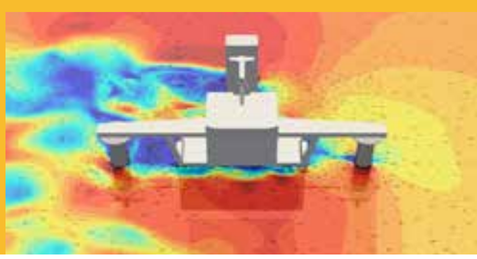
The Marintec China Edition issue 2-21

newswave

The Hamburg Ship Model Basin Newsletter

Optimisation and Ice Model Tests in Close Cooperation with CSDC

EcoLibrium – a Holistic Assessment of Wind-Assisted Propulsion



Currently under Construction – the World-First Zero-Emission Fast Ferry

editorial

Dear reader,

This year has been very special in any respect. Hence, we had to face the recent news that Marintec China had been postponed. However, we are very pleased to present this brand new issue of our NewsWave which we originally aimed at presenting there.

China is an important market for HSVA, and for many years HSVA was dedicated to Marintec as one of the most significant international events of the maritime community, and we used to be there in presence.

We regret very much that this time the circumstances do not allow us to meet in person our colleagues and partners and all people who have become friends over the years. However, we are very proud that we will be represented at the tradefair 2022 by our esteemed Chinese partners from WestEast Marine.

We have delivered many interesting projects in the recent months, also together with our partners from China and all over the world. And we are happy to present a selection of these in this issue of NewsWave – the first to be published bilingually in English and Mandarin.

I wish you all the best and hope to see you soon again in person – stay safe and healthy!

Prof. Dr. Janou Hennig

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IMO's GHG-Strategy:

EEXI and CII Ahead!

Climate Change forces the global society to reduce CO_2 emissions drastically and quickly. In this context the International Maritime Organization (IMO) has set out its strategy on the reduction of Green House Gas Emissions (GHG).

by Florian Kluwe

Main instrument for short term measures is the Energy Efficiency Design Index (EEDI). As EEDI targets only newbuildings IMO has extended this instrument to the entire existing fleet by introducing the Energy Efficiency Index for Existing Ships (EEXI). All ships in service need to be compliant with the EEXI from 2023 onwards. It is expected that about 80 % of the world merchant fleet will be non-compliant with EEXI without additional measures. IMO has opened the possibility for an overridable limitation of main engine power in form of shaft power limitation (ShaPoLi) and engine power limitation (EPL) (MEPC.335(76)) which is an efficient way of reducing the attained EEXI. The required power limitation can be significant for certain vessels, in particular tankers and bulkers are affected most.

Classical methods of performance optimisation such as hullform modification or the installation of energy saving devices have a limited effect on the index value as they contribute to the formula only by an increased reference speed V_{ref}, but they may be useful for mitigating the speedloss caused by EPL/ShaPoLi. More effective is a direct reduction of the main engine power value P_{ME} in the formula. This is the case for all energy efficiency technologies which are covered by MEPC.1/Circ.815, category "B". This covers for example wind assisted propulsion systems like Flettner Rotors (see Figure 1) which can deliver a significant contribution. ▶

