Innovative paths for high performance at sea

A.I. and innovative technologies for ship design and operation, ship efficiency and fuel savings – the renowned expert conference HIPER 24 (High-Performance Marine Vehicles) took place in Monastery Druebeck. *By Hans Payer*

As last year, the HIPER Conference has taken place in the Harz highland region in Northern Germany, with 31 valuable presentations and more than 50 experts from all around the world attending. The selection of seven of these should give a good overview of what has been discussed this year.

As in the previous years HIPER 24 was a very interesting and successful conference. The topics treated were related to ship design and operation, to trim optimisations and fuel savings, mostly resulting in significant reductions in greenhouse gas (GHG) emissions. Trim optimisation techniques, routing optimisation, energy saving devices (ESD) as well as proactive cleaning devices were discussed. Artificial Intelligence played a prominent role in many of the presentations.

Lukas Kistner and Kevin Koosup Yum from Hyundai Europe described a digital twin for design and operation in »Multi-component Ship Power Systems«. While conventional ship power trains mainly incorporate propulsion and auxiliary engines, modern designs are more complex, additionally integrating shaft generators, fuel cells, and batteries to enhance energy efficiency and reduce CO_2 emissions.

Due to the diversity of vessel characteristics, a universally best-performing design is hardly possible. Instead, different technologies with their particular characteristics and operational limitations are favoured, also requiring specific system control strategies. The authors introduce an early-stage modular energy management approach aimed for operational efficiency and flexibility, which can be used for model-based system design optimization tasks. In their paper, the generalised strategy is tested with various power system configurations.

- Case 1 represents the traditional power system made up of a mechanical propulsion system with a main engine and electric power system with gensets.
- Case 2 introduces the potential interaction of mechanical shaft and electrical bus bar through a shaft generator.
- Case 3 shows an electric propulsion system including electrochemical fuel conversion of solid fuel cells (SOFCs) as principal source for power as well as a genset plus battery system support.
- Case 4 finally includes all components under consideration.

Such a digital twin can be used for optimisation of a complex design and its operation.

Robert Dane of Ocius Technology, Australia, gave a fascinating presentation about »Sustainably powered autonomous surface vessels« – for which he received *HANSA*'s »Maritime Innovator Award«, as this is considered to be a significant step in the development of marine technocology. (see right page).

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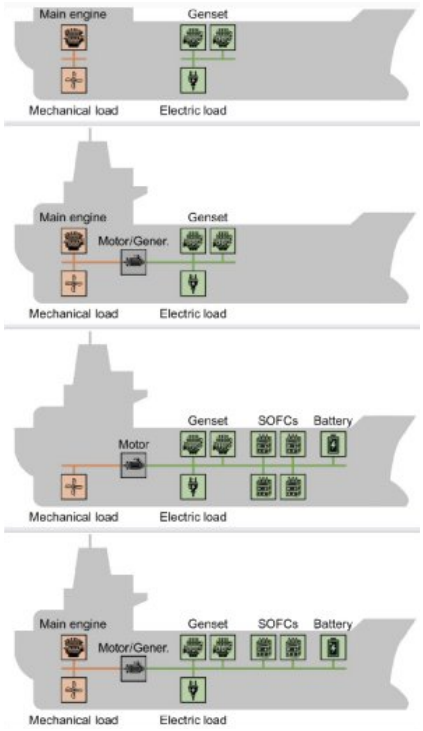
More than 50 international experts gathered at HIPER 2024



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»Multi-component Ship Power Systems« presented by experts from Hyundai Europe

Intelligent Drones patrol autonomously as satellites of the sea, a coast or maritime region. The Bluebottle range of USVs (Unmanned Surface Vehicles) are very interesting and innovative and are designed to provide long-term autonomous surveillance and communications for defence, offshore, or oceanographic applications, These vehicles represent a unique combination of technologies making them »doubly autonomous«: intelligence autonomous, as well as energy autonomous. Robert Dane will will provide a more detailed and comprehensive description for a forthcoming *HANSA* issue, so we can look at other projects at this point in time.

Changbae Jin, Yoichi Wakabayashi, Changbae Jin, Nobuyuki Onishi and Yoshihiko Sugimoto of Mitsui O.S.K. Lines and Oshima Shipbuilding have written a report on updates and future plans for the famous »Wind Challenger Project«.

