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Reviewing Simulation and Modelling Methods for Safe Ship Design in Transportation and Personnel Accommodation

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Abstract: This paper serves as a way of examining simulation and modeling methods for the assessment of certain approaches tailored to ensure the safety of ship designs and also effective transportation. Through an extensive analysis of relevant articles, this study aims to provide insights into the diverse approaches utilized, with a primary emphasis on safety considerations. Key topics explored include the manufacturing and design of computational fluid dynamics (CFD) methods. By synthesizing findings from these studies, this review contributes to a deeper understanding of the efficacy and limitations of those techniques, thereby informing future research directions and practical applications in the maritime industry.

1. Introduction

The safety of ship design is a paramount concern in the maritime industry, which has increasingly relied on simulation and modeling methods to predict the behavior of ships under various conditions and ensure their safe operation. This paper reviews the current state of simulation and modeling methods used in ship design, with a focus on their role in enhancing safety and transportation efficiency.

2. The Role of Computational Fluid Dynamics (CFD) in Ship Design

2.1. Basics of CFD and Its Application in Maritime Design 2.2. Recent Advances in CFD Techniques 2.3. Case Studies: Successful Applications of CFD in Ship Safety Enhancements.

In the past few years, structural analysis has emerged for checking the current eligible low-cost techniques, including shipbuilding. In this article we will analyze the high pressure caused by an underwater explosion, near the ship's hull. In the past wars, especially world wars, mines were used at large scale, and had done a lot of destruction against military ships. The purpose of this analysis is to find out how we can improve the ship's hull, so that it can resist against high pressure, without changing its handling or displacement. To perform the test, Ansys Static Structural was used and the method of calculation was „Finite Element Method".

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3. Other Simulation Methods in Maritime Design

3.1. Finite Element Analysis (FEA) for Structural Integrity 3.2. Virtual Reality (VR) and Its Emerging Role in Safety Training 3.3. Integration of Simulation Tools for Comprehensive Safety Analysis.

Specialized simulation software is now available and it can assist technicians and ship-owners with almost any problem they encounter with their vessel's thruster. A wide range of simulation products can prevent damages and lifetime calculations based on a various set of parameters like blade dimensions, output power and fluid flow around bow thruster impeller. The bow thruster is design to provide lateral force in order to steer the ship in narrow places like harbors. Modern ships are fitted with bow thrusters for fast operation in ship handling and for increased safety. In operation can occur catastrophic events like blade fracture due to ice or other restrictions of movement. The purpose of this paper is to analyze the bow thruster impeller pressures, speeds for easily understand structural integrity failures. The paper includes an analytical calculation and numerical analyses with finite elements of the bow thruster. The main conclusions are summarized in the results section.
Research methods of currents applied are mainly of the two types:

- Direct survey by means of mobile current-meter devices or to bed-fixed acoustic doppler current profiler (ADCP) aimed to record, at daily intervals, the velocity and direction of marine current at various depths.

In-situ data for marine currents were obtained using ADCP on-board R/V Cătuneanu of Maritime Hydrographic Director ate by NIMRD oceanographers. The results of the measured marine currents vectors (u – horizontal velocity and v – vertical velocity) were analyzed in this paper and the graphical method were performed using the specialized program: Golden Software – Surfer, fig. 2.

- Indirect assessment in terms of the current dependency (geostrophic relation) on surface pressure variability through horizontal cur rents. The approach is similar to the meteorological one, where atmospheric pressure applies to wind field mapping. In both cases, of winds and currents, the geostrophic velocity is parallel to the pressure contours of the mapping and of inverse proportionality to their spacing (distances). The assessment is made for relative values of velocity to a reference sea water depth; the absolute velocity may be obtained when measurements of current velocities are also performed at the reference depth.

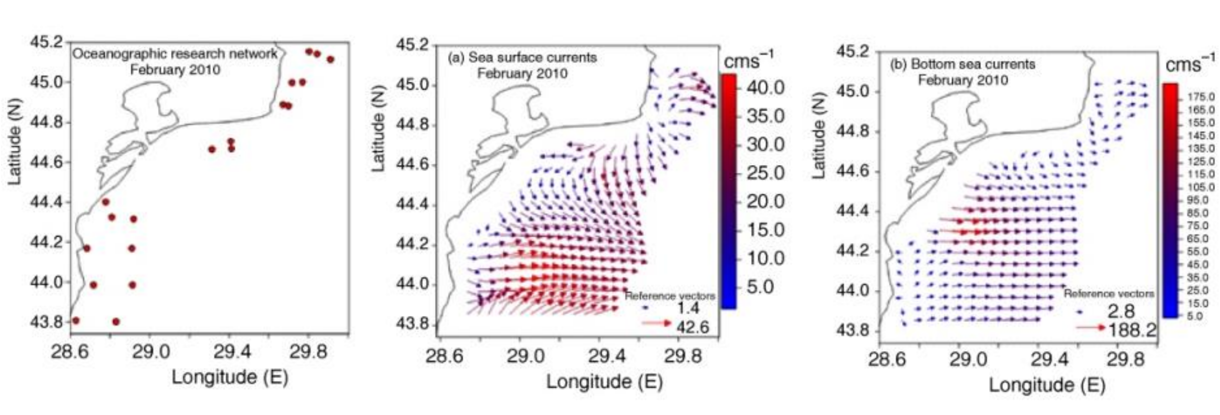

Figure 2. Marine currents distribution in february 2010 in the western part of the Black Sea's continental shelf

6. Conclusion

This review has highlighted the critical role of simulation and modeling in advancing the safety of ship design. Despite the challenges and limitations faced, the continuous improvements in computational methods and the integration of new technologies hold promising potential for the future. Further research is required to bridge the gap between theoretical models and practical applications, ensuring that simulation tools can effectively enhance both the safety and efficiency of maritime transportation.

