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Section Information

The Marine Engineering Section is open to receive high-quality papers reporting marine biotechnology, marine resources, marine chemistry, marine environment, chemical oceanography, geological oceanography, physical oceanography, ocean engineering, coastal engineering as well as other basic phenomena in these field. Applied Sciences in general and this Section on Marine Engineering in particular offers high-quality peer review followed by a rapid publication decision.

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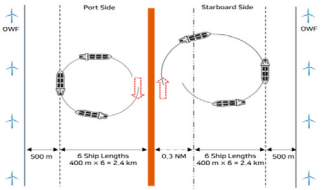
Featured Papers

DOI:10.3390/app12020635

Extracting the Maritime Traffic Route in Korea Based on Probabilistic Approach Using Automatic Identification System Big Data

Authors: Jeong-Seok Lee and Ik-Soon Cho

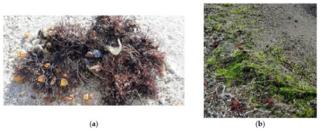


Abstract: To protect the environment around the world, we are actively developing ecofriendly energy. Offshore wind farm generation installed in the sea is extremely large among various energies, and friction with ships occurs regularly. Other than the traffic designated area and the traffic separate scheme, traffic routes in other sea areas are not protected in Korea. Furthermore, due to increased cargo volume and ship size, there is a risk of collisions with marine facilities and marine pollution. In this study, maritime safety traffic routes that must be preserved are created to ensure the safety of maritime traffic and to prevent accidents with ecofriendly energy projects. To construct maritime traffic routes, the analysis area is divided, and ships are classified using big data. These data are used to estimate density, and 50% maritime traffic is chosen. This result is obtained by categorizing the main route, inner branch route, and outer branch route. The Korean maritime traffic route is constructed, and the width of the route is indicated. Furthermore, this route can be applied as a navigation route for maritime autonomous surface ships.

DOI:10.3390/app12073599

Assessment of the Resource Potential of Baltic Sea Macroalgae

Authors: Yuliya Kulikova, Stanislav Sukhikh, Olga Kalashnikova, Evgeny Chupakhin, Svetlana Ivanova, Boris Chubarenko, Julia Gorbunova and Olga Babich

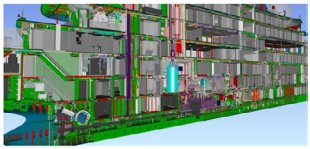


Abstract: The excess biomass of drifting algae and their casting to the Baltic Sea coast imposes a significant environmental burden. The analysis of beach-cast algae showed that the dominant species are macroalgae *Ulva* sp., *Furcellaria lumbricalis*, *Cladophora* sp., and *Polysiphonia fucoides*. The biomass of *Furcellaria* and *Polysiphonia* algae, containing 25.6% and 19.98% sugars, respectively, has the greatest resource potential in terms of obtaining carbohydrates. Fucose, glucose, and galactose were found to be the most common carbohydrates. The lipid content did not exceed 4.3% (2.3–4.3%), while the fatty acid composition was represented by saturated fatty acids (palmitic, stearic, methyloleic, behenic, etc.). The highest content of crude protein was found in samples of macroalgae of the genus *Polysiphonia* and amounted to 28.2%. A study of the elemental composition of drifting algae revealed that they have a high carbon content (31.3–37.5%) and a low hydrogen (4.96–5.82%), and sulfur (1.75–3.00%) content. Red algal biomass has the most resource potential in terms of biofuel generation, as it has a high number of lipids and proteins that can produce melanoidins during hydrothermal liquefaction, enhancing the fuel yield. The study noted the feasibility of using the biomass of the studied algae taxa to produce polysaccharides and biofuels. The analyses of antioxidant properties, fat content, and fat composition do not provide convincing evidence of the viability of using the aforementioned macroalgae for their production.