In light of IMO's strategy to reduce total GHG emissions from ships by 50 % by 2050, the telescopic type of hard sail solution for large vessels has been developed by Mitsui O.S.K. Lines and Oshima Shipbuilding through joint research together with research institutions and a classification society. It was successfully installed on the large bulk carrier »Shofu Maru« and has been in operation since 2022. In the meantime, it has completed eight voyages. Now there are plans to install it on various types

HANSA HONOURS FORWARD THINKING EXPERTS

Innovator Awards for Robert Dane and Oliwia Galecka

It has become a good tradition that *HANSA*, as media partner of the HIPER Conference, honours special achievements with an award. This year at Druebeck, the focus was again on projects or technical applications that can drive the maritime industry in a unique way.

Maritime Innovator Award

The »Maritime Innovator Award« goes to Robert Dane from Ocius Technology. He is the successor of Helle Vines Ertsås, Global Category Manager for Hull Skating Solutions at Jotun.

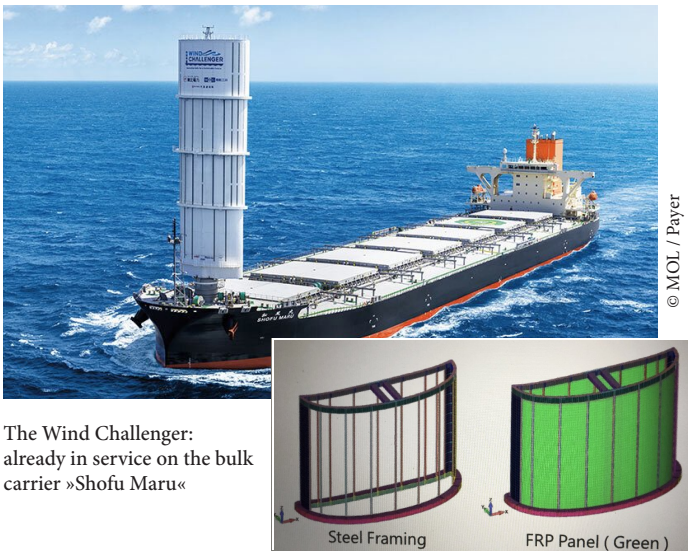
In his paper »Sustainably Powered Autonomous Surface Vessels« Robert describes Ocius' concept of an Uncrewed Surface Vessel (USV) design, called Bluebottle. This autonomous Drone of the Sea is powered by solar, wind and wave energy, facilitating, together with back-up batteries, long periods of operation, covering vast areas. The drones are team capable and approved by AMSA, the Australian Maritime Safety Agency, for operating in Australia's EEZ (Exclusive Economic Zone) to conduct long-duration autonomous surveillance missions. Ocius is currently deploying Bluebottles for defence, oil & gas and oceanographic missions around Australia. The drones are autonomous not only regarding propulsion – but also »intelligence autonomous« in some decision making, using for example AI for autonomous collision avoidance and team capabilities. The Bluebottle drones could in theory stay at sea indefinitely. They have been tested extensively and shown to be reliable for long services.

Young Innovator Award

The »Young Innovator Award« goes to Oliwia Galecka, Energy Transition Analyst at Irish shipping company Ardmore Shipping. She succeeds Florian Gerland, co-founder of German startup Larabicus, who won the award last year. In her paper »The Effect of Using Robust Voyage Optimization on a Tanker's CII«, Oliwia describes a vessel's Carbon Intensity Indicator (CII) as defined by the IMO, as the total mass of CO_2 emitted per cargo carrying capacity. Thus, the CII rating of a vessel may be improved by reducing the CO_2 emitted by the vessel over a year. There are several ways to achieve this, such as running on low-carbon fuels, installing supplementary wind-assisted propulsion or solar power onboard, or through speed and routing optimization. Generally, most easily attainable is improving the quality of the voyage optimization techniques used, resulting in improved fuel efficiency. Voyage optimization, as described in her paper, is defined by three elements: pre-voyage planning, voyage execution and post-voyage analytics, allowing the voyage to be adequately planned for, effectively conducted and reviewed for future improvements.

Oliwia is a remarkable young lady. She studied Naval Architecture in Newcastle. During her studies she got summer training jobs from Ardmore Shipping Services. Therefore she was already somewhat familiar with the company, when she got a job there in Cork, Ireland, after her graduation from Newcastle University. *HP*

Conference host Volker Bertram with award winner Oliwia Galecka



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The Wind Challenger: already in service on the bulk carrier »Shofu Maru«

of other large vessels in the future. Development and design for this purpose are currently underway. The paper provided a general introduction to the Wind Challenger project, its technical background, the performance measurements and evaluations of the »Shofu Maru« during seagoing voyages, including lessons learned and future plans.

