

**ON THE COMPARATIVE SEAKEEPING ANALYSIS IN IRREGULAR WAVES OF COMMERCIAL SHIPS HAVING SAME DISPLACEMENT, FOR NAVIGATION SAFETY ASSESSMENT**Carmen Gasparotti<sup>1</sup>, Eugen Rusu<sup>2</sup>, Leonard Domnisoru<sup>3</sup><sup>1</sup> "Dunarea de Jos" University of Galati, Faculty of Naval Architecture, Naval Architecture Department<sup>2</sup> Dunarea de Jos" University of Galati, Faculty of Mechanics, Applied Mechanics Department<sup>3</sup> "Dunarea de Jos" University of Galati, Faculty of Naval Architecture, Naval Architecture Department**Abstract**

For the shipping companies one of the operational safety criteria of their fleet is based on irregular waves seakeeping assessment. This study is focused on the comparative seakeeping analysis of two container ships, having in common only a same displacement 18000 t, with overall lengths of 139.96m and 149.50 m. The seakeeping analysis is based on the linear strip theory with frequency domain solution for the response transfer functions calculation on coupled heave - pitch and uncoupled roll motions. There is considered a full range 0-360 deg. heading angle and several ship speeds 0-20 knots. The short term irregular waves seakeeping analyses are carried out for ITTC, ISSC, JONSWAP and Pierson-Moskowitz reference wave power density spectra. The numerical analyses are carried out with own DYN\_OSC program. The operational safety seakeeping criteria are expressed as limit RMS root mean square values for heave, pitch, roll motion and acceleration amplitudes, specific for commercial maritime ships. Based on the resulting statistical short term dynamic response polar diagrams, on each motion component and cumulative, this study is pointing out the influence of ship dimensions, speed and heading angle on the navigation safety assessment.

**Keywords:** seakeeping analysis, operational safety criteria, irregular waves.

**I. INTRODUCTION**

The navigation safety assessment in irregular waves represent a mandatory analysis carried out for maritime ships [8],[9], taking into account the environmental conditions and seakeeping criteria restrictions [5],[6]. Other parameters that have to be considered at seakeeping analysis are the ship speed, heading angle and loading conditions.

The seakeeping analysis involves the following steps: computation of amplitude transfer functions on ship hull oscillation degrees of freedom, short term power density wave spectrum selection according to the environmental conditions, seakeeping limit criteria selection according to the ship type and finally ship navigation safety assessment [1],[2],[4],[11]. This study involves deterministic analysis for oscillations amplitude transfer function computation on regular waves and statistical short term analysis on irregular waves for significant wave spectra of the sea selected operation area.

This study includes the seakeeping linear analysis, coupled heave and pitch oscillations, uncoupled roll oscillations, for two container ships of 800 TEU and 1300 TEU, with different main dimensions and having selected full or intermediate loading conditions, corresponding to the same displacement of 18000 t. The irregular waves are considered for several wave significant height  $h_{0.05}$  and four short term wave spectra, ISSC, ITTC, Pierson - Moskowitz and JONSWAP [1],[2],[7],[8],[9].

The seakeeping analysis polar diagrams are obtained for a full range 0 to 360 deg. heading angle, ship speed range 0 to 20 knots and maximum wave significant height of 12 m.

The main objective of the present work is to point out the influence of ship dimensions, speed and heading angle on the navigation safety assessment.

# On The Comparative Seakeeping Analysis In Irregular Waves

**IM Harris**



## **On The Comparative Seakeeping Analysis In Irregular Waves:**

**Advances in Maritime Technology and Engineering** Carlos Guedes Soares, Tiago A. Santos, 2024-05-08 Advances in Maritime Technology and Engineering comprises a collection of the papers presented at the 7th International Conference on Maritime Technology and Engineering MARTECH 2024 held in Lisbon Portugal on 14-16 May 2024. This Conference has evolved from the series of biannual national conferences in Portugal which have become an international event reflecting the internationalization of the maritime sector and its activities. MARTECH 2024 is the seventh of this new series of biannual conferences. This book comprises 142 contributions that were reviewed by an International Scientific Committee. Advances in Maritime Technology and Engineering is dedicated to maritime transportation ports as well as maritime safety and reliability. It further comprises sections dedicated to ship design, cruise ship design and to the structural aspects of ship design such as ultimate strength and composites, subsea structures as pipelines and to ship building and ship repair. The Proceedings in Marine Technology and Ocean Engineering series is dedicated to the publication of proceedings of peer reviewed international conferences dealing with various aspects of Marine Technology and Ocean Engineering. The series includes the proceedings of the following conferences: the International Maritime Association of the Mediterranean (IMAM) conferences, the Marine Structures (MARSTRUCT) conferences, the Renewable Energies Offshore (RENEW) conferences and the Maritime Technology (MARTECH) conferences. The Marine Technology and Ocean Engineering series is also open to new conferences that cover topics on the sustainable exploration of marine resources in various fields such as maritime transport and ports, usage of the ocean including coastal areas, nautical activities, the exploration and exploitation of mineral resources, the protection of the marine environment and its resources and risk analysis, safety and reliability. The aim of the series is to stimulate advanced education and training through the wide dissemination of the results of scientific research.

