Exploitation of a Ship's Magnetic Field Signatures

John J. Holmes

Synthesis Lectures on Computational Electromagnetics

John Holmes

Exploitation of a Ship's Magnetic Field Signatures John J. Holmes, 2022-05-31 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 Exploitation of a Ship's Magnetic Field Signatures John Holmes, 2024-02-15 Exploitation of a Ship's Magnetic Field Signatures by John Holmes is a groundbreaking exploration of naval technology and strategic warfare Holmes delves into the intricate realm of magnetic field signatures emanating from ships unraveling their implications for military operations and defense systems The book meticulously examines how adversaries can exploit these magnetic signatures for tactical advantage or to devise countermeasures Holmes with authoritative expertise offers insights into the implications for naval tactics submarine warfare and the development of magnetic signature mitigation technologies. This work stands as an indispensable guide for naval professionals defense analysts and technology enthusiasts providing a thorough understanding of the nuanced interplay between magnetic fields and maritime security As a seminal contribution to the field Holmes work navigates the complex waters of magnetic signature exploitation making it a must read for anyone seeking a deeper comprehension of naval strategy and modern defense mechanisms Exploitation Of A Ship, S Magnetic Field Signatures John J. Holmes, 2006 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

Reduction of a Ship's Magnetic Field Signatures John Holmes, 2008-10-08 Decreasing the magnetic field signature of a naval vessel will reduce its susceptibility to detonating naval influence mines and the probability of a submarine being detected by underwater barriers and maritime patrol aircraft Both passive and active techniques for reducing the magnetic signatures produced by a vessel s ferromagnetism roll induced eddy currents corrosion related sources and stray fields are presented Mathematical models of simple hull shapes are used to predict the levels of signature reduction that might be achieved through the use of alternate construction materials Also the process of demagnetizing a steel hulled ship is presented along with the operation of shaft grounding systems paints and alternate configurations for power distribution cables In addition active signature reduction technologies are described such as degaussing and deamping which attempt to cancel the fields surrounding a surface ship or submarine rather than eliminate its source Table of Contents Introduction Passive Magnetic Silencing Techniques Active Signature Compensation Summary Modeling a Ship's Ferromagnetic Signatures John J. Holmes, 2007 Ferromagnetic models of ships and submarines that predict or reproduce their magnetic signatures have found applications in the development of both offensive and defensive military systems from World War II to the present The mathematical basis of generalized coordinate systems will be presented and demonstrated with example applications to analytic spherical and prolate spheroidal magnetic ship models In addition the advantages and pitfalls of using complex finite element and boundary element numerical techniques to predict high order near field ship signatures will be discussed followed by a short description of the design and testing of complementary physical scale models Extrapolation of measured magnetic signatures from testing environments to threat areas using semi empirical math models will be presented along with an explanation of their inherent instabilities and methods for regularizing them These magnetic ship signature modeling techniques are used today in designing optimized signature reduction systems that have a minimum impact on ships and their systems The discussion will be closed with an important discussion of the verification and validation of magnetic models of surface ships and submarines Bulletin of the Atomic Scientists ,1970-06 The Bulletin of the Atomic Scientists is the premier public resource on scientific and technological developments that impact global security Founded by Manhattan Project Scientists the Bulletin's iconic Doomsday Clock stimulates solutions for a safer world

Bulletin of the Atomic Scientists, 1970-06 The Bulletin of the Atomic Scientists is the premier public resource on scientific and technological developments that impact global security Founded by Manhattan Project Scientists the Bulletin s iconic Doomsday Clock stimulates solutions for a safer world *Modeling a Ship's Ferromagnetic Signatures* John

Holmes, 2007-12-31 Ferromagnetic models of ships and submarines that predict or reproduce their magnetic signatures have found applications in the development of both offensive and defensive military systems from World War II to the present The mathematical basis of generalized coordinate systems will be presented and demonstrated with example applications to analytic spherical and prolate spheroidal magnetic ship models In addition the advantages and pitfalls of using complex finite element and boundary element numerical techniques to predict high order near field ship signatures will be discussed followed by a short description of the design and testing of complementary physical scale models Extrapolation of measured magnetic signatures from testing environments to threat areas using semi empirical math models will be presented along with an explanation of their inherent instabilities and methods for regularizing them These magnetic ship signature modeling techniques are used today in designing optimized signature reduction systems that have a minimum impact on ships and their systems The discussion will be closed with an important discussion of the verification and validation of magnetic models of surface ships and submarines Synthesis Lectures on Computational Electromagnetics, 2006 Ship Magnetism and the Magnetic Compass F. G. Merrifield, 1963 Ship Magnetism and the Magnetic Compass F. G. Merrifield, 2014-05-09 Ship Magnetism and the Magnetic Compass deals with the magnetism of ships and the deviation of the magnetic compass produced by this magnetism Emphasis is placed on the distinction between the deviation itself and what causes the deviation Numerous worked examples for exercise are found at the end of each chapter Comprised of 15 chapters this volume begins with an introduction to magnetometry paying particular attention to the magnitude of the forces involved in magnetism and the manner in which these forces act The strength of a magnetic pole is also considered along with the angle of deflection of the needle when in two magnetic fields Subsequent chapters offer a thorough treatment of the strength of the magnetic field and the magnet's moment of inertia and magnetic moment the earth's magnetic force and how the different parts of the ship s magnetic force give different types of deviation The book also explains the heeling error and its causes the principle underlying successful compass adjustment the effect of the ship's magnetic forces on the directive force felt by the compass needles and sub permanent magnetism This monograph will be of value to students and practitioners interested in ship magnetism and the magnetic compass Navy's N-Layer Magnetic Model with Application to Naval Magnetic **Demining** Sam Poteete, 2010 The Navy and Marine Corps Forward From the Sea strategic concept has expanded naval operations from open ocean blue water combat environments to the littoral regions in which naval mines can both be an extremely menacing threat to U S forces and an effective force multiplier for the Fleet The Navy Marine Corps must have efficient Mine Warfare MIW forces to ensure the Fleet can carry out operations in the open ocean and littorals including maintaining open sea lanes of communication and supporting Ship to Objective Maneuver Warfare from the Sea while denying operating areas to the enemy Every ship has a magnetic signature which is caused by its iron and steel components Additionally the earth's natural magnetic field induces a magnetization in a ship depending on its latitude longitude and

heading Exploitation of surface ship and submarine magnetic field signatures by naval influence mines has occurred throughout time In order to calculate the swept path width for magnetic minesweeping systems currently in use by the U S Mine Warfare MIW forces it is necessary to calculate the vector components of the magnetic field strength which are generated by each of several possible system configurations The Navy s Magnetic Model addresses this needed capability The Navy s N Layer Magnetic Model NLMM is used to predict the expected performance of magnetic minesweeping equipment in a complex environment consisting of N layers each with arbitrary conductivity and thickness The model is used to compute the magnetic field strength produced by various U S Navy magnetic minesweeping configurations using a random environmental vertical conductivity structure To better determine which parameters had the greatest effect on the model and which could be simplified or enhanced a series of tests were run on actual data sets

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