Pre-Swirl Stator and Propeller Design for Varying Operating Conditions

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Over the last two decades, an increasing number of studies have been conducted to develop and improve energy saving devices (ESDs) in order to increase the propulsive efficiency. One well-known example is the pre-swirl stator (PSS), which consists of an often asymmetric arrangement of fixed stator blades ahead of the propeller. This paper describes the hydrodynamic design of a pre-swirl stator with radially variable pitch, paired with a conventional propeller. The aim is to achieve the highest possible efficiency in various operating conditions, and to avoid efficiency penalties in off-design operation. To investigate the propeller and stator designs and configurations in different operating conditions, the computationally inexpensive vortex-lattice method is used as a first step to optimize the geometry in an initial parameter study. Then the flow over hull, stator and propeller is simulated in a CFD-based approach to confirm the results obtained in the first stage.

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