The Royal Institution of Naval Architects

Full Scale Ship Performance

International Conference
Full Scale Ship Performance
24 - 25 October 2018,
RINA HQ, London, UK

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Call Catherine on +44 (0) 20 7235 4622 or email conference@rina.org.uk
10.40-11.15 HYDRODYNAMIC DIGITAL TWIN: MACHINE LEARNING AND TRADITIONAL MODELLING, Ivoane Meillo, D’Amico Shipping Group, UK, Alessandro Pesceatto, ARINA Services SpA, Italy. Collecting large amounts of reliable data on board ships is no longer restricted to rich pioneers and technology enthusiasts. With numerous permanent monitoring systems now on the market, it’s easy and affordable for all of us. The era of big data has reached the maritime sector. Big data can help increase the understanding of the ship hydrodynamics in full scale by using a state-of-the-art numerical approach, exactly as it provides a balance between experimental methods and CFD. In particular, it is demonstrated how some kind of analysis are almost impossible using noon reports data. Furthermore, it is also presented and benchmarked different methods for building hydrodynamic digital twin of a ship, capable to forecast propulsive performance in the different loading and environmental conditions: one more possible solution for increasing data driven monitoring (FPM) technologies, and the other one using a black box approach through machine learning techniques.

11.15-11.40 COFFEE

11.40-12.15 THE IMPORTANCE OF DATA QUALITY IN MODELLING, Boris Zinovieff, BMT, UK. Data driven methods analysis rely on the quality of the data. However, the data quality may be affected by incorrect data management, preprocessing or related to the changes of the vessel, payload, conditions. This talk will present a set of equations, which can be used to understand the upper limits to the data quality, based on a lifting surface analysis of the different subsystems. The quality of the data-driven models is directly proportionate to the reliability and quality of data being used to generate or train the model. This paper will aim to show the importance of data quality when looking to develop data-driven ship performance and models with the aim of voyage optimisation and planning. Furthermore to present how to identify bad datasets and what to do in these instances when the data is not suitable for building these models.

12.15-12.50 DEVELOPMENT OF A NUMERICAL MODEL ON DISPLACEMENT CORRECTION FOR SHIP PERFORMANCE IN CALM SEAS BASED ON FULL-SCALE MEASUREMENT, Naoto Sagihara, Akiko Sakurada, Mariko Kudo, Masaru, Tatsunori, Yoshikazu Sugimoto, Ken Hasegawa, National Maritime Research Institute, Japan. This paper discusses a model for evaluating the displacement correction for the performance of ships in calm seas, which is very small, to be considered. The Admiralty coefficients are used for this correction. Otherwise a relationship between displacement and speed or power obtained by means of model tests can be used. However, it is not appropriate to apply the Admiralty coefficients to container ships or vehicle carriers since the displacement is widely varies. Authors propose a numerical model on the influence of displacement in calm seas based on full-scale measurement. The objective of this model is to provide practical correction on displacement. Data which are regarded as in calm seas are screened out and fitted to the numerical model, which enables accurate prediction of ship’s performance in calm seas for any displacement. The validation of the proposed model is carried out by comparing full-scale measurement for container ship and vehicle carrier and vessel performance simulation in which the model is applied.

13.45-14.20 JORES JIP - A UNIQUE JOINT INDUSTRY PROJECT TO CLOSE THE KNOWLEDGE GAP, Dmitry Punkovrut, UK, Gijs Struijk, MAN, The Netherlands. The implementation of new environmental regulations the shipping industry is challenged and hence highly motivated to explore new energy efficiency solutions. A well-designed ship hull, appendages, propeller or ESDs (Energy Saving Devices) is of paramount importance to this. Ship designers make use of Computational Fluid Dynamic (CFD) for their design work. While being a flexible and relatively low-cost tool, its results are subject to validation. For this a model test is often used, as it offers a well-controlled, physical measured value. However, the uncertainty in both scaling effects and the modeling of full-scale flow in CFD is not addressed. It is due to a lack of good flow data on full-scale that the industry has not been able to close the loop between model tests, CFD and the full-scale reality. With this understanding, a group of key companies and research bodies have now stepped up to close this knowledge gap and propose the Jores JIP (Joint Industry Project). Jores JIP aims to increase the understanding of the ship hydrodynamics in full scale by using a state-of-the-art measurement techniques (PIV/LDV for propeller flow, thrust measurements by optical sensors, Speed Through Water assessment by wave radar etc). By doing this, corrections have to be added to the CFD results to obtain the most accurate prediction of the ship self-propulsion point. Various methods may be defined to do so and that will be discussed in the present paper. The test case of the 2016 LR Workshop on Ship Scale Hydrodynamic Computer Simulation will be used as an example.

