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Introduction

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Green retrofitting through optimisation of hull-propulsion interaction

Energy saving has been a top priority for ship owners and operators for many years now. Despite fluctuating fuel prices, reducing the energy consumption of a ship remains financially attractive and has a positive impact on the environment and exhaust gas emissions. New design methods can be used for new built vessels to optimise the hull shape and the propeller, including optimisation of the hull – propeller interaction. For existing vessels changes in the hull shape are too costly, and Energy Saving Device (ESD) can be installed to optimise the hull – propeller interaction providing a potential fuel saving of several percent.

Over the past decades many ESDs have been developed with varying success. A limiting factor in the success of ESDs is the lack of validation data. In several applications model tests promised positive results while results of the full scale application were disappointing. Model testing a device operating in the boundary layer of the ship is subject to scale effects due to the difference in boundary layer between model and full scale.

With CFD calculation tools developing and computer capacity increasing, CFD evaluation of ESDs becomes a viable option. One of the mayor benefits of CFD is the possibility to study the local flow around ESDs accurately helping in the understanding of why certain ESDs work and others don't. CFD furthermore supports the model tests as the calculations can be done for both model and full scale, giving insight into the scale effects on ESDs.

In order to study the working principles of ESDs, a consortium consisting of BV, CMT, Fincantieri, HSVA, VICUS, Wartsila, Acciona, Imawis, Uljanik, CETENA and Arttic lead by MARIN, started the project GRIP supported by the European Commission under the 7th Framework Program. GRIP extensively studied the working principles of pre-swirl stators, pre-ducts, rudder bulbs and propeller boss cap fins. CFD analysis has been applied to these devices to study the working principles in details.

An Early Assessment Tool (EAT) was developed in GRIP by Wartsila and MARIN in which a first estimate of the fuel saving potential for different ESDs can be evaluated. Based on main ship dimensions and ESD type, a first principles calculation is done to come to an estimate of the fuel saving. From the general ESD dimensions an estimate of the retrofitting costs is made through which a payback period can be determined.

Fitting an ESD to the hull imposes some structural challenges with respect to loads, fatigue and vibration. BV, VICUS, Wartsila and Fincantieri have assessed the structure of different types of ESDs in normal operating conditions including the wave induced loads.

ESDs are not only applicable for new built ships but are especially suitable as retrofit to existing ships to improve the propulsion performance. After a ship has changed owner, the hull drawings can get lost meaning that the details of the hull shape are not always known to the current owner. CMT and IMAWIS have studied methods to measure the hull shape to be used in the detailed design of an ESD by means of laser scanning. Furthermore the yard processes for installing the ESD have been studied and optimised as part of the GRIP project.

The GRIP consortium furthermore designed an ESD for a Uljanik built bulk carrier. A concept design for a pre-duct, pre-swirl stator and rudder bulb was made, the best ESD was selected and built. An extensive set of dedicated trials was performed on the vessel before and after installation of the ESD to validate the fuel saving. Full scale cavitation observations were performed before and after the installation to validate the CFD predications of the local flow in the vicinity of the propeller.

In this special edition of ISP the main GRIP results are published. Papers describing the technical results of the early assessment of ESD performance, yard processes, structural assessments and hydrodynamic design. GRIP partners contributed to this special edition of ISP sharing their experience and knowledge gained in the project. The GRIP projected ended successfully in March 2015, after which partners have taken up the project results in their daily services.