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A STUDY OF INTERCEPTOR PERFORMANCE FOR DEEP-V PLANING HULL

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Beny Cahyono, S.T., M.T., Ph. D.
HEAD OF MARINE ENGINEERING DEPARTMENT INSTITUT TEKNOLOGI SEPULUH NOPEMBER

Dr. Eng. Dhimas Widhi Handani, S.T., M.Sc.
HEAD OF THE CENTER OF EXCELLENCE OF MARITIME SAFETY AND MARINE INSTALLATION

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A study of interceptor performance for deep-v planing hull

Samuel S.[a]; Yulianti, Serliana[a]; Manik, Parlindungan[a]; Fathuddiin, Abubakar[b]
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[a] Department of Naval Architecture, Faculty of Engineering, Diponegoro University, Semarang, 50275, Indonesia
[b] Blue Gulf Cat, Sheikh Rashid bin Saeed St, Abu Dhabi, 41655, United Arab Emirates

Abstract

The acting on the planing hull is the most complex hydrodynamics simulation. Therefore, an analysis was done to evaluate drag, lift force, and seakeeping in two degrees of freedom (2-DOF) which is heave and trim. It was fundamental aspects of the overall high-speed vessel. This article focused on the hydrodynamic performance of a complete interceptor configuration that could control the motion behavior of deep-V planing hull in calm water conditions. The benchmark study was undertaken by comparing numerical results with experimental study by Park at al. Models with and without interceptors had been analyzed by numerical simulation performed using Reynold Averaged Navier Stokes (RANS) to describe turbulence model with k epsilon based on computational fluid dynamic (CFD). In this study , the interceptor proper applies at a speed of less than Froude number 0.87. Interceptor reduce by 21% drag at Froude number 0.87 and also reduce by 16% trim and 6% heave at Froude number 0.58. Nevertheless, applied interceptor in high Froude number such as more than Froude number 1.16 caused interceptor lose effectiveness due to producing a decisive moment which made negative trim (bow-down) and increase total drag.

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Table of contents

Volume 1081

2022

◂ Previous issue Next issue ▸

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Preface

Papers

A study of interceptor performance for deep-v planing hull

S. Samuel[1], Serliana Yulianti[1], Parlindungan Manik[1], Abubakar Fathuddiin[2]

[1]Department of Naval Architecture, Faculty of Engineering, Diponegoro University, Semarang, 50275, Indonesia
[2]Blue Gulf Cat, Sheikh Rashid bin Saeed St, Abu Dhabi, 41655, United Arab Emirates

Coresponding author: serliana.yuliantii@gmail.com

Abstract. The acting on the planing hull is the most complex hydrodynamics simulation. Therefore, an analysis was done to evaluate drag, lift force, and seakeeping in two degrees of freedom (2-DOF) which is heave and trim. It was fundamental aspects of the overall high-speed vessel. This article focused on the hydrodynamic performance of a complete interceptor configuration that could control the motion behavior of deep-V planing hull in calm water conditions. The benchmark study was undertaken by comparing numerical results with experimental study by Park at al. Models with and without interceptors had been analyzed by numerical simulation performed using Reynold Averaged Navier Stokes (RANS) to describe turbulence model with k epsilon based on computational fluid dynamic (CFD). In this study, the interceptor proper applies at a speed of less than Froude number 0.87. Interceptor reduce by 21% drag at Froude number 0.87 and also reduce by 16% trim and 6% heave at Froude number 0.58. Nevertheless, applied interceptor in high Froude number such as more than Froude number 1.16 caused interceptor lose effectiveness due to producing a decisive moment which made negative trim (bow-down) and increase total drag.

Keywords: CFD, drag, full interceptor, heave, lift force, planing craft

1. Introduction

The interceptor is a thin rectangle mounted on the vessel's transom to modify local flow near the stern. The interceptor generates substantial additional pressure towards the vessel's stern. This concept is adopted from an aerodynamic device called a gurney flap on race cars to increase down-force on the car's rear wing. The interceptor mechanism aims to increase the lift to drag ratio pressure on the vessel, which is slightly different from the situation on race cars. The aerodynamic aspect of a racing car does not affect drag friction. However, drag friction is significantly affected even in steady flow on the vessel. The interceptor will modify the pressure distribution in the same way as the gurney flap. However, the interceptor can affect the balance, which impacts the generation of the stern wave system and the resistance due to the waves. In addition, the increase in lift force also reduces sinkage and wetted surface areas as well as frictional resistance to the hull.

An experimental study conducted by Day and Cooper reported that the interceptor could reduce drag on sailing yachts [1]. Furthermore, Van Oossanen conducted a 45 m motor yacht with an interceptor dimension of 50 mm using the CFD approach. The study resulted in a reduction in the trim of 1 degree and decrease in drag of 7% at Froude number 0.6 [2].