14.20-14.55 ON THE ANALYSIS OF RANS - BASED FULL-SCALE POWER PREDICTIONS, Bram Starke, MAN, The Netherlands. When performing full-scale power predictions at the trial conditions, a balance has to be found between resistance and thrust and torque and RPM. For various reasons this balance will not necessarily be found from a CFD computation; not even when one is able to show that the common numerical errors (the discretization error and the iterative error) are typically small, the ADMIRALTY coefficient can be used for the correction. Most notable errors in the resistance due to physical features that have not been taken into account in the simulations: most notably the superstructure, surface roughness and in the case of [2] also the bilge keels and the anodic protection of the hull. The frictional resistance and the propeller wake field are also affected by the choice of turbulence models, and the propulsive parameters may be affected by the choice of propeller modeling: RANS-BEM or RANS-Sliding interface. Therefore, corrections have to be added to the CFD results to obtain the most accurate prediction of the ship self-propulsion point. Various methods may be defined to do so and that will be discussed in the present paper. The test case of the 2016 LR Workshop on Ship Scale Hydrodynamic Computer Simulation will be used as an example.

15.15-16.30 VALIDATION OF A NOVEL APPROACH TO FULL SCALE - PROPULSION NUMERICAL SIMULATIONS, Marco Bovio, Leading Edge Marine Engineering, the Netherlands. The paper is intended to prove how, in comparison with usual model scale experiments, modern CFD RANSE techniques provide a viable and reliable solution for the accurate power and speed prediction of full-scale vessels even at early design stages. In particular, the paper will focus on the validation of a simplified approach, based on the use of an advanced actuator disc method to reproduce the propulsion, against the full-scale data set collected during 2016 Lloyd’s Register measurements campaign on the 138m General Cargo “Royal”, which is the most recent public available benchmark useful for the scope. All the steps involved in the numerical process will be accurately described and external references to support the initial assumptions will be also provided. Particular attention will be given to the sensitivity of some parameters which play a major role in the results achieved through the numerical approach employed for the study.
0.25-10.00 SHIP PROPULSION PERFORMANCE MONITORING AND ENERGY MANAGEMENT: EXPERIENCES AND LESSONS LEARNED, Erik van Ballegooijen, VAF Instruments, the Netherlands. This study uses operational noon-report (NR) data from six ships: three bulk carriers sailing in Norwegian waters, a crude oil tanker, Silverstream Technologies have been involved in extensive data collection efforts. The NR was also compared to continuous monitoring data to assess the amount of fuel consumed by the ships over the course of their voyages. The data collected from these ships provides insights into the factors that influence fuel consumption, and how these factors can be used to improve the efficiency of ship operations.

10.00-10.35 THE EFFECT OF OPERATIONAL FACTORS ON CONTAINER SHIP FUEL PERFORMANCE, Lina Christensen, Technical University of Denmark, Denmark, Giles Thomas, John Calleja, UCL, UK, Ulrik Nielsen, Centre for Autonomous Marine Operations and Systems, The Norwegian University of Science and Technology, Norway. This paper presents a case study of a ferry sailing in Danish national waters. The study has been conducted and the system developed for a ferry sailing in Danish national waters. The paper will detail the challenges encountered with on-board data collection encompassing the use of LDA allows a non-intrusive measurement without perturbing the flow over the ship hull. Here a window was installed on the underside of the hull, which also houses the LDA and computer controlled traversing rail. The set-up allows the outward-looking LDA to measures the velocity gradient in the turbulent boundary layer formed over the hull (during steady sailing) across some traversable region. Initial results show that there is a substantial increase in skin-friction drag for a recently cleaned ship-hull compared to the hydrodynamically smooth surface.

10.35-11.10 IMPROVING THE ENERGY EFFICIENCY OF FERRIES BY OPTIMISING THE OPERATIONAL PRACTICES, Marie Lützen, University of Southern Denmark, Denmark, Bjarne Christiansen, Bjarne Christiansen & Co, Denmark. Over recent decades, there has been an increasing focus on sustainable maritime transport. Stakeholders in the maritime industry have identified several methods of improving energy efficiency, and a large number of studies have been conducted. It is found that improving the energy efficiency is not only a technical and efficient issue and operation is not achieved by only installing new equipment on board, increasing speed or reducing the draught. In addition, it is also important to consider significant reduction in fuel can be achieved through changes in operational practices. The aim of this study is to develop a system for a more efficient operation of ferries sailing on a fixed route. The system includes an optimization of the operation, which is performed by the officers onboard. This optimization can be compared to each other directly. If voyages of similar external conditions result in different energy consumptions, there is reason for analysing the voyages in detail and obtaining appliances to improve the performance. The study of the system has been conducted and the system developed for a ferry sailing in Danish national waters. However, it is assumed that the results can easily be used as guidance for development of systems in other ferries and vessels with shorter sea passages, where the focus is on the work they perform as e.g. supply vessels.

11.10-11.35 COFFEE

11.35-12.10 NORMALISATION OF SHAFT POWER FROM FULL SCALE MEASUREMENT TO THE CALM WATER PERFORMANCE OF A SHIP, Arun Puram Lakshmyaranagaran, Dominic A. Hudson, University of Southampton, UK, M. Limelette, University of Western Brittany, France. The need to monitor performance of ships at full scale has increased in recent years due to the influence of various stakeholders such as policy makers, insurers, classification societies and others. This has led to the development of full scale testing facilities in various countries. The aim of this study is to develop a method for normalising shaft power from full scale measurements of a ship to its calm water performance. The method makes use of the full set of environmental conditions experienced during the full scale sea trials. The method is validated by comparing the results with those obtained from other studies.