**Oceanography**, 1963 Results of Comparative Model Tests with a Conceptual Hull Form and the Original R-class Icebreaker Donald Carter, Donald Carter & Associates, Transportation Development Centre (Canada), 1990. This report documents the results of a model test program to ascertain the icebreaking efficiency, ice clearing ability, open water resistance and sea keeping performance of a hull form which was generated by software. A test program was devised using the existing model of the original R class ice breaker to act as the benchmark against which the performance of the conceptual bow form could be compared. The model tests were carried out in both the ice tank and the towing tank at the Institute for Marine Dynamics in St John's Newfoundland during April 1990. Calm water resistance and seakeeping experiments were performed in the towing tank and level ice resistance and presawn ice resistance experiments were performed in the ice tank. *Trends in Maritime Technology and Engineering* C. Guedes Soares, T.A. Santos, 2022-06-07 Trends in Maritime Technology and Engineering comprises the papers presented at the 6th International Conference on Maritime Technology and Engineering MARTECH 2022 that was held in Lisbon Portugal from 24-26 May 2022. The

Conference has evolved from the series of biennial national conferences in Portugal which have become an international event and which reflect the internationalization of the maritime sector and its activities MARTECH 2022 is the sixth of this new series of biennial conferences The book covers all aspects of maritime activity including in Volume 1 Structures Hydrodynamics Machinery Control and Design In Volume 2 Maritime Transportation and Ports Maritime Traffic Safety Environmental Conditions Renewable Energy Oil Gas and Fisheries and Aquaculture Trends in Maritime Technology and Engineering aims at academics and professionals in the above mentioned fields [International Shipbuilding Progress](#) ,1963

**Numerical Ship Hydrodynamics** Lars Larsson, Frederick Stern, Michel Visonneau, 2013-09-30 This book assesses the state of the art in computational fluid dynamics CFD applied to ship hydrodynamics and provides guidelines for the future developments in the field based on the Gothenburg 2010 Workshop It presents ship hull test cases experimental data and submitted computational methods conditions grids and results Analysis is made of errors for global resistance sinkage and trim and self propulsion and local flow wave elevations and mean velocities and turbulence variables including standard deviations for global variables and propeller modeling for self propulsion The effects of grid size and turbulence models are evaluated for both global and local flow variables Detailed analysis is made of turbulence modeling capabilities for capturing local flow physics Errors are also analyzed for head wave seakeeping and forward speed diffraction and calm water forward speed roll decay Resistance submissions are used to evaluate the error and uncertainty by means of a systematic verification and validation V V study along with statistical investigations Post workshop experimental and computational studies are conducted and analyzed for evaluation of facility biases and to draw more concrete conclusions regarding the most reliable turbulence model appropriate numerical methods and grid resolution requirements respectively **Progress in Maritime Technology and Engineering** Carlos Guedes Soares, T.A. Santos, 2018-04-17 Progress in Maritime Technology and Engineering collects the papers presented at the 4th International Conference on Maritime Technology and Engineering MARTECH 2018 Lisbon Portugal 7 9 May 2018 This conference has evolved from a series of biannual national conferences in Portugal and has developed into an international event reflecting the internationalization of the maritime sector and its activities MARTECH 2018 is the fourth in this new series of biannual conferences Progress in Maritime Technology and Engineering contains about 80 contributions from authors from all parts of the world which were reviewed by an International Scientific Committee The book is divided into the subject areas below Port performance Maritime transportation and economics Big data in shipping Intelligent ship navigation Ship performance Computational fluid dynamics Resistance and propulsion Ship propulsion Dynamics and control Marine pollution and sustainability Ship design Ship structures Structures in composite materials Shipyard technology Coating and corrosion Maintenance Risk analysis Offshore and subsea technology Ship motion Ships in transit Wave structure interaction Wave and wind energy Waves Progress in Maritime Technology and Engineering will be of interest to academics and professionals involved in the above

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