Fluxgate Magnetometers used for Onboard Closed Loop Degaussing

Objectives

To reduce the threat created by sea mines, and reduce the signature of a vessel, magnetic sensors may be used to measure the signature in real-time. This information may be used to compensate for signature change over time. As this method remains an R&D project, sensors supplied are mounted on scaled models, or on vessels used for trials.

Instrumentation

- Three-axis magnetometer
- Mag613 submersible three-axis magnetic field sensor array (includes eight sensors)

Background

Degaussing is the process of removing magnetisation from an object. Typically, it involves applying a strong AC field, the amplitude of which is progressively decreased to lower the level of the permanent magnetisation of the vessel. Onboard degaussing systems generate a field opposite to the vessel's signature, thus giving an apparent null signature.

Warships and submarines are degaussed for several reasons, and was first carried out to reduce the threat of mines. Sea mines contain magnetic triggers; a degaussed ship would have a smaller magnetic signature, reducing the chance of activating a mine. Submarines are degaussed as part of their broader range of discretion characteristics; for example to reduce the risk of detection from airborne MAD (Magnetic Anomaly Detection) surveys.

CLDG (Closed Loop DeGaussing) is the most comprehensive and effective method for degaussing a ship or submarine. The system is built-in to the vessel, with sets of degaussing coils and magnetic field sensors surrounding the different compartments. It is called Closed Loop because the system defines the level of degaussing, measures the effects, and feeds back alterations in real-time.

CLDG is of particular importance for submarines, as these are the more critical naval assets. Other than minesweepers, surface vessels are more likely to use a less extensive means of degaussing.

Method

The principle is to deploy a range of sensors spread around the vessel. Demilier et al, 2010 describes an experimental setup for a scaled model submarine. In this setup, the coils and sensors are placed around the inner hull, in between the double hulls. This shields the sensors from the interference of stray magnetic fields from electronics and other sources inside the inner hull.

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Degaussing coils are arranged around the inner hull in sections. A series of sensors is then positioned around the vessel. The magnetometers give magnetic field readings in three dimensions, allowing accurate mapping of the magnetic field.

With the signature of the vessel determined by additional sensors positioned away from the model, the equivalent of a permanent signature range, the initial vessel signature can be compensated for.

With the desired signature achieved, the fluxgates act as feedback sensors, capable of measuring small field variations caused by changes over time and position.

For scaled model work, sensors such as the Mag613 offer very compact heads, which can be placed close to each other. Trials of continuous signature measurement also seem to be part of the research stage on closed-loop degaussing. In this case, sensors such as Mag-03 or Mag-13 could be suitable for installation on a test vessel.

Submersible and non-submersible versions of the sensors are available, depending on the installation.

References

Demilier L. et al, “Validation of Closed Loop Degaussing System for Double Hull Submarines”, Marine System and Technology, Rome, Italy (2010)

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