Application of Optimal Control in Vertical Weight Stabilizer System for Actual Ship

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IIUM
Press
Gombak • 2017

First Print, 2017

IIUM Press is a member of the Majlis Penerbitan Ilmiah Malaysia - MAPIM
(Malaysian Scholarly Publishing Council)

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Muhammad Zahir Ramli
Application of Optional Control in Vertical Weight Stabilizer System for Actual Ship / MUHAMMAD ZAHIR RAMLI,
ISBN 978-967-418-705-7
1. Ocean engineering. 2. Ships--Safety regulations.
I. Yoshiaki, Hirakawa. II. Title.
620.4162

Published & Printed in Malaysia by
IIUM Press
International Islamic University Malaysia
P.O. Box 10, 50728 Kuala Lumpur, Malaysia

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Nowadays, demands on new technologies for conventional ships around the globe getting higher by years. Besides the development of environment-friendly energy, the improvement of stability based on ship hull form play a major role in developing more comfortable sea-keeping quality, anti-rolling devices and systems. Regarding technologies involving the use of anti-rolling system, quite a large number of anti-rolling devices proposed and developed in the past, and some of them are used practically until now. These devices generally divided into two main types. One is the passive type while the other is the active type. Study in this research book utilized a new type of anti-rolling system namely Vertical Weight Stabilizer (VWS). This device was developed by Prof. Hirayama from YNU lab and the efficiency was tested and analyzed through a full size ship experiments. In the last 3 years of carrying out full scale experiments, result have shown that the stabilizer succeeded in improving damping effect and reducing the ship rolling. Also, there are possibilities different control system results in different efficiency of VWS. It is thus of great importance to consider alternative control system in future study. In the same research lab, the book will elaborate more on the study from Funamizu where he observed the characteristics of VWS by utilizing a small boat model and results from Okada who estimated a measured angular frequency using kalman method as input of the control algorithm. Furthermore, as additional improvement to the existing PD control, new control system to minimize the whole control energy is introduced: "Optimal Control Regulator". Numerical simulations of VWS experiments are carried out to validate effects of new control in controlling roll angle. For that reason, analyzed result can be implemented to determine which condition correlate the best with specific damping effect, stroke and stroke phase. Finally, some simulation in free roll conditions and in wave conditions are done to verify the influence to the models subjected. Discussions are then made by comparing the rate of energy consumption of optimal control with the results from previous PD control experiments.

Muhammad Zahir Ramli is a lecturer in Marine Science, with a background in physical oceanography, numerical analysis and computer simulations. He studied the engineering and obtained his BSc degrees from Tokai University, Japan in 2010 and MEng from Yokohama National University (YNU), Japan in 2012. He received his PhD in Fluid and Structure Interaction studies at the University of Southampton in 2016. Dr Zahir is experienced in both development and applications of computational methods for fluid-structure interactions in physical oceanography and coastal engineering.

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ISBN 978-967-418-705-7

9 789674 187057

IIUM Press
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