3DM-GX3®

Importing Magnetic Vectors for Hard and Soft Iron Calibration

Overview

LORD MicroStrain® [3DM-GX3®-25](#), [3DM-GX3®-35](#) and [3DM-GX3®-45](#) inertial sensors contain magnetometers. The magnetometer values are available as fully calibrated outputs and are also used to correct heading drift in the Orientation Matrix, Euler Angles and Quaternion outputs. The 3DM-GX3® has been carefully designed to eliminate as many ferro-magnetic components as possible to prevent distortions in the readings of Earth's magnetic field. In addition, the magnetometers are factory calibrated on non-magnetic stages in order to compensate for any remaining internal sources of error. However, these measures can only compensate for error sources that are internal to the device; they cannot compensate for errors that may be introduced externally by mounting structures or adjacent devices. Careful mounting of the 3DM-GX3® can avoid external magnetic anomalies caused by sources such as coils, magnets, and ferrous metal structures and mounting components (steel nuts and bolts). Often these sources are hard to avoid or are hidden, and so a field calibration of the magnetometer after final installation is highly recommended. This can be accomplished by using LORD MicroStrain® Hard and Soft Iron Calibration software; its Quick Start Guide may be found [here](#). Please read this document before proceeding.

The Hard and Soft Iron Calibration software is designed to collect magnetic vectors, process the magnet vectors into calibration coefficients, and write the coefficients to non-volatile memory on the 3DM-GX3®. The software can be used in two fashions: 1) the software can collect the magnetic vectors directly from the 3DM-GX3® in real time for further processing, or 2) the software can import a spreadsheet containing the magnetic vectors and further process the data. This second method is quite helpful in those circumstances where the Hard and Soft Iron Calibration software and the Windows computer that supports it are cumbersome to the calibration rotation process, or can't be used at all. An example would be where the 3DM-GX3® is installed in an underwater vehicle, has no access to a Windows computer, and the magnetic vectors can only be collected by the Linux single board computer (SBC) that is embedded in the vehicle. Using the MIP™ data communication protocol for the 3DM-GX3®, the SBC can be programmed to collect the magnetic vectors during the calibration 'runs'. On return to the dock, the vectors can be uploaded to a spreadsheet, imported into the Hard and Soft Iron Calibration software, processed, and the resultant coefficients written to the 3DM-GX3®. This technical note assumes familiarity with the 3DM-GX3®, its MIP™ data communication protocol and software coding.

Collecting Magnetic Vectors

For purposes of this technical note, we will use a 3DM-GX3®-45 and its [MIP™ data communication protocol](#) as our example. The MIP™ data communication protocol presents the Scaled Magnetic Vector command to acquire magnetic vectors, as shown in figure 1. This command can either be programmed in polling mode or continuous mode. The application developer should build this command into a coding sequence that will collect and record the X, Y and Z axis magnetic vectors while the 3DM-GX3®-25, and the object to which it is attached, go through the rotations associated with hard and soft iron calibration.

Scaled Magnetometer Vector (0x80, 0x06)

Description	Scaled Mag Vector				
Notes	This is a vector which gives the instantaneous magnetometer direction and magnitude. It is fully temperature compensated and is expressed in terms of the 3DM-GX3®'s local coordinate system in units of Gauss.				
Field Format	*Field Length*	*Data Descriptor*	*Message Data*		
			Binary Offset	*Description*	*Data Type*	*Units*
	14 (0x0E)	0x06	0	X Mag	float	Gauss
			4	Y Mag	float	Gauss
			8	Z Mag	float	Gauss

Figure 1: **Scaled Magnetic Vector command**

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Writing the Magnetic Vectors to a CSV

- Download the magnetic vectors from the host computer and write them into a CSV (comma separated values) file.
- Figure 2 shows the file structure, as viewed in Notepad.
- Line 1 should contain the first row of X, Y and Z vectors; line 1 should NOT contain any column description headers.
- Commas should separate the X, Y and Z vectors in each line. No comma should be placed at the end of any line.
- In figure 2, we see in line 1 an X value of 0.098, a Y value of 0.147 and a Z value of 0.355.
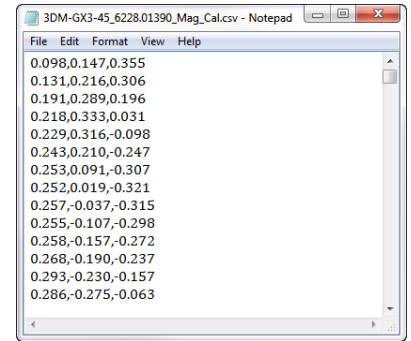

Figure 2: CSV file viewed in Notepad

Import into Hard and Soft Iron Calibration software

- Launch the Hard and Soft Iron Calibration software and establish communication with the 3DM-GX3®-25 as normal.
- Highlight the Device.
- Click Load Data and a dialog box appears, as shown in figure 3.
- Navigate to the CSV and select.
- Click OK, the dialog box disappears, the data in the CSV is imported and the data points are displayed to the grid as shown in figure 4.
- Proceed as normal to *Step 4d: Click Spherical Fit and/or Ellipsoid Fit to show the calculated calibration result* in the Quick Start Guide, and continue on as instructed.
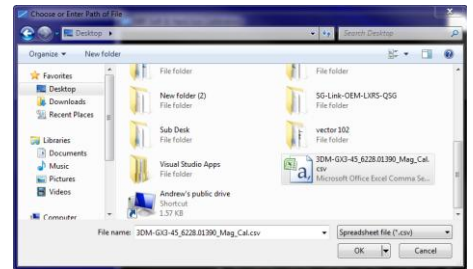

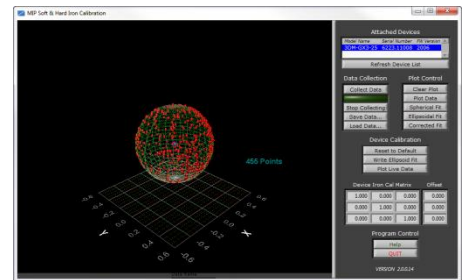
Figure 3: Navigate to the CSV and select

Figure 4: Data points displayed from CSV

Support

LORD MicroStrain® support engineers are always available to expand on this subject and support you in any way we can.