1. Introduction

The international seaborne trade by volume is divided into 60% loaded and 70% discharged trade, which means that the marine industry today is still the number one means of transportation for the human kind. As the trade amount is vast, the power included in that transportation field is the same high. Although maritime transport is pointed to as an energy-efficient mode of transportation, its emission of GHGs is still high despite new technologies that have been adopted [1]. Optimization and the use of new fuels with new technologies for power generation of such systems are always tasks that are necessary in order to improve efficiency of the power generation system and to reduce GHG emissions [2–6].

The second important thing is the reliability of such systems. As ships and submarine machines [7,8] are far away from available services, their machinery must be reliable in operation. For example, the failure of turbocharger of the standby generator could cause blackout and loss of propulsion [9]. The probability of avoiding such scenario increases with the number of generators that are on the stand-by mode at the time.

The intent of this Special Issue was to collect recent research in the field that improves such systems. This issue is composed of nine articles and one review paper. The six papers cover energy efficiency with numerical and optimization methods. Two papers are in the field of the submarine machines and two papers are dealing with the system failures. The brief description of each paper are given in the following section.

2. Papers Details

Gospić et al. [1] discusses the possibility of applying the trigeneration energy concept (cogeneration + absorption cooling) on diesel-powered refrigerated ships, based on systematic analyses of variable energy loads during the estimated life of the ship on a predefined navigation route. From a methodological point of view, mathematical modeling of predictable energy interactions of a ship with a realistic environment yields corresponding models of simultaneously occurring energy loads (propulsion, electrical, and thermal), as well as the preferred trigenerational thermal effect (cooling and heating). Special emphasis is placed on the assessment of the upcoming total heat loads (refrigeration and heating) in live cargo air conditioning systems (unfrozen fruits and vegetables) as in ship accommodations. The obtained results indicate beneficiary energy, economic, and environmental effects of the application of diesel engine trigeneration systems on ships intended for cargo transport whose storage temperatures range from –25 to 15 °C. Further analysis of trigeneration system application to the passenger ship air conditioning system indicates even greater achievable savings.

Andelić et al. [2] collected the publicly available dataset for the Combined Diesel-Electric and Gas (CODLAG) propulsion system, which was used to obtain symbolic expressions for estimation of fuel flow, ship speed, starboard propeller torque, port propeller torque, and total propeller torque using genetic programming (GP) algorithm. The dataset consists of 11,934 samples that were divided into training and testing portions in an 80:20 ratio. The training portion of the dataset, which consisted of 9548 samples, was used to train...
the GP algorithm to obtain symbolic expressions for estimation of fuel flow, ship speed, starboard propeller, port propeller, and total propeller torque, respectively. After the symbolic expressions were obtained, the testing portion of the dataset, which consisted of 2386 samples, was used to measure estimation performance in terms of coefficient of correlation ($R^2$) and Mean Absolute Error (MAE) metric, respectively. Based on the estimation performance in each case, the three best symbolic expressions were selected with and without decay state coefficients. From the conducted investigation, the highest $R^2$ and lowest MAE values were achieved with symbolic expressions for the estimation of fuel flow, ship speed, starboard propeller torque, port propeller torque, and total propeller torque without decay state coefficients, while symbolic expressions with decay state coefficients had slightly lower estimation performance.

Baress Šegota et al. [3] presented an improvement of marine steam turbine conventional exergy analysis by application of neural networks. The conventional exergy analysis requires numerous measurements in seven different turbine operating points at each load, while the intention of MLP (Multilayer Perceptron) neural-network-based analysis was to investigate the possibilities for reducing measurements. At the same time, the accuracy and precision of the obtained results should be maintained. In MLP analysis, six separate models are trained. Due to a low number of instances within the data set, a 10-fold cross-validation algorithm was performed. The stated goal was achieved, and the best solution suggests that MLP application enables the reduction of measurements to only three turbine operating points. In the best solution, the MLP model errors fall within the desired error ranges: Mean Relative Error (MRE) < 2.0% and Coefficient of Correlation ($R^2$) > 0.95 for the whole turbine and each of its cylinders.

