Ongoing hydrodynamic research project

To remain a world-leading company at the forefront of hydrodynamics and deliver innovative and sustainable maritime solutions for our clients and partners we need to continuously sharpen our tools. New methods and technologies will be needed to meet the huge challenges of adapting the shipping industry to future economical as well as environmental goals. At SSPA, our specialists are involved in research and development in parallel with their commercial commitments. In this way, there is a direct link between R&D and commercial application. Four of our hydrodynamic experts will here present examples of ongoing hydrodynamic research projects intended to improve today's methods in different areas.

Research on predicting the risk of cavitation erosion on ship propellers

Damage to propellers due to cavitation erosion is a phenomenon that is becoming more frequent as propeller designers try to increase propeller efficiency. Energy-efficient propellers have usually some amount of cavitation at the design point and cavitation erosion damage may then occur, especially if the ship is operated off-design. An alternative design with a lower cavitation volume is not generally acceptable since this usually increases the fuel consumption. Our experts understand that there is a growing need to find new measurement methods to optimise propellers while at the same time minimising the risk of cavitation erosion. The measurement methods used today are too time-consuming to be used in more than a few operating conditions.

"Need to find new measurement methods to optimise propellers while at the same time minimising the risk of cavitation erosion."

SSPA is collaborating on a project with other partners who are world leaders in their fields. The project will primarily develop an acoustic method that will allow model-scale tests to predict and quantify the risk of erosion at full scale, which will include the development and testing of measuring equipment to determine whether the acoustic emission technique is useful in a model scale and the extent to which the method correlates with full-scale observations. This new method will enable the fast and reliable scanning of a large number of operating conditions in order to map them, figure out which operational range is safe and what the risk of cavitation erosion is. The project will run until April 2019 with the partners Lloyds Register, Daewoo Shipbuilding and Marine Engineering, and the University of Southampton.

Has this propeller risk of cavitation erosion damage? Ongoing tests on a propeller in our Cavitation tunnel. Photo: Anders Mikaelsson, SSPA.

Jan Hallander
Project Manager

Jan graduated with an MSc in Mechanical Engineering in 1991 and received his PhD in Naval Architecture from Chalmers University of Technology in 2002. He has been at SSPA since 1998. He has been involved in various research and consultancy projects in the areas of general hydromechanics, propulsion and underwater acoustic signatures, with a particular focus on phenomena related to cavitation and noise induced by propellers.

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Research on
improved prediction methods for ships

Improved standards for ship performance evaluation in the design stage are a prerequisite for reducing the energy consumption of the world's fleet. The existing official standards are based on experimental methods (EFD). Numerical methods (CFD) have been introduced as alternatives, but they cannot be used stand-alone with high confidence. Could hybrid CFD/EFD methods be the way forward? Our researchers are now trying to answer questions such as: how can EFD and CFD be combined in smart ways, what is required to correlate and validate the methods before they are adopted as standards, how can the quality of the new methods be assured and how are these standardised?

SSPA and Chalmers University of Technology run a joint research project on power prediction methods using combined CFD and EFD since January 2018. By developing new hybrid methods, we take advantage of the benefits of both approaches and ensure higher confidence in the predictions. The project will run until the end of 2020 and will primarily develop a strategy for developing hybrid methods. The work includes mapping the need for improvements and evaluating different approaches, CFD/EFD combined methods and strategies to ensure the reliability of new methods. The project is linked to the Specialist Committee on Combined CFD and EFD Methods of the International Towing Tank Conference (ITTC).

Sofia Werner

Manager Strategic Research – Hydrodynamics

Received an MSc in Naval Architecture from Technical University of Denmark (DTU) in 2001 and a PhD in Naval Architecture from Chalmers University of Technology in 2006. She joined SSPA in 2007 and worked with ship design, CFD and towing tank testing for commercial clients for eight years. Since 2016, Sofia has managed the strategic research plans in the area of hydrodynamics. She is currently chair of the ITTC Specialist Committee on Combined CFD/EFD Methods.

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Ongoing research to increase knowledge of a ship's added resistance in waves. SSPA is now conducting a research project to increase the accuracy and efficiency of detecting added resistance in waves experimentally and numerically. Photo: Anders Mikaelsson, SSPA.

