Title: **Systematic approach to develop an optimized nozzle design for up to date and future demands**

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Abstract

The increasing size of support vessels and longer distances from shore to offshore oil, gas and renewable energy locations are leading to new – and in some respects contradictory – requirements on the performance of ducted propellers. This is a two-fold challenge. On the one hand, short travel times must be achieved while keeping fuel oil consumption low. On the other hand, the maximum possible thrust capabilities must be maintained at very low speeds during station keeping in harsh environments.

Using a systematic approach, a global and local hydrodynamic optimization of dedicated nozzle profiles and attachments was carried out. A preliminary CFD analysis of established nozzle designs served as a benchmark. Based on this analysis, an initial design was developed and digitally parameterized. With the assistance of a generic algorithm, these geometry parameters were varied and optimized in a closed loop CFD investigation. Using different objective functions, it was possible to generate new nozzle cross sections with clearly better overall performance than traditional shapes.

Thanks to a series of model tests and in full scale measurements the theoretical determined behaviour of the final designed nozzles was approved.

A follow-up local flow optimization led to an innovative anode concept in terms of shape and placement.