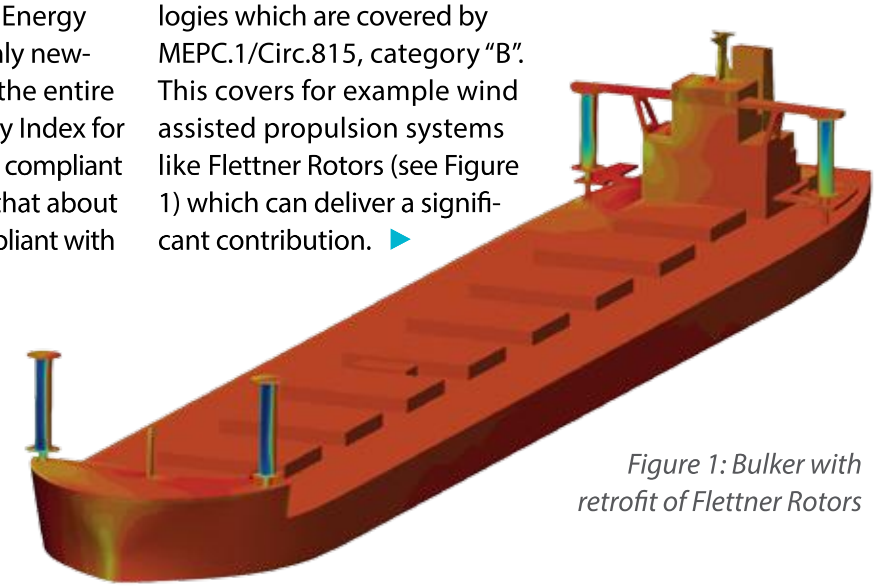

Figure 1: Bulker with retrofit of Flettner Rotors

Investments into such kind of measures become even more attractive when taking into account the second short term instrument that will enter into force in 2023: The Carbon Intensity Indicator (CII) delivers a yearly assessment of the energy efficiency of ships in operation. CII evaluates the CO_2 emissions per year as reported via the IMO Data Collection System (DCS) in relation to the transport work performed. All ships are to be classified into efficiency categories A to E while ships in categories D and E need to take actions for improvement (MEPC.339(76)). The CII reference lines will be reduced every year by a certain percentage value compared to the initial 2019-baseline generating increasing demand for the implementation of further GHG-reduction measures.

In close cooperation with Ship Design and Consult (SDC) HSVA is covering the relevant questions that arise in connection with EEDI/EEXI/CII. Our services comprise i.a.:

- **Determination of Reference Speed V_{ref}**
- **Assessment of attained EEXI**
- **Evaluation of reduction measures**
- **Assessment and documentation of the performance of energy saving technologies**
- **SEEMP enhancement**
- **CII implementation**

Please let us know how we can assist you.

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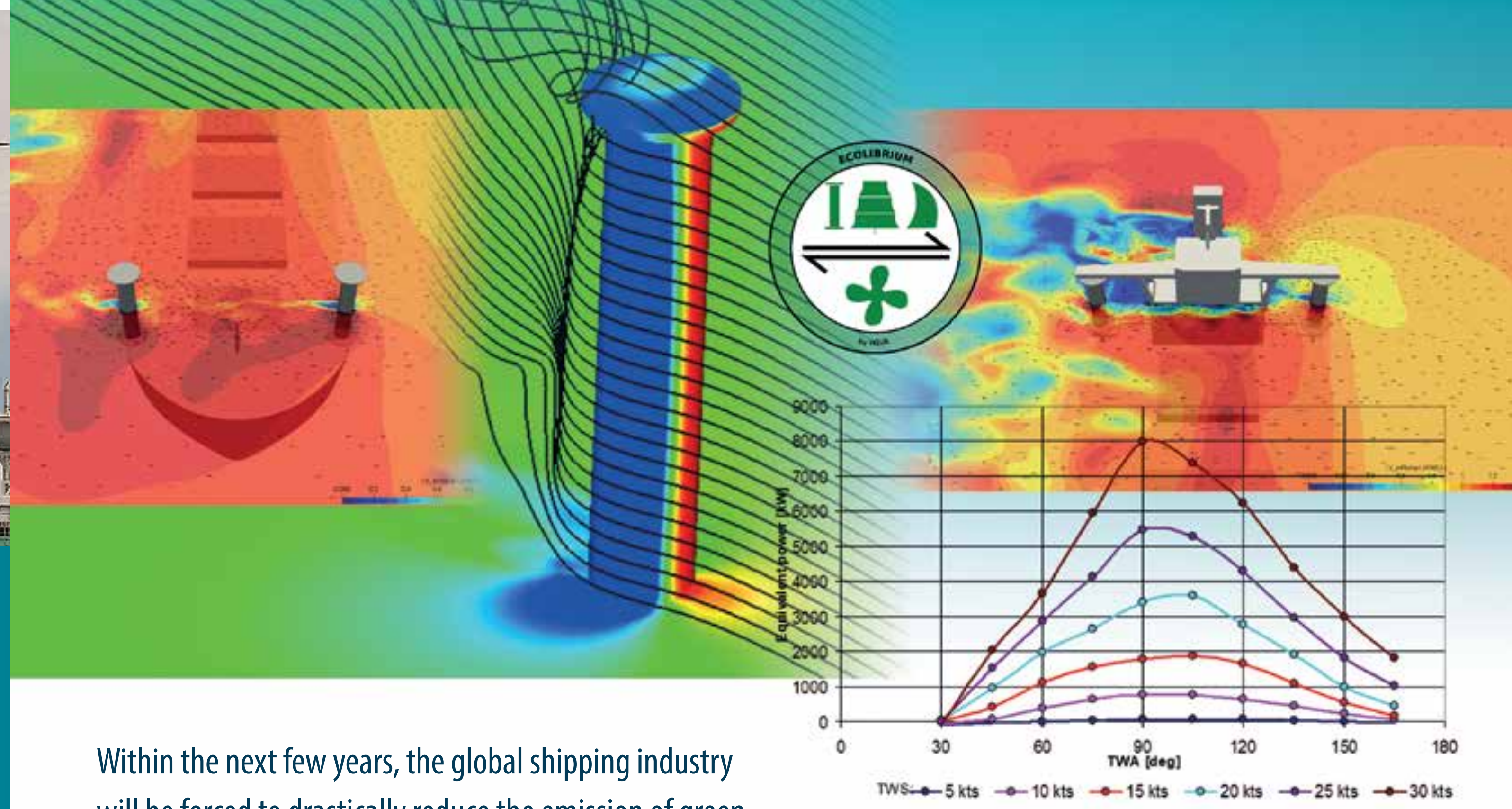
Determining the Reference Speed V_{ref} Correctly

