Exploitation of a ship's magnetic field signatures

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Abstract: Surface ship and submarine magnetic field signatures have been exploited for over 80 years by naval influence mines, and both underwater and airborne surveillance systems. The generating mechanism of the four major shipboard sources of magnetic fields is explained, along with a detailed description of the induced and permanent ferromagnetic signature characteristics. A brief historical summary of magnetic naval mine development during World War II is followed by a discussion of important improvements found in modern weapons, including an explanation of the damage mechanism for non-contact explosions. A strategy for selecting an optimum mine actuation threshold is given. A multi-layered defensive strategy against naval mines is outlined, with graphical explanations of the relationships between ship signature reduction and minefield clearing effectiveness. In addition to a brief historical discussion of underwater and airborne submarine surveillance systems and magnetic field sensing principles, mathematical formulations are presented for computing the expected target signal strengths and noise levels for several barrier types. Besides the sensor self-noise, equations for estimating geomagnetic, ocean surface wave, platform, and vector sensor motion noises will be given along with simple algorithms for their reduction.
Author Keywords: Magnetic anomaly detection; Magnetic signatures; Naval mines; Submarine surveillance

Year: 2006
Source title: Synthesis Lectures on Computational Electromagnetics
Volume: 9
Page : 1-74
Link: Scorpus Link
Document Type: Article
Source: Scopus
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