

# Magnetic Calibration

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Shadow Version 4.0

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## 1 Introduction

To achieve the most accurate orientation output, it may be necessary to calibrate your MotionNode or Shadow Inertial Measurement Unit (IMU) for your location or any hardware mounting. The magnetic calibration corrects for any constant offset to the measured intensity of the geomagnetic field.

The offset is caused by proximity to ferromagnetic materials, such as iron and nickel. The source of the offset could be environmental, from the structure of the building you are in, or from the frame of your desk. We recommend an in-location calibration if:

- You are mounting the device to any hardware that contains ferromagnetic material.
- Your application requires extremely accurate absolute orientation measurements.
- The orientation output does not appear to meet the error specification.

The Motion Service includes orientation output modes that do not use the magnetometer measurements. Use one of these orientation modes to troubleshoot magnetic offsets.

## 2 Procedure

The Motion Service will automatically calibrate the sensors based on a take, a set of recorded data streams. Use the following procedure to get the best calibration, and as a result, the most accurate measurements. The calibration process only requires a couple of minutes.

1. Open the **Settings** panel in the desktop application. Make sure that **User Calibration** option is enabled if you want to perform a location based calibration.
2. Open the **Calibrate** panel in the desktop application. You can access the **Calibrate** view from the **Help** panel.

Choose the device you want to calibrate from the drop down. The chart shows a live data stream that you can use while running the calibration process. The **Accelerometer** is the most useful channel to look at while hand calibrating.

3. Start the take from the command roll out. The **Calibrate** panel has a built in timer of 15 seconds per axis and highlights the current working axis. This is only for reference and does not affect the actual recording or calibration.

**Note:** To use the new calibration on another computer, you must check the **Factory calibration** option. This is not the usual mode of operation and is for advanced usage only. This will overwrite the calibration stored in the device non-volatile memory. Factory calibration is only available over the USB connection.

4. Rotate the IMU in space. The more complete the *coverage*, the better the resulting calibration. Think of *coverage* as the total number of orientations you rotate the sensor through. See Figure 1 for an example in 2D, on a circle. You will have to work in 3D, on a sphere, but the concept is the same.

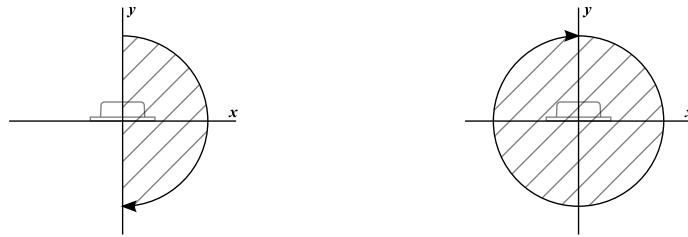


Figure 1: From left to right:  $180^\circ$  of coverage, or 50%.  $360^\circ$  of coverage, or 100%.

The most important orientations to capture are the extrema of each of the three axes, the minimum and maximum values. See Figure 2 for an example in 2D.

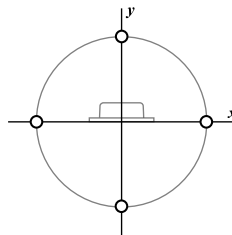


Figure 2: Extrema, minimum and maximum value, of each axis.

Do not worry too much about capturing every orientation and the extrema of every axis. The calibration algorithm finds the best calibration given the available orientations. The algorithm will still perform well, even without full coverage.

**Note:** Do not simply place the inertial sensor flat on your desk to capture the axis extrema. Instead, rotate the sensor continuously to capture many orientations.

The Motion Service maintains a calibration for each device in each location. When you generate a new calibration it is stored in a database on your computer. A user calibration takes precedent over the default calibration stored on the device non-volatile memory.