For the calculation of the attained EEXI the correct determination of the reference speed is essential. In case sea trial reports are available that meet a certain quality standard (at least ISO 15016:2002) and that contain the required loading conditions these may be used for the assessment. In other cases the reference speed needs to be determined either from model tests or numerical simulations (CFD). In both cases a certain minimum quality standard needs to be demonstrated to the administration in order to be accepted for the EEXI determination. HSVA is recognized by all major classification societies for conducting EEDI/EEXI model tests and/or numerical calculations. In all cases it is essential that a proper correlation model is in place when evaluating experiments/calculations. Numerical calculations need to be carried out according to ITTC standards and the assessment needs to be calibrated by a reference case. Please get in touch with us to find the most convenient and compliant way of achieving the correct reference speed. HSVA in this context discourages the use of the simplified assessment as given in Resolution MEPC.333(76) as this results in a big penalty in achieved speed of up to 1 knot.

EcoLibrium

Enabling a Holistic Assessment of Wind-Assisted Propulsion



Within the next few years, the global shipping industry will be forced to drastically reduce the emission of greenhouse gases. Besides other means to further improve the efficiency of ships, employing wind to propel ships is an obvious choice to reduce emissions, without reverting completely to costly alternative fuels.

by Jörn Kröger and Jan Lassen

Profound analyses gained from model tests or CFD simulations are the basis for assessing a vessel with (additional) wind propulsion, but here looking at each hydro- or aerodynamic aspect in isolation is not enough. Compared with a conventional vessel, wind-assisted propulsion adds a number of significant interaction mechanisms to the system, varying considerably with wind speed and angle of incidence. An important example is the yawing moment created by wind propulsion devices, requiring a compensation e.g. by deflecting the rudder accordingly. In addition the total lateral force induces a drift angle which increases the hull resistance. Correct arrangement and effective appendage design therefore are essential.

HSVA is actively developing the modular software solution HSVA EcoLibrium providing a deeper insight into the operation of sail-assisted ships and supporting their design. The tool incorporates all major external forces and moments and brings them into equilibrium. Declaring specific configuration parameters allows to efficiently compare different concepts. The modular architecture of EcoLibrium aims at maximum expandability with respect to new propulsion devices and environmental influences. Thus, the developed tool covers a vast range of configurations, from the common retrofitting solution Flettner Rotor to the most exotic setups we currently cannot even imagine today. The output delivers for example polar diagrams of required power (power savings) or maximum speed. During the design phase, these results can be used to assess hull designs and propulsion concepts, e.g. to compare different arrangements of propulsion devices. Feeding the data into a route optimisation algorithm (for a projected vessel or as an on-board voyage-planning system of a vessel in service) will provide the insight necessary to minimise fuel consumption.

Thanks to extensive experience with fluid dynamics and the ability to bring all relevant physical aspects together to form the complex system "wind-propelled vessel", HSVA is the perfect partner to support shipyards, designers and operators in improving their solutions and their ecological footprint.

