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EVALUATION OF INTERCEPTOR DESIGN TO REDUCE DRAG ON PLANING HULL

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Abstract

A planing hull is a high-speed craft with relatively complex hydrodynamic characteristics. An increase in speed can induce a significant change in trim angle with an increment in ship drag . One solution to reduce ship resistance is to use an interceptor . This research aimed to analyze the hydrodynamics of a planing hull vessel by applying an interceptor . The fundamental aspects reviewed included the analysis of drag , trim, heave, and lift force. The interceptor would be investigated on the basis of its integrated position at its height. This research also used the computational fluid dynamic (CFD) method in calm water conditions. All simulations were conducted with the same mesh structure, which allowed the performance evaluation of the interceptor in calculating turbulent air–water flow around the ship. Numerical calculations used the Reynolds-averaged Navier–Stokes (RANS) equation with the k–ε turbulence model to predict the turbulent flow. The vertical motion of the ship was modeled using dynamic fluid– body interaction (DFBI) in the fluid domain through an overset mesh technique. The numerical approach was compared with the experimental test results of Park et al. to ensure the accuracy of the test results. The interceptor was designed at the transition phase, which showed the highest trim angle followed by high drag .

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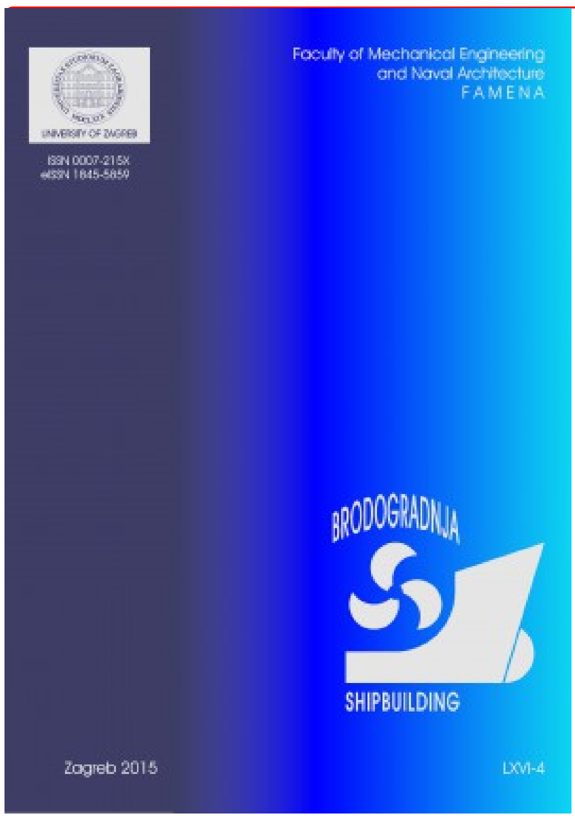

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(str. 135-150)

Andrija Ljulj, Vedran Slapničar, Juraj Brigić

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Sažetak

A planing hull is a high-speed craft with relatively complex hydrodynamic characteristics. An increase in speed can induce a significant change in trim angle with an increment in ship drag. One solution to reduce ship resistance is to use an interceptor. This research aimed to analyze the hydrodynamics of a planing hull vessel by applying an interceptor. The fundamental aspects reviewed included the analysis of drag, trim, heave, and lift force. The interceptor would be investigated on the basis of its integrated position at its height. This research also used the computational fluid dynamic (CFD) method in calm water conditions. All simulations were conducted with the same mesh structure, which allowed the performance evaluation of the interceptor in calculating turbulent air–water flow around the ship. Numerical calculations used the Reynolds-averaged Navier–Stokes (RANS) equation with the k–ε turbulence model to predict the turbulent flow. The vertical motion of the ship was modeled using dynamic fluid–body interaction (DFBI) in the fluid domain through an overset mesh technique. The numerical approach was compared with the experimental test results of Park et al. to ensure the accuracy of the test results. The interceptor was designed at the transition phase, which showed the highest trim angle followed by high drag. The interceptor would experience negative trim at high speeds; thus, it was not recommended. The research results indicated that the most effective use of the interceptor was at Froude number 0.87 close to the chine position with a height of 100%. This interceptor could reduce a maximum of 57% drag, 17% heave, 8.48% trim, and 0.12% lift force. The interceptor could increase excessive drag and trim at Froude numbers over 1.16. The interceptor proved to be remarkably useful in trim control and ship drag reduction, but selecting the wrong dimensions and positions of the interceptor could endanger the ship. This simulation was performed on Aragon-2; thus, the interceptor performance may possibly change if a different hull geometry is used.

Ključne riječi

planing hull, drag, heave, lift force, trim

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NUMERICAL INVESTIGATIONS ON THE EFFECTS OF SEABED SHALLOW SOILS ON A TYPICAL DEEPWATER SUBSEA WELLHEAD SYSTEM

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Sažetak

Deepwater subsea wellheads may be significantly threatened under extreme sea conditions and operations, especially when the seabed is composed of very soft clay properties. A numerical model of a deepwater wellhead system is established using the classic ocean pipe element and nonlinear spring element of ANSYS to examine the behaviors of subsea wellheads in diverse seabed soil. Nonlinear spring elements coded in the APDL language are used to model three types of seabed soils: very soft soil, soft soil, and firm soil. The dynamic and quasi-static behaviors of the wellhead system in the typical coupled and decoupled models of the drilling riser system are particularly investigated in depth. The effects of the nonlinear seabed soil properties on the detailed wellhead are realistically simulated using time domain and extremum analysis. The results show that the softer the seabed soil, the greater the displacement, rotation angle, curvature, and bending moment of deepwater subsea wellheads. When the seabed soil reaches a particular depth, the mechanical characteristics of the wellheads under the three types of seabed soil conditions are almost simultaneously close to zero. Overall, several conclusions reached in this study may provide some useful references for design and stability analysis.

Ključne riječi

Subsea wellhead, Seabed soil, Mechanical behaviour, Nonlinear spring

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UNMANNED SURFACE VEHICLE – TRITOR

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Abstract

This paper presents an unmanned surface vehicle Tritor that was developed, constructed, and tested within an innovative, multi-purpose, multidisciplinary, low-budget and environmentally friendly solution. The idea behind this work was trying to invent a new concept of a miniature surface vehicle that will be unmanned, remotely controlled and autonomous, with electric propulsion, and with an innovative Three Slender Cylinders Hull (3SCH) form gaining advantages in comparison to existing surface vehicles. This initial work is focused on vehicle prototype design, propulsion system development and optimization, control design, and trials, while research related to advantages of the vehicle in terms of naval architecture criteria such as drag and power, stability, seakeeping, and maneuverability will be investigated in further work. In addition, the paper intends to contribute to a new trend in developing vehicles with electrical propulsion that could use renewable sources of energy such as wind and solar energy. The potential usage of the vehicle can be civilian or military, and further work will be focused on larger models, improved based on the experience got during the development of the vehicle. Tritor vehicle was successfully designed, constructed, and tested in real environmental conditions. The preliminary results show that the vehicle has required performances and potential for improvements in the future. The main scientific contribution of this work is advanced surface vehicle development with a focus on a new hull form and the integration of electric propulsion in it.

Keywords

unmanned surface vehicle, autonomous, remote control

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