data.

Option	*Description*
Cancel	Close the dialog. No output is created.
Create	Create the output CSV file from the map data at the increments specified.

Axis Display

The axis data is displayed in a split view with the upper section showing the text and the lower section showing a graphical representation of the data. The graphical representation can be toggled between 2D or 3D by clicking on the *Show 2D* or *Show 3D* button. The 2D display can graphically show any type of data where the 3D display is limited to selections from the standard eighteen compensation parameters.

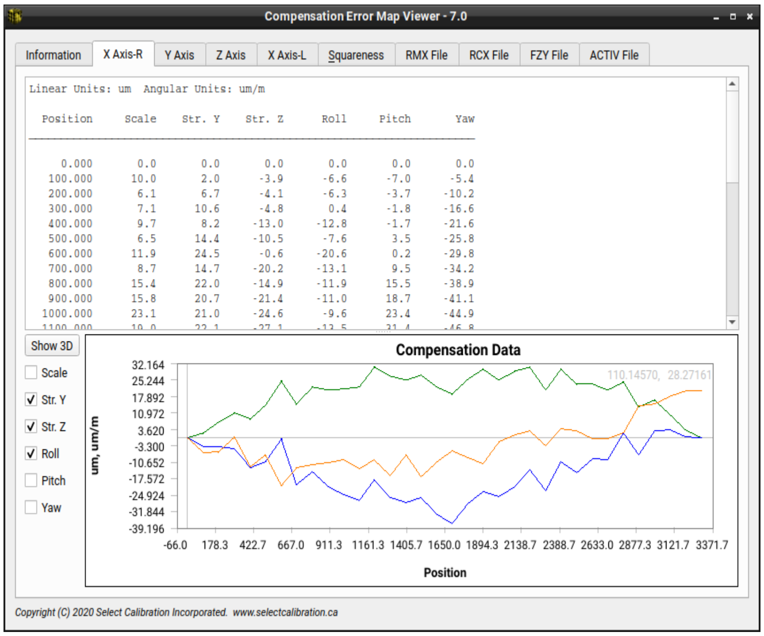


Illustration 4: Display of axis data in 2D mode.

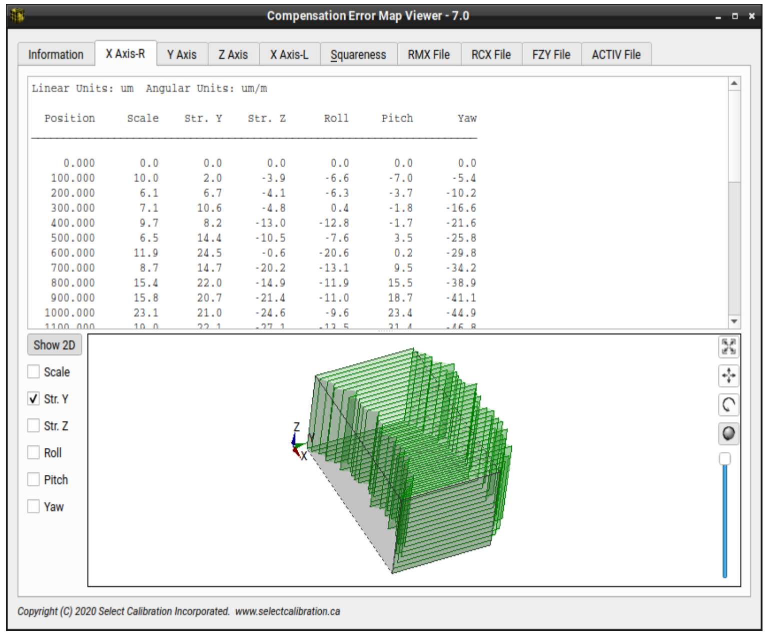


Illustration 5: Display of axis data in 3D mode. Display is showing an exaggeration of the horizontal straightness.

