A practical tool for the hydro-acoustic optimization of naval propellers

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ABSTRACT

Propeller optimization is always the focus of the propeller design process, as such process is aimed at finding the best compromise between often conflicting objectives accounting for many design constraints. The use of optimization algorithms combined with blade shape modification techniques has been proposed by a number of research groups in the past few years and has proved to have a potential for practical applications, but integration in the everyday propeller design process is still not so consolidated.

In the past one and a half years, CETENA, University of Genoa and the Fincantieri's Naval Vessels Business unit have teamed to setup a propeller optimization software environment to be used by Fincantieri's propeller designers in their everyday design work. A specification of the optimisation environment was worked out based on an analysis of the current design process, in order for the new procedures and tools to allow continuity of current practices while offering new possibilities in the comparative investigation of design variants and the identification of the very best design solution.

The resulting optimisation environment integrates different software tools and consists of three main components linked by JAVA scripts: a software tool for blade shape modification (1), a BEM code for the evaluation for the propeller performance (2) and the open-source software DAKOTA (3).

The software suite has been setup such as to be compatible with both Windows and Linux operating systems, in order to take advantage of all available computational resources, from single Windows workstations to the company's cluster, which operates under Linux.

An ad-hoc '2D modeler' has been developed by the University of Genoa to model and modify the propeller design table, while a 3D modeller has been developed by CETENA to generate 3D description of the variants suitable for CFD RANS computations, starting from the 2D description. The propeller performance is evaluated using CRS BEM code PROCAL and CRS Empirical Tip Vortex model. Measures of merit usually include the propeller efficiency and pressure coefficient at specific locations on the blade back and face and may include the tip vortex induced pressure.

The paper and presentation will provide details on the setup of the optimization environment and present an application to the optimization of a naval propeller. The specific needs of the final users of the optimization suite will be highlighted and the expected benefits will be discussed, related to the time frame of the design process and the possibility of performing thorough investigations of design variants.

REFERENCES

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