

Accepted Manuscript

Electromagnetic Trajectory Simulation using Triaxial Cage

Ankita Modi, Faruk Kazi

PII: S0304-8853(17)30289-5

DOI: <http://dx.doi.org/10.1016/j.jmmm.2017.09.016>

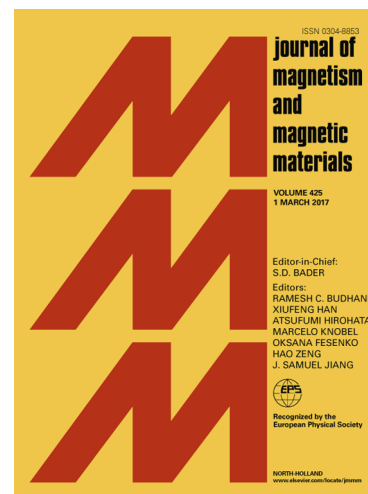
Reference: MAGMA 63145

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 10 February 2017

Revised Date: 18 August 2017

Accepted Date: 7 September 2017



Please cite this article as: A. Modi, F. Kazi, Electromagnetic Trajectory Simulation using Triaxial Cage, *Journal of Magnetism and Magnetic Materials* (2017), doi: <http://dx.doi.org/10.1016/j.jmmm.2017.09.016>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Electromagnetic Trajectory Simulation using Triaxial Cage

Ankita Modi^{a,*}, Faruk Kazi^{a,1}

^aCenter of Excellence in Complex and Nonlinear Dynamical Systems (CoE-CNDS),
Veermata Jijabai Technological Institute (VJTI), Mumbai, INDIA

Abstract

This paper implements an open-loop controller for generating earth's magnetic field in vessel's co-ordinate frame. It also incorporates the rotational movements along the three axes, without physically moving the object. This has potential application in prediction of signature for ferromagnetic marine vessels in changing earth's magnetic field experienced by the vessel due to change in location. It also considers the effect of roll, pitch and heading changes. Uniform magnetic field simulator is designed to generate the required magnetic field in the vessel's coordinate frame. Simulation results are verified using experimental laboratory setup.

Keywords: IGRF, Earth's magnetic field, Open-loop controller, Trajectory tracking, Signature, Degaussing

1. Introduction

Ships and submarines, have been targeted by underwater and airborne mines and torpedoes. The magnetic presence of these marine vessels cannot be seen or felt unlike of acoustic signatures. The various reasons for magnetic presence of vessels are, firstly, induced magnetism due to presence of earth's magnetic field, secondly, eddy currents due to rotation of electrically conducting vessel in earth's magnetic field [1], thirdly, due to corrosion protection systems [2] and lastly, due to machineries of onboard vessel [3] [4]. The magnetic presence of the vessel is designated as signature of the vessel. In recent decades utilizing earth's magnetic field for mitigating ship's and naval vessel signature has been increasing rapidly. The high permeability of ferromagnetic material, used for construction of marine vessels, as compared to that of air, leads to disturbances in ambient earth's magnetic field [5]. Ferromagnetic materials permit much higher flux values (B) for relatively low magnetic field strengths (H), and reach a saturation point after which very little additional flux (B) can be forced through the material. Thus, the ferromagnetic cylinder provides a channel for magnetic flux, creating

chunks of flux convergence and divergence as shown in Figure 1 near the ferromagnetic cylinder [6].

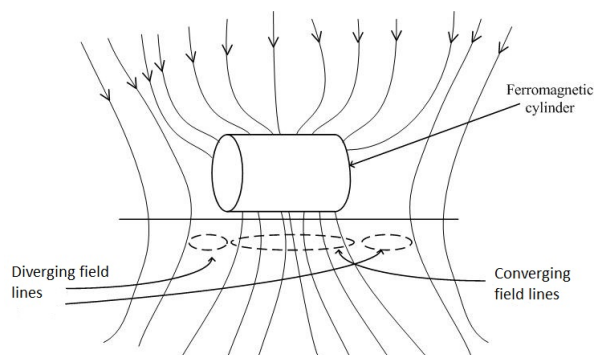


Figure 1: Ferromagnetic cylinder in ambient magnetic field.

The main contribution of this paper is to analyze several aspects of electromagnetic signatures related to variation of earth's magnetic field and to propose an open-loop controller to generate the three components of earth's magnetic field. This open-loop controller will be used to develop a degaussing strategy for ferromagnetic body. Degaussing refers to an active system which minimizes the magnetic signature of the ferromagnetic vessel. Ideally, one would install degaussing coils and pump appropriate currents through each of the coils such as to produce a magnetic field which would exactly cancel the distortion in the earth's field created due to the presence of ferromagnetic object. Also the sea vehicle's roll, pitch and heading change during their

*I am corresponding author

Email addresses: ankitasept@gmail.com (Ankita Modi),
fskazi@vjti.org.in (Faruk Kazi)

¹Professor in Electrical Department at Veermata Jijabai Technological Institute, Mumbai, INDIA and Principal Investigator of Center of Excellence in Complex and Nonlinear Dynamical Systems.

Download English Version:

<https://daneshyari.com/en/article/8153964>

Download Persian Version:

<https://daneshyari.com/article/8153964>

[Daneshyari.com](https://daneshyari.com)