Volkmar Wasmannsdorff from Bremen-based Movena and Roland Lindinger from LR Shipdesign talked about the »Aft Opt« technology in their presentation »The Design of the Ships' Hulls based on Application of Aircraft Wing and Fuselage Engineering Principles«. The paper presented the application of new findings in fluid mechanic sciences with the aim of significantly reducing the overall ships' resistance and to improve its propulsion.

»Aft Opt« technology applied to ship hulls originates from the transfer and application of principles used in the design of aircrafts. The application of these to hydrodynamic and hydromechanic principles, using proprietary CFD software, leads to a new design approach for the aft hull of ships. According to the experts, hull shape and lower hull flow lead to a much better filled propeller disk, wake flow and better rudder characteristics. As a result, the required main engine power may be reduced by more than 6 %.

The authors believe that ships will only be competitive in the future if all the latest requirements of builders and users are combined. Ship owners should not be shy to use their purchasing power to combine more economical shipbuilding know-how with their own ship operational experience and requirements. Aft Opt is said to help the ship owner and the party paying for the fuel to stay ahead of other market participants. The savings have been confirmed by renowned ship model basins and classification society DNV.

Lennart Cederberg and Eleonor Mamefelt from Swedish Noor Care together with Ingegerd Snöberg from Linnaeus University prepared a paper on »AI + Human Factor = Fuel Saving«. Cederberg is a marine meteorologist and sophisticated consultant and adviser for optimum routing, making use of AI and today's optimum weather predictions. He is a pragmatist and pleasant to read. His paper summarises three years of technical development and research in close collaboration with several major shipping companies. Besides the technical AI-based decision support systems, the project has focused on the human element, how the support systems become efficient help for real, both ashore and onboard. The importance to create knowledge and understanding among technical-, commercial- and operation-departments within the organisations on how to implement new methods became clear. The »Arctic Tern« in the end showed fuel savings of 2 % up to 14 %.

AI-based route optimisation systems with ANN (Artificial Neural Networks) and supervised machine learning for ships with robust and high-frequency sensor data are a prerequisite for more detailed optimisation of speed and engine set points. These modern and much more accurate tools are very important for faster and easier decision making on speed and engine settings for a particular ship on a particular route with a unique cargo condition, and for the ability to operate ships in a more energy-efficient and climate-friendly manner on a large scale.

In her highly interesting paper »Reimagining Proactive Cleaning: Benefits of High-Frequency Cleaning by Means of an Autonomous In-Transit Hull Grooming Robot«, Stav Jacob from Nail AI Robotics, Nir Am, Israel, pointed out the advantages of high frequency cleaning of biofouling.

The development of a robot that can achieve this is described. High frequency in this context is defined as once every ten days on average, when an autonomous robot is deployed to clean the slime layer off the ship's hull, setting a new standard for what is considered proactive cleaning. High-frequency hull cleaning offers significant benefits in terms of greenhouse gas emissions and a significant reduction in the migration of invasive species. Both have a significant impact on the environment and offer savings to the ship operator.

The main operational benefits are fuel savings due to the continuous maintenance of a clean hull and improved AF coating life due to gentle cleaning. On the environmental side, the benefits are reduced greenhouse gas emissions due to reduced fuel consumption, and the prevention of invasive species migration due to preventative cleaning before biofouling reaches a harmful state. These points have been proven by research, but few companies are trying to put them into practice. This is likely to change with legislation that may require proactive cleaning.

The paper also describes NakAI's Proactive Hull Grooming Device, a first of its kind, fully autonomous, in-transit cleaning robot. NakAI's robot has special hydrodynamic features that allow it to remain attached to the ship while it sails, and incorporates a unique version of SLAM to navigate autonomously. The robot remains on the ship in a docking station, allowing it to clean anywhere along the route as long as sea conditions allow. NakAI aims to lead the industry's shift to high-frequency hull cleaning to reduce the shipping sector's footprint and preserve the world's oceans.

The final paper of the conference was presented by Tracy Plowman and Volker Bertram from DNV Maritime in Hamburg: »AI Tools for Maritime Applications – Success and Failure«.

Today, AI-based tools are being advocated or successfully used for various functions in the maritime world. In 2023, Bertram, together with Henrique Gaspar, tested various AI-based tools for maritime applications and came to the conclusion that the tools gave rather disappointing results. Since then, experience with AI-based tools supporting various tasks in ship design and other maritime operations has led to a much more differentiated view.

The conclusion and advice for using AI today may be summarised as follows: AI is helpful but has no creativity. A saying in German goes: »Es gibt nichts Gutes, außer man tut es« – loosely translated as »There will be nothing outstanding, if you do not do it.« Be aware of limitations, but embrace the possibilities of evolving AI technologies – also for maritime applications. ■