Compensation error grids display all data in a single tab of the *CompView* utility. Grid data cannot be displayed in 2D as this doesn't make sense so the graphical display is always 3D.

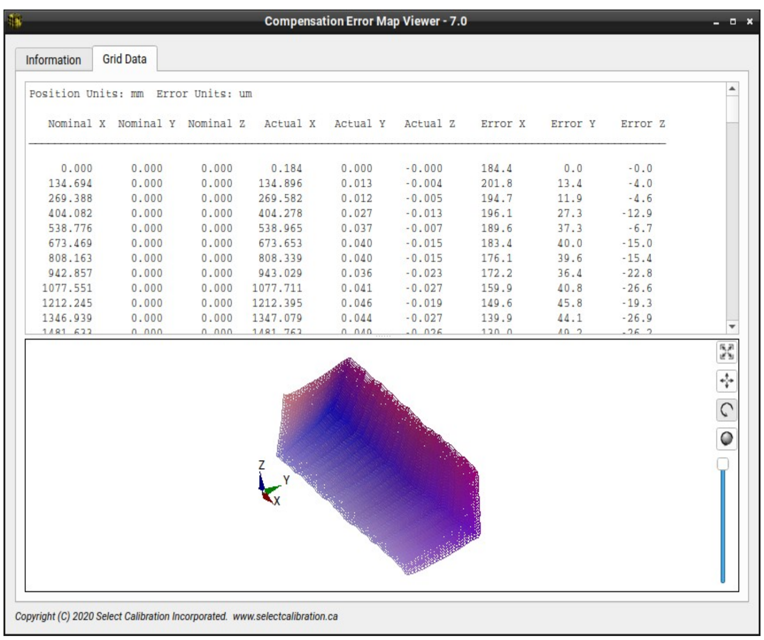


Illustration 6: Display of grid data in 3D with exaggeration of the error. The data grid colors are based on the amount of error along the X, Y, and Z axis.

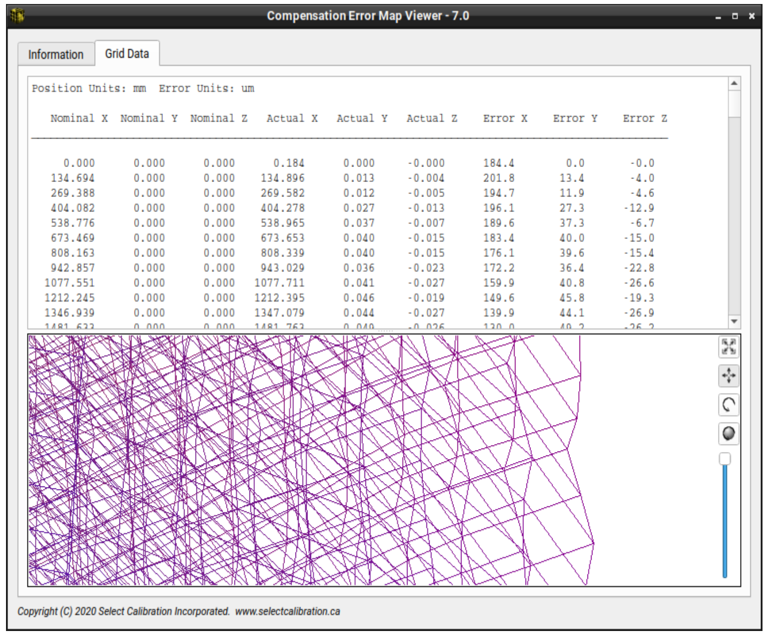
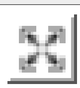
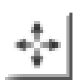
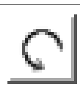
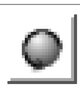


Illustration 7: Close up view of one section of a compensation error grid.

Display 3D Controls

The display of the 3D model is not fixed and can be manipulated in a variety of ways.