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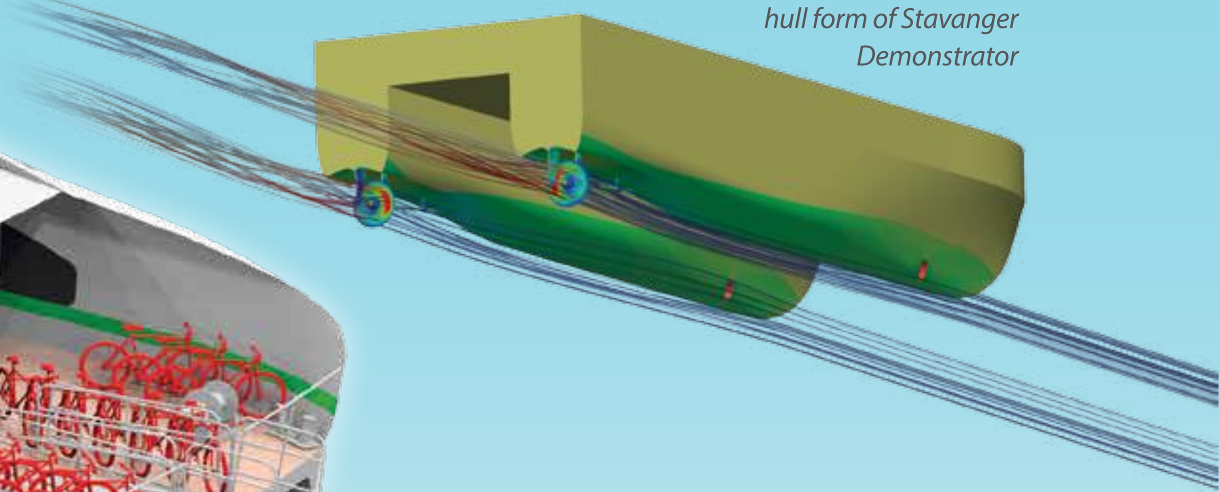

Figure 2: CFD optimised hull form of Stavanger Demonstrator

At Top of its Form

the World-First Zero-Emission Fast Ferry

Figure 3: The Catamaran Medstraum under construction

As the TrAM[1] project's demonstrator vessel, Medstraum (literally "with electricity" and "co-current" in Norwegian) is designed for a service speed of 23 knots, carrying about 150 passengers and operating on a multi-stop commuter route between the city of Stavanger and surrounding communities and islands. It will begin a trial passenger service in spring 2022.

by Yan Xing-Kaeding

The catamaran will be 31 meters long with a nine-meter beam and equipped with two electric motors and a 1.5 MWh capacity battery with charging power of more than 2 MW. This will be the world's first fully electric and zero emission fast ferry classed in accordance with the International Code of Safety for High-Speed Crafts (HSC Code).

HSVA carried out the extensive numerical optimisation and experimental studies of the hull form and propulsion system of the catamaran, which have been reported both in earlier issues of our NewsWave and in several scientific publications [1] [2] [3]. Figure 2 demonstrates the optimised hull form based on a multi-objective optimisation utilising the HSVA in-house RANSE code ***FreSCo+***. The vessel is currently under construction at the Fjellstrand shipyard on the west coast of Norway, Figure 3.

The TrAM project (www.tramproject.eu) scope also includes the development of two further "replicator" vessels, one for passenger operations on the River Thames in London and the other for deployment on inland waterways in Belgium. ■

Reference:

[1] Papanikolaou, A., Xing-Kaeding, Y., Strobel, H., Kanellopoulou, A., Zaraphonitis, G., Tolo, E., Numerical and Experimental Optimization Study on a Fast, Zero Emission Catamaran, Journal of Marine Science and Engineering, MDPI, 2020, 8, 657.

[2] Xing-Kaeding, Y. and Papanikolaou, A., Optimization of the Propulsive Efficiency of a Fast Catamaran, Journal of Marine Science and Engineering, MDPI, 2021, 9, 492.

[3] Xing-Kaeding, Y. and Papanikolaou, A., Numerical and Experimental Study on the Steady and Unsteady Forward Speed Motion of a Catamaran, ISOPE 2021-TPC-0199, The Thirty First (2021) International Ocean and Polar Engineering conference, Rhodes, Greece (Virtual), June 20-25, 2021.

[1] The TrAM H2020 project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 769303.

