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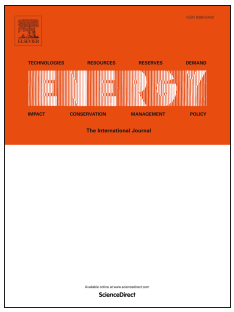

Editorial Special issue dedicated to MOSES2019: 2nd International Conference on Modelling and Optimisation of Ship Energy Systems Glasgow, Scotland, United Kingdom, 8–10 May 2019

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Editorial

Special issue dedicated to MOSES2019: 2nd International Conference on Modelling and Optimisation of Ship Energy Systems Glasgow, Scotland, United Kingdom, 8–10 May 2019

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Introduction

This special issue aims at presenting cutting-edge research addressing the contemporary challenges in the field of the ship energy systems design and operation, and constitutes a collection of articles, the preliminary version of which was presented in the 2nd International Conference on Modelling and Optimisation of Ship Energy Systems (MOSES2019).

MOSES is the name for a series of international conferences organised on biannual basis, responding to the challenge of providing a forum to act as the breeding ground for concepts, exchanging the most innovative ideas, methodologies and techniques, as well as sharing and debating views in the area of ship energy systems including modelling, optimisation, control, maintenance, safety, autonomy/automation, environmental friendliness, sustainability, as well as required regulatory framework.

MOSES2019 was organised by the Maritime Safety Research Centre and the Department of Naval Architecture, Ocean and Marine Engineering of the University of Strathclyde in Glasgow, United Kingdom, in the period 8–10 May 2019. The MOSES2019 conference included 10 technical sessions (academic and industrial tracks), 35 technical presentations including 26 peer-reviewed full papers, incorporating presentations from premiere maritime industry companies' experts, high calibre academics and young researchers from world leading institutions. The conference was attended by 70 persons with delegations coming from 18 countries and 4 continents, demonstrating its wide acceptance in the pertinent scientific community as well its broad geographical reach. Based on recommendations by the reviewers and the session chairpersons, the authors of selected articles were invited after the conference to submit their articles for publication in this Special Issue, after a second thorough peer review process.

Research in this special issue

International shipping, although the most efficient mode of transportation, is still responsible for over 10% of the anthropogenic NO_x and SO_x emissions, as well as 3% of CO_2 emissions. For reducing the shipping industry environmental footprint, considerable research and innovation efforts have been

dedicated in increasing efficiency of all the ship systems and components both in design and operating phases. The ship energy systems are widely acknowledged as an area where focus and innovation are required. The continuously stringent environmental regulations, the volatility of fuel prices, the availability of alternative fuels and the development of emerging technologies combined with artificial intelligence methods, big data analytics and ship systems autonomy can provide to the ship energy systems designer and operator both challenges and opportunities, which, if appropriately addressed, will result in step changes in the way the ships energy systems are perceived today. To address a number of the above challenges, nine articles are published in this special issue focusing on the following three main research areas: (i) alternative fuels including liquefied natural gas (LNG) plants and systems; (ii) alternative energy systems and energy storage optimisation and control, and (iii) marine engines modelling and digital twins.

The role of liquefied natural gas (LNG) as a transition fuel for the maritime industry is widely acknowledged in the scientific community, together with its clear contribution to decreasing other pollutant emissions. The articles selected for this special issue follow this trend, dealing with several challenges related to the use and storage of natural gas on board ships. Bolbot et al. (2020) investigated and comparatively analysed optimal power plant solutions for different fuel types, including diesel, LNG and methanol, for a modern cruise ship by employing cost, emissions and safety objectives in a life-cycle basis, and demonstrated that configurations with dual fuel engines operating with natural gas exhibit lower lifecycle cost and lifetime emissions. Dimopoulos et al. (2020) carried out a model based investigation comparing various technologies for re-liquefying the excess boil-off gas on LNG carriers, concluding that the optimal selection of re-liquefaction system highly depends on the ship operational profile. Thiaucourt et al. (2020) developed a dynamical model to assess the methane number of the gas fuel injected in an engine inlet of an LNG fuelled ship. Based on this model, a mixing strategy to avoid “off-specs” methane number at engine inlet was developed and tested for two different LNG qualities.

Similarly to other transportation sectors, the maritime industry is also moving towards alternative energy systems, driven by the improved performance and decreased costs of batteries and other technologies. Baldi et al. (2020) focused on the use of solid oxides fuel cells (SOFCs) by investigating the energy, cost, and emissions savings on ships resulting from using an optimisation-based approach for a cruise ship and a tanker, and showing that SOFCs could provide a reduction in ship greenhouse gas emissions by up to 34%. Chen et al. (2020) focused on the development of an advanced energy management strategy based on support vector machine and frequency control, for a marine propulsion system with fuel cells and electrical energy storage devices, showing that it performs significantly better than the conventional, rule-based energy management strategy. Ritari et al. (2020) developed a fast-computing model for optimising the hybrid ship operation and applied it by using data from a RoPax ship operation, finding that the benefits of using batteries are primarily based on supplying reserve power for emergency manoeuvring, thus enabling the auxiliary engines to operate at higher efficiency. Trinklein et al. (2020) focused on system operations and proposed the application of a model predictive control approach using exergy for the control of a shipboard power and cooling system that features a pulsed load (an electromagnetic railgun), achieving fuel savings of up to 0.86% when compared to a fixed flow rate control strategy.

Finally, the research presented in this special issue addresses the need for fast running models and digital twins for marine engines that still represent the majority of installed power in marine applications. Bondarenko and Fukuda (2020) presented an improved model for fast, dynamic simulation of marine Diesel engines, bringing new material for the further development of monitoring systems based on the “digital twin” concept. Mestemaker et al. (2020) conducted a simulation study of a dredger power plant with dual-fuel engines and a kinetic energy storage system (KESS) for investigating the effects of the choice of these engines and the KESS on emissions and fuel consumption of a dredger ship, concluding that dual-fuel engines perform rather poorly due to the highly dynamic nature of dredging operations, whereas the energy storage can assist but at the cost of increasing fuel consumption.

Concluding this editorial introduction, we are confident that the MOSES conferences and this special issue will provide stimulus to drive and further develop the current and future research and innovation activities in the area of Ship Energy Systems.

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