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 axis data.*

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

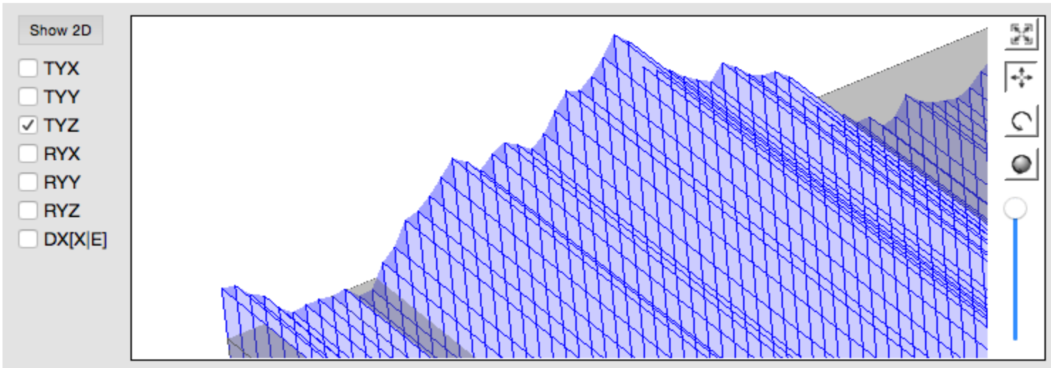


Illustration 8: Example showing relative errors for Y axis straightness in Z direction.

The method to display the error map in 3D was chosen to generically represent the data. The display simulation may not match the method used by the inspection software.

OpenGL

Running *CompView* 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 9.

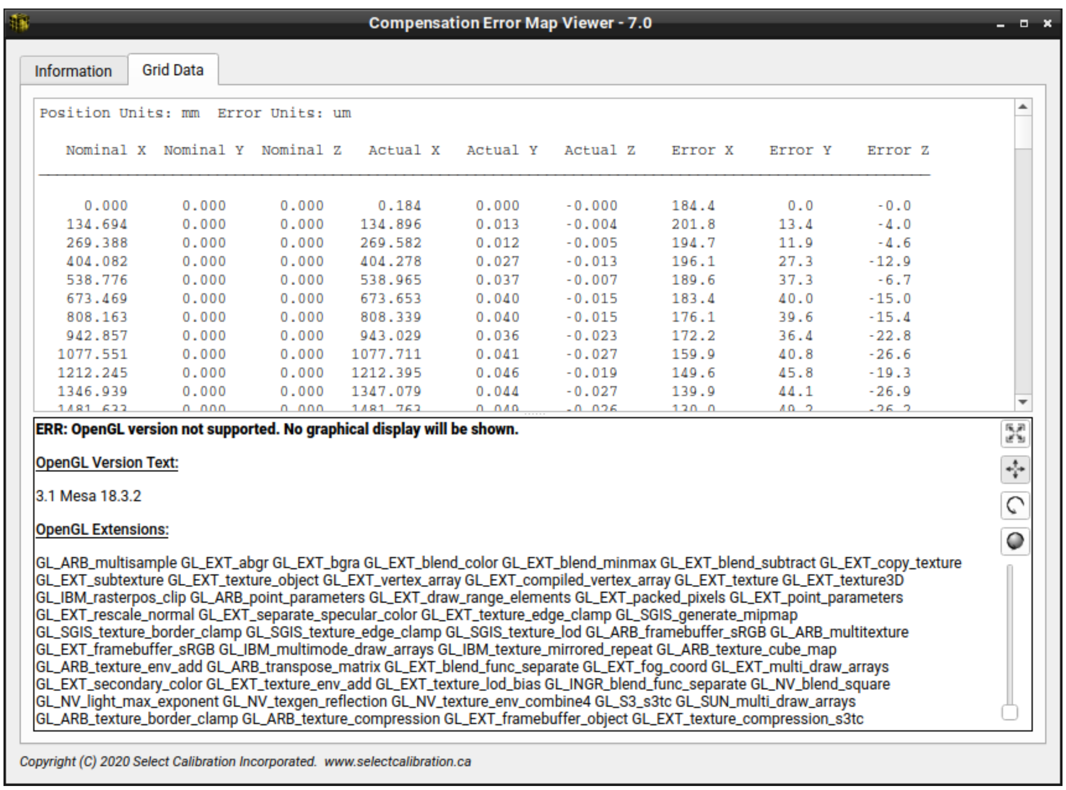


Illustration 9: Information screen that is displayed with an unsupported OpenGL version.