European Commission

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Figure 1: Model of the MPV in level ice during the break out manoeuvre

Optimisation and ice model tests with a Multi-Purpose Vessel

Figure 2: Model of the MPV in brash ice

In 2020, HSVA was contracted by China Ship Design & Research Center (CSDC) to assist with ship hull lines optimisation of two ice-going vessels and further to carry out various model tests with a Multi-Purpose Vessel (MPV). In all cases CSDC developed the basic initial hull form, which HSVA did then analyse and optimise for its calm water and ice performance.

by Timo Stange

Before the physical testing campaign in our ice facilities started, the ship hull lines of the MPV were optimised to find the best possible balance between calm water and ice performance. Following, with ice model tests the capabilities of the MPV, operating under various ice conditions were tested. In detail tests in two different level ice- and floe thicknesses were conducted, 0.5 m and 0.7 m in full scale. Thereby, the attainable speed in ice was verified and the manoeuvring capability in ice was investigated, see Figure 1. Besides these aspects also brash ice tests were conducted with the MPV, see Figure 2. The model tests results were compared to the Finish Swedish Ice Class Rules (FSICR) results to analyse the differences and benefits between model tests and conservative FSICR regulations regarding required engine power. Finalising the project HSVA assisted CSDC on the ship hull lines optimisation for another MPV design in terms of its brash ice performance and for a COT vessel that should operate under heavy ice conditions. A possible area of operation for such vessels for example is the Northern Sea Route in summer and autumn period, which opens new and fast trade routes between Asia and Europe. The project was finalised successfully within this year and we want to thank CSDC for the good cooperation throughout the whole project. ■

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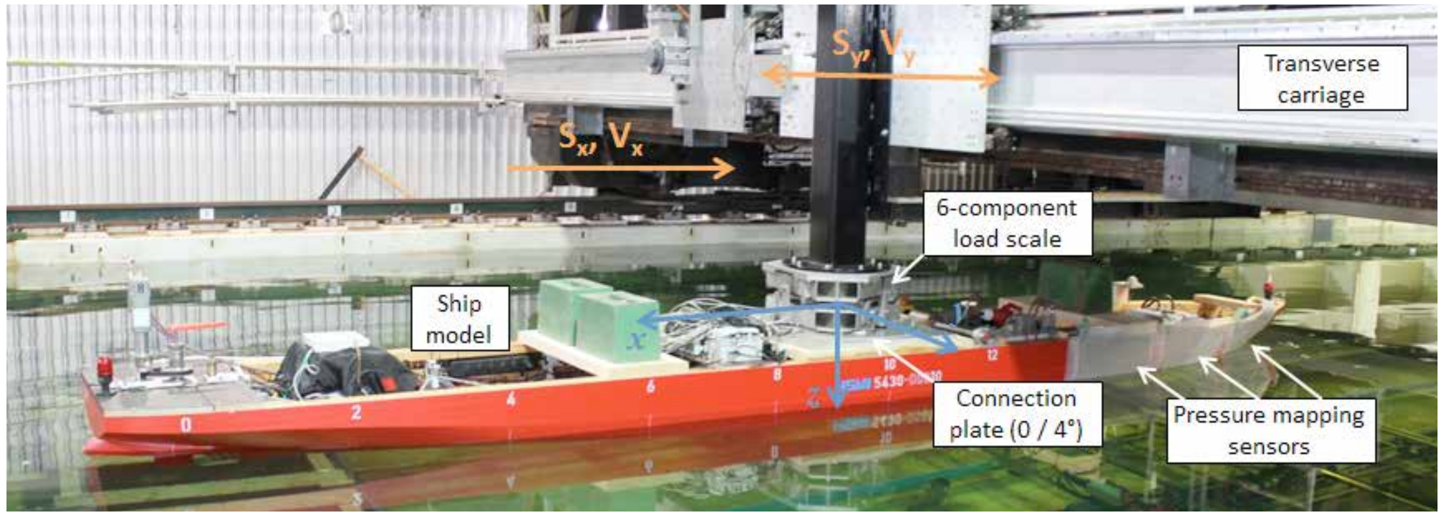

Figure 1: Test set-up for oblique towing test under varying ice conditions

Multiple Tests with an Icebreaking Research Vessel

A consortium consisting of China Ship Scientific Research Center (CSSRC), Marine Design & Research Institute of China (MARIC), China Ship Design & Research Center Co., Ltd (CSDC) and Harbin Engineering University (HEU) has awarded HSVA to provide assistance to investigate the performance of an icebreaking research vessel.

by Daniela Myland and Quentin Hisette

The scope of the project mainly included an extensive model testing campaign comprising varying ice types, e.g. pre-sawn ice as well as varying testing types, i.e. oblique towing (Figure 1), propeller-ice interaction, ramming, resistance, towed and free propulsion. Therefore, special testing methods and equipment were developed and utilized, such as pressure mapping sensors fitted to the model to measure local forces at various locations.