The examination of simulation and modeling methods for safe ship design in transportation offers valuable insights into the complex dynamics of maritime environments and vessel structures. Through a comprehensive review of relevant literature, several key conclusions emerge.

Various methodologies exist for assessing marine currents, ranging from direct surveys with mobile current-meter devices to indirect assessments based on surface pressure variability. These methods provide essential data for understanding the dynamic nature of currents, crucial for safe ship navigation.

CFD simulations offer a powerful tool for studying fluid dynamics around ships. The analysis conducted between Midia Cape and Constanta coastline highlights the interaction of marine currents with coastal profiles, emphasizing pressure distribution and velocity effects. Such simulations aid in optimizing ship design and coastal infrastructure planning.

The utilization of specialized simulation software facilitates the analysis of bow thruster performance, essential for maneuverability in harbors and confined spaces. By evaluating impeller pressures, speeds, and structural integrity, potential failure modes can be identified and addressed, enhancing safety during vessel operations.

Structural analysis, particularly in scenarios involving underwater explosions near a ship's hull, is paramount for ensuring vessel survivability. Finite element method simulations, as demonstrated in this study, provide crucial insights into areas vulnerable to high-pressure events, enabling the optimization of hull designs without compromising operational capabilities.

The application of finite element calculation involves several stages, including mesh discretization, interpolation functions, determination of stiffness matrices, and analysis of nodal forces. These steps are essential for accurately predicting structural responses and identifying critical areas for reinforcement.

The simulation results highlight areas of high-pressure impact on the ship's hull and structural components. By understanding the distribution of stresses and strains, engineers can refine design parameters, material selections, and construction methodologies to enhance vessel resilience and safety.

In conclusion, the integration of advanced simulation and modeling techniques plays a pivotal role in ensuring safe ship design and effective transportation. By leveraging these methodologies, stakeholders in the maritime industry can mitigate risks, optimize vessel performance, and uphold the highest standards of safety and operational efficiency.

7. References

[1] Abdulla Shafiq, J., & Zaid, R. K. (2024). The Impact of Teaching English Literature on improving EFL University Learners' Performance. *Technium Education and Humanities*, 9, 81–90. https://doi.org/10.47577/teh.v9i.11561

[2] Anderson, J.D. (2010). *Fundamentals of Aerodynamics*. McGraw-Hill Education.

[3] Bosneagu, M. R., Scurtu, I. C., Popov, P., & ... R.-D. M. (2018). Simulation on Marine currents at Midia Cape-Constanta area using computational fluid dynamics method. *Thermal Science*, 22 (Suppl. 2), 353–360.

[4] Bosneagu, R., Scurtu, I. C., Popov, P., Mateescu, R., Dumitrache, L., & Mihailov, M. E. (2019). Hydraulics numerical simulation using computational fluid dynamics (CFD) method for the mouth of Sulina channel. *Journal of Environmental Protection and Ecology*, 20(4), 2059–2067.

[5] Dragomir, M. C., Calimanescu, I., & Scurtu, I. C. (n.d.). Use of 3D Finite Element Analysis in Geometric Optimization and Crack Analysis of a Port Quay Crane's Sheave. *Uso de 3D Análisis de Elementos Finitos en Optimización Geométrica*.

[6] Fratila, C., Axinte, T., Cojocaru, R. C., Berescu, C., & Scurtu, I. C. (2020). The study of the lifting mechanism of the crane arm to a barge.

[7] Hughes, T.J.R. (2012). *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis*. Dover Publications.

[8] International Maritime Organization (IMO). (2018). *Guidelines for the Application of Plastic and Visual Simulations in Ship Design*. IMO Publications.

[9] Larsson, L., & Raven, H.C. (2014). *Ship Resistance and Flow*. Society of Naval Architects and Marine Engineers.

[10] Paik, J.K., & Thayamballi, A.K. (2007). *Ship Design for Efficiency and Economy*. Butterworth-Heinemann.

[11] Petrov, A., & Brebbia, C.A. (2018). *Computer Simulations in Shipbuilding*. WIT Press.

[12] Rahman, M. (2016). "Integration of CFD in Conceptual Ship Design". *Marine Technology*, 53(2), 41-56.

[13] Savenkov, O., Radchenko, A., Bileka, B., Scurtu, I. C., & Kalinichenko, I. (2021). Improving the Efficiency of Operation of Gas Turbine Plants Based on Turbo-Gear Units. *Conference on Integrated Computer Technologies in Mechanical Engineering*.

[14] Sörensen, K. (2019). "Challenges in Maritime Simulation and Modeling". *Journal of Marine Science and Engineering*, 7(4), 120.

[15] JA Shafiq (2023). Nikki Giovanni: The Poet Laureate of the Black Community. *Alustath Journal for Human and Social Sciences*, 61(4), 386-395.

[16] JA Shafiq (2023). THE PORTRAIT OF THE SPINSTER IN VICTORIAN NOVELS: A Socio–Feminist Study. *Journal of English Language for Linguistics and Literary Studies*, 1(1), 30-38.

[17] Scurtu, I. C., & Panaitescu, V. N. (2019). Turbulent Flow Numerical Simulation for Unconventional Propulsion. *Revista de Chimie*, 70(10), 3508–3511.

[18] Zhang, S., & Zheng, Y. (2021). "Application of AI and Machine Learning in Maritime Industry Simulations". *Artificial Intelligence Review*, 54(1), 789-812.

TechHub Journal Vol. 7, pp.237-241 (2024)
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www.techhubresearch.com

[19] Zienkiewicz, O.C., & Taylor, R.L. (2000). *The Finite Element Method: Its Basis and Fundamentals*. Elsevier Science.