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 10. Prior versions of *CompView* labeled the Z axis pitch as the rotation of the Z axis around the X axis of the machine.

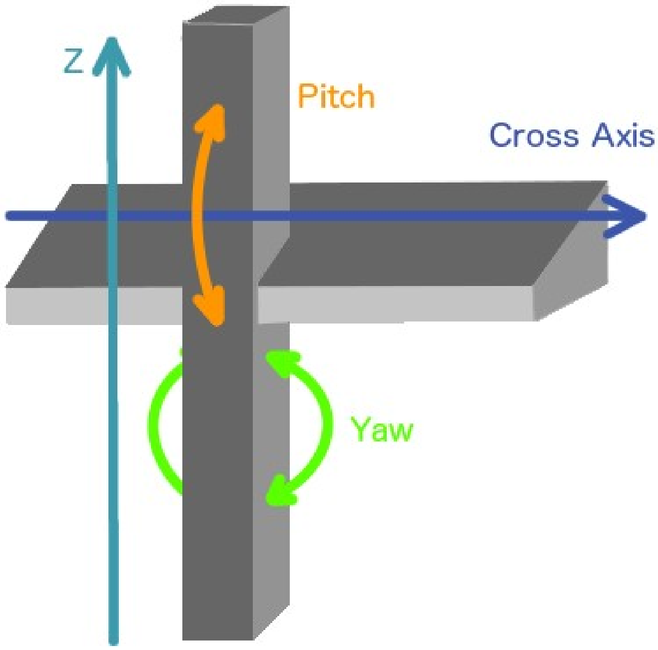


Illustration 10: Naming convention for Z axis pitch and yaw.

For the new naming convention the Z axis 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*. 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 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.

Brown and Sharpe CT1/CT2 Compensation Maps

The Brown and Sharpe compensation maps are a single file containing the axis data, rotary table data, and generic deflection data. The older CT1 format is a fixed size of 50 steps where the CT2 is variable and can have up to 200 steps for each linear axis and 180 steps for a rotary axis.

The naming convention used for the deflection parameters of BnS CT1/CT2 maps has changed starting in *CompView* version 5.1. The name describes the direction of the correction and the parameters associated with the correction. The naming convention is similar to the method used by older versions of *CompView*.

The following are examples of the naming convention:

- DX[XE] – Compensation in the X direction based on the X position and Error.
- DZ[XE] – Compensation in the Z direction based on the X position and Error.
- DXZ[XZE,XE2] – Compensation in the X and Z direction. The X direction is the product of the X and Z position and the Error. The Z direction is based on the X position and the Error squared (E2).

Brown and Sharpe maps configured for a vertical arm CMM have the deflection parameters associated with the Y axis and Z axis for a horizontal arm CMM. Illustration 11 shows an example of deflection compensation for a vertical arm CMM (DZ[XE]) and is an example of the naming convention used for CT1/CT2 maps.