DOI:10.3390/app122412721

Using Digital Twin in a Shipbuilding Project

Authors: Zoran Kunkera, Tihomir Opetuk, Neven Hadžić Nataša and Tošanović

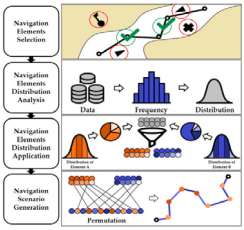


Abstract: Three-dimensional modelling software tools enable the creation of a digital replica of the product—"Digital Twin"—a representative of "Virtual Reality" as one of the prominent trends of Industry 4.0. The development of the Digital Twin can start simultaneously with the development of the product, primarily for the purpose of selecting optimal technical and technological solutions prior to and during physical construction, and, ultimately, with the intention of managing the entire product life cycle. The Digital Twin, as one of the key technological achievements in the implementation of the business system transformation from traditional to smart, should also be recognized as the cornerstone of the "Shipyard 4.0" model, i.e., its "Cyber-Physical Space." This paper is based on statistical and empirical data of the observed shipyard with the aim to represent the significance of the Digital Twin ship in preserving and improving the competitiveness of the shipbuilding industry. Namely, with the emphasis this article places on the contribution of "advanced outfitting" in achieving savings in the shipbuilding process as well as its role in attaining high standards of environmental protection and workplace safety, the importance of its further improvement is an obvious conclusion—with Digital Twin being one of the recognized tools for this purpose.

DOI:10.3390/app12031651

Navigation Scenario Permutation Model for Training of Maritime Autonomous Surface Ship Remote Operators

Authors: Taemin Hwang and Ik-Hyun Youn



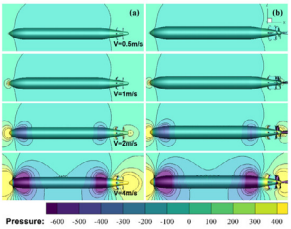
Abstract: The development of autonomous ships has begun. Artificial intelligence (AI) is expected to be partially responsible for navigation; nevertheless, the importance of human intervention is higher than ever. Human intervention in the control of an autonomous ship via the remote operator requires navigation proficiency. The education method for the remote operators that is presently considered is simulation training. However, the simulation training does not take long enough time for enabling trainees to develop their navigation proficiency equivalent to that of conventional ships navigators. In addition, the simulation training should contain various navigation scenarios to train the trainee properly. Therefore, this paper suggests the methods to generate the massive and practical navigation scenarios by extracting navigation elements' distribution from actual ship trajectory data and applying them to the permutation of navigation elements. The results demonstrated the advantages of the proposed methods by comparing the sample navigation scenario and an example of an impractical navigation scenario. In conclusion, it is expected that the massive generation of practical navigation scenarios using the proposed permutation model will positively affect the simulation training of the maritime autonomous surface ship remote operators.

DOI:10.3390/app12146975

Numerical Simulation of the Hydrodynamic Performance and Self-Propulsion of a UUV near the Seabed

Authors: Xiaodong Liu, Yuli Hu, Zhaoyong Mao and Wenlong Tian

Abstract: Unmanned underwater vehicles (UUV) face maneuverability and rapidity challenges when they are applied for detecting and repairing submarine oil and gas pipelines, and fiber cables near the seabed. This research establishes numerical models of the bare UUV and self-propelled UUV near the seabed using the computational fluid dynamics (CFD) method. The effect of dimensionless distance *Hd* and Re_L on the hydrodynamic performance of the vehicle and the interaction between the hull and the propeller is investigated. The range of *Hd* is 1.5*D*–10*D*, and the Re_L is 9.97 × 10^5~7.98 × 10^6. Findings indicate that: (1) There is an obvious strong coupling between the hydrodynamic performance of the bare UUV and *Hd*. With the increase of Hd, the hydrodynamic performance such as C_d, the absolute value of C_l and m_y decreases continuously and finally tends to be stable. The absolute values of C_d and C_l increase with the increase of Re_L. The change trend of m_y is opposite to that of C_l. (2) The variation trend of hydrodynamic performance of the self-propelled UUV with Hd is consistent with those of the bare UUV. Additionally, it increases to some extent, respectively, compared with the bare UUV. (3) The self-propelled characteristics such as *t*, η_H *w* and η_i are weakly related to *Hd*. The *t* and η_i increase with the increasing of Re_L, while η_H and *w* decrease with the increasing of Re_L.



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