Pelić et al. [4] discussed the medium-speed diesel engine in diesel-electric propulsion systems, which is increasingly used as the propulsion engine for liquefied natural gas (LNG) ships and passenger ships. The main advantage of such systems is their high reliability, better maneuverability, greater ability to optimize and significant decrease in the engine room volume. Marine propulsion systems are required to be as energy efficient as possible and to meet environmental protection standards. The paper analyzes the impact of split injection on fuel consumption and NO$_x$ emissions of marine medium-speed diesel engines. For the needs of the research, a zero-dimensional, two-zone numerical model of a diesel engine was developed. A model based on the extended Zeldovich mechanism was applied to predict NO$_x$ emissions. The validation of the numerical model was performed by comparing operating parameters of the basic engine with data from engine manufacturers and data from sea trials of a ship with diesel-electric propulsion. The applicability of the numerical model was confirmed by comparing the obtained values for pressure, temperature, and fuel consumption. The operation of the engine that drives the synchronous generator was simulated under stationary conditions for three operating points and nine injection schemes. The values obtained for fuel consumption and NO$_x$ emissions for different fuel injection schemes indicate the possibility of a significant reduction in NO$_x$ emissions but with a reduction in efficiency. The results showed that split injection with a smaller amount of injected pilot fuel and a smaller angle between the two injections allow a moderate reduction in NO$_x$ emissions without a significant reduction in efficiency. The application of split injection schemes that allow significant reductions in NO$_x$ emissions led to a reduction in engine efficiency.

Nirbito et al. [5] explains the performance analysis of a propulsion system engine of an LNG tanker using a combined cycle whose components are gas turbine, steam turbine, and heat-recovery steam generator. The researchers are to determine the total resistance of an LNG tanker with a capacity of 125,000 m$^3$ by using the Maxsurf Resistance 20 software, as well as to design the propulsion system to meet the required power from the resistance by using the Cycle-Tempo 5.0 software. The simulation results indicate a maximum power of the system of about 28,122.23 kW with a fuel consumption of about 1.173 kg/s and a system efficiency of about 48.49% in fully loaded conditions. The ship speed can reach up to 20.67 knots.
Poljak et al. [6] described and evaluated the atmospheric drain condensate system of a marine steam power plant from the energetic and exergetic points of view at a conventional liquefied natural gas (LNG) carrier. Energy loss and exergy destruction rate were calculated for individual stream flows joined in an atmospheric drain tank with variations of the main turbine’s propulsion speed rate. The energy efficiency of joining streams was noted to be above 98% at all observed points as the atmospheric drain tank was the direct heater. The exergy efficiency of the stream flows into the drain tank was in the range of 80% to 90%. The exergy stream flow to the tank was modeled and optimized by the gradient reduced gradient (GRG) method. Optimization variables comprised contaminated and clean condensate temperature of the atmospheric drain tank and distillate water inlet to the atmospheric drain tank with respect to condensate outlet temperature. The optimal temperatures improve the exergy efficiency of the tank as the direct heater to about 5% in the port and 3% to 4% when the LNG carrier was at sea, which is the aim of optimization. Proposals for improvement and recommendations are given for proper plant supervision, which may be implemented in real applications.

Lu et al. [7] studied the safety and stability of the anchoring and hooking of ships, bedrock friction, and biological corrosion of submarine cables. A hydraulic jet submarine cable-laying machine manages to bury the submarine cables deep into the seabed and effectively reduces the occurrence of external damage to the submarine cables. This machine uses a hydraulic jet system to realize trenching on the seabed. However, the hydraulic jet submarine cable-laying machine has a complicated operation and high power consumption with high requirements on the mother ship, and it is not yet the mainstream trenching method. In this paper, a mathematical model for the hydraulic jet nozzle of the submarine cable-laying machine is established, and parameters that affect the trenching efficiency are studied. The effects of jet target distance, flow, angle, and nozzle spacing on the working efficiency of the burying machine are analyzed by setting up a double-nozzle model. The results of the theory, numerical simulation, and experiment show that the operational efficiency of the hydraulic jet submarine cable-laying machine can be distinctly improved by setting proper jet conditions and parameters.