The model tests were performed to meet the following objectives:

- **determine influence of floe ice concentration on ship resistance**
- **determine influence of ramming speed on local ice loads at the bow and on penetration length in level ice**
- **determine resistance forces in level ice under the influence of different coatings, i.e. friction coefficients**
- **determine resistance components (breaking + submersion) under the influence of different coatings**
- **determine forces, moments and pressure on the ship and its propeller to calibrate a manoeuvring model**
- **determine forces and moments on propeller shaft during propeller-ice interaction under controlled conditions**
- **assess the ridge breaking capability of the ship.**

After completion of the tests, the results were used by the consortium to assess the ship design and its operational profile. Moreover, the results can serve as a broad database to validate simulations of ships in ice. ■

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Rapid manufacturing

New production, new material, ongoing research

HSVA puts major effort in the research and development of rapid manufacturing techniques and materials which allow flexible and fast production of versatile and complex models.

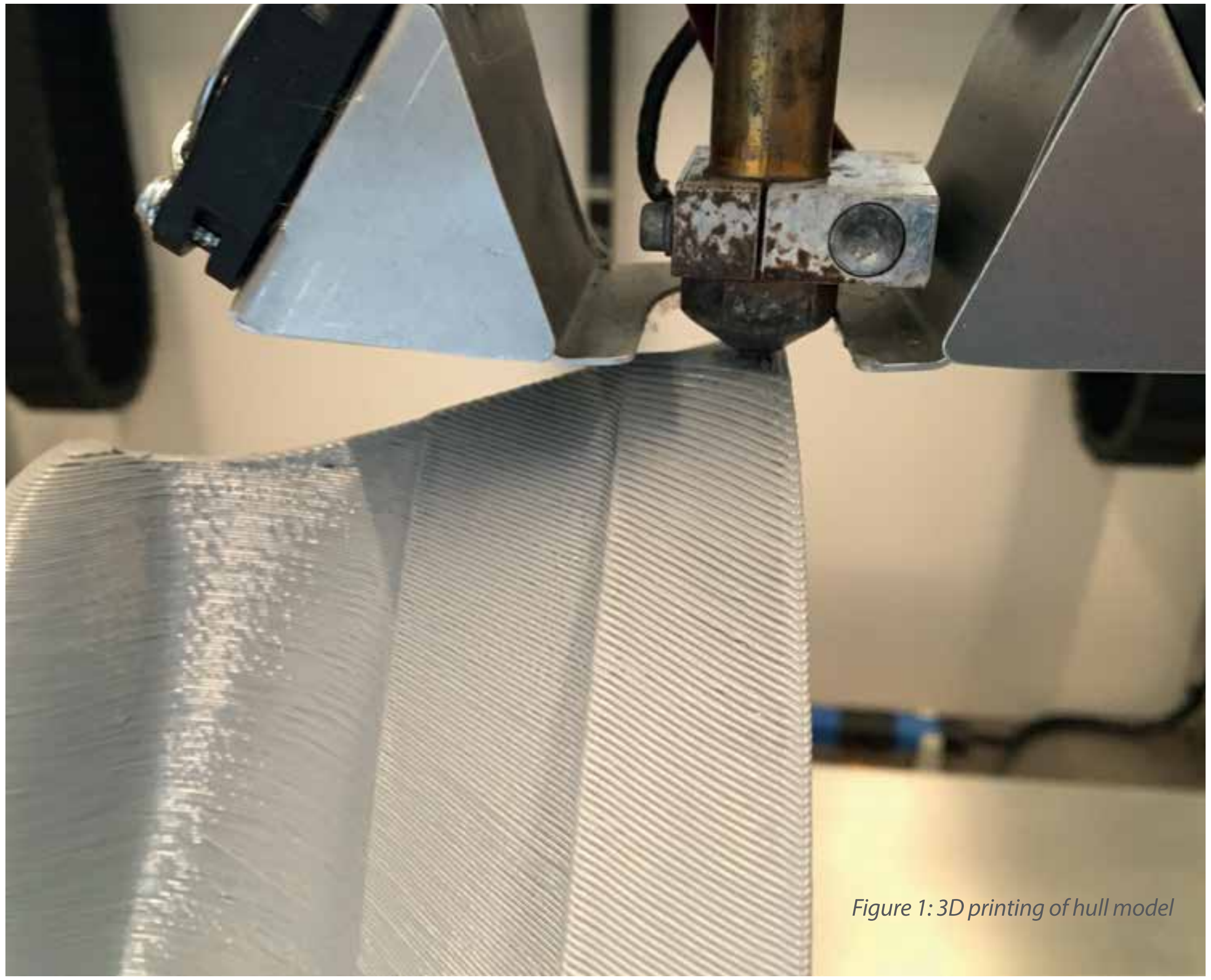

Figure 1: 3D printing of hull model

by Johannes Strobel

The fast and cost efficient availability of high-quality ship models is one major factor contributing to a successful model test campaign no matter of its complexity or extent. Hulls, steering appendages, propulsion improving devices or superstructures are only parts of the selection which are required to be built in the context of a model test campaign. Rising demands with regard to time, quality and costs require new manufacturing processes and organisation. One of the main aspects HSVA is focussing since many years is the integration of different 3D printing techniques in the overall production process. 3D printing allows fast, flexible and sustainable manufacturing of small to medium sized complex geometries at reasonable costs. The properties of a component (e.g. surface roughness, strength, and coloring) can be defined by selecting different machines, operating settings and (even recyclable) materials. While for example the shaft line brackets need to be very stiff and strong, any transversal thruster tunnel grids may be designed and manufactured more fragile. While any component which is exposed to the water flow makes high demand on a smooth surface, any other component at the superstructure of the model may have a coarser surface. These examples show that an appropriate selection of a customised manufacturing setup is a crucial aspect for establishing an efficient production process.