Research on
predicting ship performance in waves

Traditionally, contracts between shipyards and shipowners are based on the fulfilment of a single contractual point, namely that a ship achieves a certain speed with a given engine power in calm water. Such a one-sided approach can obviously result in the ship performing poorly in off-design conditions. It is for this reason that the current focus seems to have moved away from that single contractual point and towards operational profiles, design for overall performance and the ability of a ship to fulfil a certain transport task in a given time. This paradigm shift is closely related to today's emphasis on energy-efficient shipping, slow steaming and route optimisation. Modern ships are now designed to perform well in a range of realistic conditions rather than merely in calm water. Consequently, performance predictions under the influence of wave and wind loads are becoming more and more important. This in combination with the introduction of the Energy Efficiency Design Index (EEDI) has resulted in numerous ideas such as improved bow shapes to reduce "added resistance" in waves. The International Maritime Organization (IMO) has also introduced guidelines to determine the minimum propulsion power that can be used to maintain the manoeuvrability of ships in adverse conditions.

Our experts find that manoeuvring and seakeeping performance generally features too late in the design process and that sometimes the shipyards have to make costly and time-consuming last-minute changes to the design if the standards for ship manoeuvrability are not met or seakeeping performance is poor. All these developments increase the demand for ship manoeuvring and seakeeping performance with higher accuracy than before, and stipulate new and more stringent requirements for testing techniques and evaluation methods. SSPA is now conducting a research project to increase the accuracy and efficiency of detecting added resistance in waves experimentally and numerically. More accurate and efficient numerical and experimental procedures will make it possible to cost-effectively predict overall ship performance in a seaway early during the design process and to avoid costly pitfalls.

Frederik Gerhardt

Senior Technical Expert

Frederik received a Dipl.-Ing. in Aeronautical Engineering from RWTH Aachen in Germany in 2005 and a PhD in Mechanical Engineering from the University of Auckland in 2011. He has been employed at SSPA since 2011 and has mostly worked on research and consultancy projects related to seakeeping and manoeuvring issues. Frederik has been a member of the International Towing Tank Conference (ITTC) Seakeeping Committee since 2014.

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Research on dynamic design of ships

Merchant vessels are getting bigger and bigger, but what if their weight and the amount of steel required to build them could be reduced? It may be possible to optimise the design to reduce the weight and quantity of steel and thereby lower the cost of building and operating the ship. This will make transports more energy efficient and reduce the environmental impact on the sea, and might also lead to reduced costs for the shipowners when building the ship. More research is needed to ensure that lighter hulls satisfy requirements in terms of strength, sea characteristics, environmental requirements and maritime safety. According to a pre-study conducted in 2016, dimensional regulations do not fully take into account the interaction between wave loads and the ship's dynamic response. There is uncertainty as to whether the safety margins are sufficient or unnecessarily conservative, which may lead to vessels being oversized and having a higher energy consumption and environmental impact.

SSPA together with Chalmers University of Technology, the Royal Institute of Technology (KTH) and Stena Teknik has been conducting joint research on methods of dynamic ship dimensioning and the understanding of dynamic loads on ships since March 2017. During this project, a vessel model has been manufactured that is equipped to measure structural loads. Model wave tests will also be performed, and numerical calculations will be validated against the model wave tests. Stena's concept vessel Stena Elektra has been chosen as a model vessel. The project will be completed at the end of 2018.

Jonny Nisbet

Project Manager

Jonny received his MSc in Naval Architecture from the Chalmers University of Technology in 1989 and his PhD in Thermo-Fluid Dynamics from Chalmers in 1994. He has worked for SSPA since 2009, except for one year spent on research and consultancy projects related to manoeuvring and seakeeping. He specialises in submarine hydrodynamics, model testing and the simulation of manoeuvring performance.

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* The General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679) is a regulation by which the European Parliament, the Council of the European Union, and the European Commission intend to strengthen and unify data protection for all individuals within the European Union (EU). It takes effect on 25 May 2018.

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Through commitment, integrity, insight and expertise, we facilitate our customers' path to success.

SSPA is a dedicated partner that offers a wide range of maritime services, including ship design, energy optimisation, finding the most effective ways to interact with other types of transportation, and conducting maritime infrastructure studies together with safety and environmental risk assessments.

Our experts have a broad range of knowledge and profound expertise, and we use our resources such as databases, analysis and calculation capabilities, laboratories, collaborative platforms and skills to create value.

SSPA Your Maritime Solution Partner

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