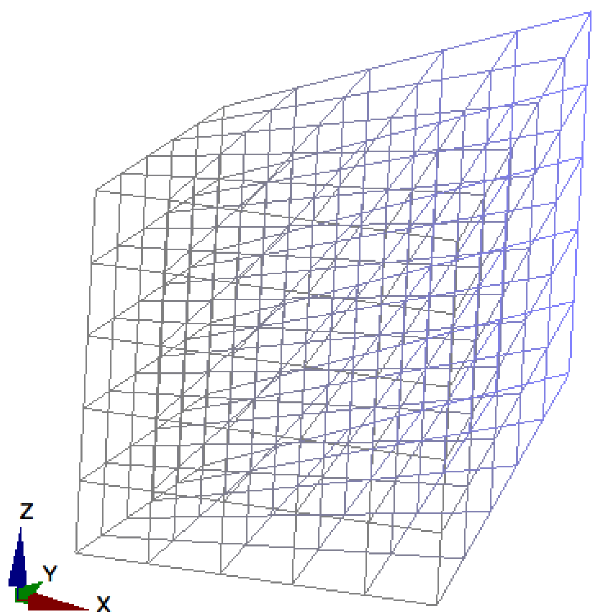


Illustration 11: Example of deflection compensation for DZ[XE] from a vertical arm BnS compensation map.

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 compensation error grid 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 data will include files for all linear, straightness, and angular corrections along with the compensation grid file (typically 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.

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.

DEVA compensation native format is not well defined. The preferred method to create a DEVA compensation file is to export a known map format as a DEVA grid from Compedit or any suitable editor.

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 compensation error grid containing a collection of nominal and actual measurement points throughout the measurement volume of the CMM.

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 the 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.

Metrolog Compensation Maps

Metrolog has three known compensation formats. The old format, designated as type 1, uses extended double precision values and is very similar to the version used by the Apogee software. The newer versions designated type 2 and type 3 are more conventional and replaces the original type 1 format. All Metrolog compensation maps include data for tracking changes. This information is currently ignored by *CompView*.

Compensation Error Grids

The *CompView* utility can load 2D or 3D compensation grid files. The 2D formats are common for optical systems where the 3D grid files are usually the product of a standard compensation error map. Using a compensation error grid allows for faster data lookup when performance is critical such as applications involving high speed scanning.

Compensation error grids can be very large. For example, a compensation grid consisting of a modest 80 steps for each axis would require 512,000 individual entries. If each entry contained the nominal and actual XYZ linear error (double precision binary) it would require 24,576,000 bytes to store all this information. A typical grid file will contain a sum of the angular errors in addition to the pre-calculated linear error so it is expected to be even larger for the same number of axis steps.

Compensation error grids with large number of axis steps are automatically reduced in size when loaded by *CompView* so that each axis has no more than 30 steps. The method used to reduce the size is to throw out every other entry. The information section of *CompView* will iindicate if the data size has been reduced from the original size.

The CompView utility will not load compensation grid files with a size greater than 100,663,296 bytes (greater than ~100mb).

Squareness

The squareness entries for XY, YZ, and ZX may be actual values stored inside the compensation data or interpreted from the compensation data when the map does not support squareness correction. For example, the Brown and Sharpe CT1/CT2 formats and the Zeiss Y file formats do not have separate squareness entries in their compensation data so the squareness data is 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, and parametric compensation files. When loading a compensation map the supplemental files will be displayed 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 information 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
Mar 3, 2019	5.0	Added ability to load and display compensation grid files. Added support for Hexagon Hybrid compensation grid format. Added support for DEVA compensation grid format. Added support for Verisurf compensation grid format. Added support for SCI generic compensation grid format.
June 6, 2019	5.1	Fixed problem with interpretation of BnS CT1/CT2 deflection data.
Feb 7, 2020	6.0	Added Metrolog Type 2 format. Added Metrolog Type 3 format.
Apr 17, 2020	6.1	Updated Renishaw map sign hints. Updated resource data.
Jan 4, 2021	7.0	Added support for Innovalia compensation maps. Rename of Input tab to Information tab. Added option to export data to a CSV file.
Jan 15, 2021	7.1	Fixed problem exporting maps with odd configurations. Fixed problem where option settings are not saved.
Sep 12, 2021	7.2	Fixed problem reading newer Zeiss guideway,square files.
May 3, 2022	8.0	Updated OpenGL to use vertex and fragment shaders. Document review.
May 4, 2023	9.0	Added option to export the compensation data at user defined increments.