12.10-12.45 SKIN- FRICTION DRAG MEASUREMENT OVER A RECENTLY CLEANED AND PAINTED SHIP HULL UNDER STEADY CRUISING VIA IN-SITU LASER-BASED MEASUREMENT, K A P Utama, I K Suastika, M L Hakin, M N Nurrahman, Teknologi Sepuluh Nopember, Indonesia, B Nugroho, R Baldy, J P Monty, N Hutchins, University of Melbourne, Australia, A K Yusim, University of Diponegoro, Indonesia, F A Prasetyo, Indonesian Bureau of Classification, Indonesia, M Yusuf, PT Dhara Lautan Utama, Indonesia, B Gunasekaranbhimab, University of Southampton, UK. A new study has been conducted and the system developed for a ferry sailing in Danish national waters. The study has been conducted and the system developed for a ferry sailing in Danish national waters. The paper will detail the challenges encountered with on-board data collection encompassing the use of LDA allows a non-intrusive measurement without perturbing the flow over the ship hull. Here a window was installed on the underside of the hull, which also houses the LDA and computer controlled traversing rail. The set-up allows the outward-looking LDA to measures the velocity gradient in the turbulent boundary layer formed over the hull (during steady sailing) across some traversable region. Initial results show that there is a substantial increase in skin-friction drag for a recently cleaned ship-hull compared to the hydrodynamically smooth surface.

12.45-13.40 LUNCH

13.40-14.15 ASSESSMENT OF BULBOUS BOW PERFORMANCE OVER OPERATIONAL PROFILES USING FULL SCALE DATA, Henry Way, University of Southampton, UK. Bulbous bows are primarily designed to reduce wave-making resistance. However, the effectiveness of bulbous bows is often not clearly understood. This paper presents a study of bulbous bow performance over operational profiles using full scale data. The study involves the analysis of bulbous bow performance over a variety of operational conditions, including different speeds and sea states. The results show that the bulbous bow significantly reduces wave-making resistance under a wide range of operational conditions.

14.15-14.50 CONSIDERATION OF ENVIRONMENTAL CONDITIONS FOR DETERMINATION OF MANOEUVRING CHARACTERISTICS BY SEA TRIALS, Carl-Uwe Böttner, Hanne Jansch, Federal Waterways Engineering and Research Institute and University of Applied Sciences, Hamburg, Germany. There is a lack of recent sea trial data to validate manoeuvring prediction approaches. This is especially the case for shallow water conditions. A contribution to fill this gap a comprehensive measurement campaign was set up to precisely determine the manoeuvring performance and characteristics of a mid-size multipurpose vessel. The campaign aims to provide a manoeuvring test case for numerical and physical models of manoeuvring character-tics and performance prediction. The sea trials were performed utilizing the M MELIA, a pollution control vessel patrolling along the German coast, owned and operated by the Federal Waterways and Shipping Administration Germany. Her particulars are length overall of 45 m, beam of 10 m and draught of 5 m. She is a twin-screw with control-lable pitch propellers in ducts and conventional rudders. The sea trials were conducted in the North Sea and the Baltic Sea during representative sea states. The study has been conducted and the system developed for a ferry sailing in Danish national waters. However, it is assumed that the results can easily be used as guidance for development of systems in other ferries and vessels with shorter sea passages, where the focus is on the work they perform as e.g. supply vessels.

14.50-15.25 FULL SCALE PERFORMANCE MEASUREMENT AND ANALYSIS OF THE SILVERSTREAM AIR LUBRICATION SYSTEM, Luke De Freelas, Noah Silberschmidt, Takis Pappas, Johannes Johannesson, Silverstream Technologies, Denmark. In this paper, Silverstream Technologies will discuss Full Scale Performance Measurement and Analysis of the Silverstream® System; an Air Lubrication Energy Efficiency Technology. This unique energy saving solution has the capability of being switched ON and OFF once installed giving owners the added benefit of measuring vessel performance in both conditions. The system can be fitted to any ship type with a minimum speed of 15 knots. The system allows for access to in-service performance data from full scale installations, Silverstream has developed a practical and effective testing regime for assessing efficiency gains. The system has been successfully deployed in over 20 ships and accounts for over 100,000 hours of accumulated run time. The system has met or exceeded the requirements for data collection, measurement and accuracy incorporating industry best practices and utilizing applicable methods outlined in ISO 19030, the results have been verified by independent third party. The paper will detail the challenges encountered with on-board data collection encompassing the accuracy of measurements received from instruments, the methodology used for analysis and the verification process. Successful deployment over a whole variety of vessels has enabled Silverstream Technologies to draw conclusions to the energy efficiency of ships, both in service and new build. The paper will also be discussed.
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