Yang et al. [8] enhance the vibration isolation effectiveness of an underwater vehicle power plant and alleviate the mechanical vibration of the outer housing; initially, discrete vibration isolators were improved, and three new types of ring vibration isolators were designed, i.e., ring metal rubber isolators, magnesium alloy isolators, and modified ultra-high polyethylene isolators (MUHP). A vibrator excitation test was carried out, and the isolation effectiveness of the three types of vibration isolators was evaluated, adopting insertion loss and vibration energy level drop. The results showed that, compared with the initial isolators and the other two new types of isolators, MUHP showed the most significant vibration isolation effectiveness. Furthermore, its effectiveness was verified by a power vibration test of the power plant. To improve the vibration isolation effectiveness, in addition to vibration isolators, it is essential to carry out investigations on high-impedance housings.

Knežević et al. [9] discussed the reliability of marine propulsion systems, which depend on the reliability of several sub-systems of a diesel engine. The scavenge air system is one of the crucial sub-systems of the marine engine with a turbocharger as an essential component. In this paper, the failures of a turbocharger are analyzed through the fault tree analysis (FTA) method to estimate the reliability of the system and to predict the cause of failures. The quantitative method is used to assess the probability of faults occurring in the turbocharger system. The main failures of a scavenge air sub-system, namely air filter blockage, compressor fouling, turbine fouling (exhaust side), cooler tube blockage, and cooler air side blockage, are simulated on a Wärtsilä-Transas engine simulator for a marine two-stroke diesel engine. The results obtained through the simulation can provide improvement in the maintenance plan, reliability of the propulsion system, and optimization of turbocharger operation during exploitation time.

Vizentin et al. [10] explained failures of marine propulsion components or systems that can lead to serious consequences for a vessel, cargo, and the people onboard a ship.
These consequences can be financial losses, delay in delivery time, or a threat to safety of the people onboard. This is why it is necessary to learn about marine propulsion failures in order to prevent worst-case scenarios. This paper aims to provide a review of experimental, analytical, and numerical methods used in the failure analysis of ship propulsion systems. In order to achieve this, the main causes and failure mechanisms are described and summarized. Commonly used experimental, numerical, and analytical tools for failure analysis are given. Most indicative case studies of ship failures describe where the origin of failure lies in the ship propulsion failures (i.e., shaft lines, crankshaft, bearings, and foundations). In order to learn from such failures, a holistic engineering approach is inevitable. This paper tries to give suggestions to improve existing design procedures with a goal of producing more reliable propulsion systems and taking care of operational conditions.

**Funding:** (3) This research has been supported by the Croatian Science Foundation under the project IP-2018-01-3739, CEEPUS network CIII-HR-0108, European Regional Development Fund under the grant KK.01.1.1.01.0009 (DATA CROSS), project CEKOM under the grant KK.01.2.2.03.0004, CEI project “COVIDAI” (305.6019-20), University of Rijeka scientific grant uniri-tehnick-18-275-1447, and University of Rijeka scientific grant uniri-tehnick-18-18-1146. (4) This work was partially supported by the Croatian Science Foundation under the project IP-2018-01-3739. This work was also supported by the University of Rijeka (project no. uniri-tehnick-18-1146 and uniri-tehnick-18-266 6469). (6) This research was supported by the Croatian Science Foundation under project IP-2018-01-3739, CEEPUS network CIII-HR-0108, European Regional Development Fund under grant KK.01.1.1.01.0009 (DATA CROSS), project CEKOM under grant KK.01.2.2.03.0004, University of Rijeka scientific grant uniri-tehnick-18-275-1447, University of Rijeka scientific grant uniri-tehnick-18-18-1146 and University of Rijeka scientific grant uniri-tehnick-18-14. (7) This research was supported by the Key Research and Development Project of Zhejiang Province (2019C03115). (8) This research was funded by the National Natural Science Foundation of China (62005204) and the Fundamental Research Funds for the Central Universities. (10) This work has been fully supported by the University of Rijeka under the project number uniri-tehnick-18-200 “Failure analysis of materials in marine environment”.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** All relevant data and links to that can be found in the presented papers at https://www.mdpi.com/journal/jmse/special_issues/Igor_marine_power_systems (accessed on 6 January 2022).

**Acknowledgments:** I wish to express my sincere gratitude to all the authors and the reviewers.

**Conflicts of Interest:** The authors declare no conflict of interest.

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