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Dynamic Safety Modelling for Ship Management Performance

Adi Mas Nizar[a], Masumi Nakamura[b], Takashi Miwa[a], Makoto Uchida[a]

[a]Graduate School of Maritime Sciences, Kobe University, Japan
[b]National Institute of Technology (KOSEN), Yuge College, Japan

email: 185w604w@stu.kobe-u.ac.jp

Abstract. Recent development and projection of ship operations as a sociotechnical system is getting more complex. In order to successfully emulate a high-reliability organization with a balance between operational efficiency and safety, the shipping companies have to grab a well understanding of the operating performance. However, because the teams are distributed spatially and temporally, a misalignment of shared situation awareness casually exists. We extended Rasmussen's dynamic safety theory and adjusted it in the context of ship management performance. A modelling study using system dynamics was done to illuminate how the feedback loops construct the interaction between safety, efficiency, and workload. The simulation result shows that the operations behave following the safety and efficiency pressures created by existing goals and boundaries. The model is also able to capture these trade-offs in different variety of operation scenarios. Application such modelling may provide the managers with a better understanding and valuable insight to implement the strategies to sustain safe operations.

1. Introduction

Balancing between efficiency and safety in ship operation is common practice, as well as other general industries. While doing it, each level of the organization's components in ship operation frequently makes a trade-off between efficiency and thoroughness to manage the available resources [1]. Naturally, an organization such as a shipping or ship management company based their decision to pursue optimum cost-effectiveness, but on the other hand, it also prepares the stage for the accident [2]. In a sociotechnical system where safety is viewed as a control problem, an accident occurs whenever this control system cannot handle component failure or external troubles [3]. Therefore, examining the behaviour in each interaction between components becomes more prominent.

Ship management operation has a characteristic of the distributed team between shore staff and onboard seafarers. Different time operations make the team distributed not only geographically but also temporally [4]. Even the accident number in maritime operations is decreasing, human error, especially the failure of situation awareness, remains dominant [5]. The failure to attain situation awareness occurs not only because the difficulty in communicating mental models between the team members onboard, but also between onboard and shore side [6]. The overall situation awareness is perceived differently by an individual based on incomplete and inaccurate information. Such condition makes the team remain locked into a false picture of the situation until accidents or incidents occur [4].

The interaction between onboard seafarers and shore management and its behavior in terms of efficiency, safety, and workload needs to be closely observed in a feedback loop environment.

Meshing generation strategy for prediction of ship resistance using CFD approach

Serliana Yulianti[1], S Samuel[1], T S Nainggolan[1] and Muhammad Iqbal[2]

[1]Department of Naval Architecture, Faculty of Engineering, Diponegoro University, Semarang, 50275, Indonesia
[2]Department of Naval Architecture, Ocean, and Marine Engineering, University of Strathclyde, Glasgow, UK.

Coresponding author: samuel@ft.undip.ac.id

Abstract. CFD is a numerical approach used to solve fluid problems. In the CFD simulation process, the meshing stage is crucial to produce high accuracy. Meshing is a process where the geometric space of an object is broken down into many nodes to translate the physical components that occur while representing the object's physical shape. The research objective was to analyze the characteristics of the mesh technique in the *Finite Volume Method* (FVM) using the RANS (*Reynolds - Averaged Navier - Stokes*) equation. The numerical simulation approach used three mesh techniques, namely overset mesh, morphing mesh, and moving mesh. The k-ε turbulent model and VOF (*Volume of Fluid*) were used to model the water and air phases. The mesh technique approach in CFD simulation showed a pattern under experimental testing. This research showed the difference in value to the experimental results, namely by using the moving mesh method, the difference in resistance difference was 8% at high-speed conditions, the difference in trim value at overset mesh was 11%, and the difference in heave value with the moving mesh method was 14% at low speed. The conclusion reported that overset mesh had better than other mesh methods.

Keywords: CFD, Fridsma hull, morphing mesh, moving mesh, overset mesh

1. Introduction

An experiment conducted by G. Fridsma in 1969 has sparked many researchers to conduct similar research related to planing hulls. Fridsma conducted experimental analysis on ships with the planing type, hereinafter known as Fridsma ship, with several L/B configurations, displacement, deadrise angle, LCG (Longitudinal Center of Gravity), and so on [1]. Supported by the ship's simple geometry, until now, there has been much research discussing the Fridsma ship.

The rapid development of technology makes research more effective to do. One technology supporting the research of ships is a numerical simulation method based on Computational Fluid Dynamics (CFD). CFD is a system program that can plan and analyze an engineering product using mathematical solutions. In the analysis using CFD, especially ship type planing, the methods used to predict the resistance and movement of the planing hull included FVM (Finite Volume Method), FEM (Finite Element Method), FDM (Finite Difference Method), and analytical-experimental. According to Yousefi in 2013, the most appropriate method used to predict drag, trim, and heave on ships was FVM because