With the opportunity of manufacturing dedicated and reproducible components, HSVA launched an internal research project focussing on the assessment and classification of individual surface qualities. Several 3D test probes have been manufactured by systematically varying the printing properties. The surface roughness of these test probes has been gauged and documented. Subsequently they were investigated in a hydrodynamic model test setup and finally assessed in terms of hydraulic smoothness. This systematic and thorough study led to a guideline for selecting an appropriate manufacturing setup depending on individual application cases.

By continuously pushing new manufacturing techniques and searching for smart production solutions HSVA is able to keep meeting the customer's demand of maximum flexibility at minimum lead time and costs.

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In memory of Prof. Dr.-Ing. Gerhard Jensen

HSVA deeply mourns the death of its former Managing Director **Professor Dr.- Ing. Gerhard Jensen**, who passed away far too early on 27 September 2021.

Gerhard Jensen was Managing Director of HSVA from 1993 to 2001 and from 2004 to 2005, and a member of the HSVA Supervisory Board between 2003 and 2006.
During his time as Managing Director of HSVA, he contributed significantly to the positive development of our organisation.

It is with gratitude that we say a farewell to Gerhard Jensen, who will always be fondly remembered for his work and his personality.

Malte Rejzek

Malte Rejzek joined HSVA in May 2019 as an engineer for measurements and controls in the department Tank Operation (now Experiments). After apprenticeship as an electromechanic in shipbuilding, he completed further qualification as a master craftsman and studied mechatronics at the University of Applied Sciences Hamburg. With his bachelor's thesis, he developed the active damping system on the main towing carriage. This was an important development for new testing methods on resistance and propulsion investigations. Together with the team of project engineers, he is constantly developing HSVA's test facilities in order to provide our customers with the best measurement results possible. In addition to his work at the HSVA, Malte Rejzek is currently finishing his master's degree in automation technology. In his spare time, he is involved in traditional sailing, loves spending time on the water and is active in various handcrafts.

marintec China

Postponed to June 2022!

HSVA at MARINTEC CHINA 2021

Since the year 2003 HSVA has been part of the MARINTEC CHINA, the leading maritime exhibition in Asia, with an own booth in the German Pavilion.

This year HSVA will also be present. Due to the Covid-19 pandemic HSVA will be attending for the first time in cooperation with our domestic partner WestEast Marine Consulting.

Our joint team is looking forward to welcoming you in our booth no. N2B3A-05 in the German Pavilion. The Chinese team members will be at your service on site and the German team is available remotely from Hamburg.

WE marine

MARINTEC CHINA will open the doors from 7 to 10 December 2021 in the Shanghai New International Expo Centre.