Application Note: Heading sensors and Magnetometer calibration

OVERVIEW

In order to calibrate magnetometers, a controlled magnetic field is required whether this is a Helmholtz coil or an electromagnet.

For calibration of low field sensors (up to 10x the Earth's field), Bartington' Helmholtz coils are available. With orthogonality compensation they are ideal for the calibration of precision magnetometers as well as compasses, AHRS sensors (Attitude and Heading Reference System), downhole tools for the oil & gas industry or even the magnetic sensors used in consumer electronics.

The coils are available in a range of sizes from 350mm to 2m, producing a homogeneous volume ranging from a 13cm diameter sphere (1%) to 1m cube (1%). In general, the larger the coils the harder it will be to produce strong or high frequency field, though all would be able to achieve about 200uT at DC minimum.

The coil size is to be selected in relation to the Device under Test (DUT) size, not just the magnetometer. In the majority of cases, the electronics and/or mechanical component that host the magnetic sensor will have some residual magnetisation (permanent magnetisation that is sometimes referred to as hard iron), as well as a given magnetic

Revised May 18, 2021

GMW Associates
www.gmw.com
sales@gmw.com
+1-650-802-8292
955 Industrial Road
San Carlos, California, USA

susceptibility which will lead to a local distortion of the background (Earth) field (that is referred to as soft iron).

As the purpose of a calibration is to determine the error parameters of the magnetometer/compass itself, it is essential for the magnetometer to be calibrated in its environment of use and take into account the error resulting from the whole DUT. In order to be accurate, the whole DUT, or the portion likely to cause magnetic disturbances (if the DUT was very large) will need to be located within a field as homogeneous as possible.

The coil is used to generate a known magnetic field in any direction, thanks to the three-axis, with an independent control of current through each of the coils using GMW's Helmholtz coil control software. It offers users the ability to perform calibration in their manufacturing facility directly without having to resort to find and travel to an area of low natural gradient, and stable field over time which would be required to perform total field calibration methods (relying on the Earth's field). The use of a Helmholtz coil will greatly facilitate and speed up the manufacturing and calibration process.

The active compensation system available with the Bartington Helmholtz coil system will compensate for any environmental field disturbances present, facilitating the use of the system in a less ideal environment, though some precautions are still required (see Helmholtz coil installation manual).

For the calibration of higher field sensors, the range of electromagnets available can enable you to perform high accuracy calibration with fields in excess of 3T. These are ideal for the calibration of hall sensors.