



Success story

modeFRONTIER helps Azimut Benetti optimize yacht propeller performance

Using modeFRONTIER to perform multi-objective cavitating propeller optimization

Azimut Benetti Group is the world's largest network producing megayachts and leading private group in the luxury yacht industry. Azimut-Benetti's R&D Centre develops unique technologies, for an effortless and safe navigating experience. The Naval Architecture and Marine Engineering Unit (DITEN Department) of Genoa University work jointly with DETRA Custom Propellers and Azimut Benetti's R&D Centre, using **modeFRONTIER** to optimize the design of a custom propeller for a high-speed Azimut Benetti 95 RPH yacht.

Challenge

“

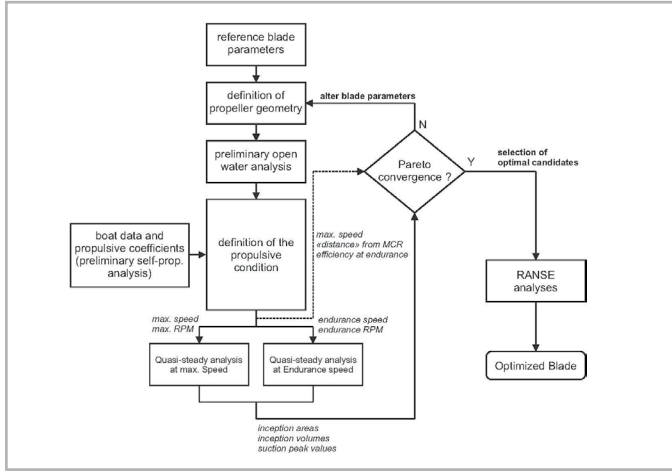
modeFRONTIER helped increase cruise speed and reduce cavitation in marine propellers.

The design of a propeller is always a trade-off between competing objectives and constraints: **maximizing the propulsion efficiency** and ship speed while avoiding cavitation and maintaining a sufficient blade strength. The traditional lifting line / surface methodologies define the propeller shape by including simplified geometric assumptions that make them not suitable for modern fast propellers design.

The application of more accurate flow solvers and the automatic investigation, possible through the parametric description of the geometry (unconventional combinations of pitch, camber, or, for instance, local hydrofoil shapes), proves to be **a successful design alternative** for a high-speed propeller.

Solution

Following this new approach, the optimization of a reference propeller with modified rake distribution was driven by the **MOGA-II**, the genetic algorithm included in the automation workflow in **modeFRONTIER**. The experimental data collected at the cavitation tunnel confirmed the reliability of both the Boundary Elements Method and RANSE numerical approaches.

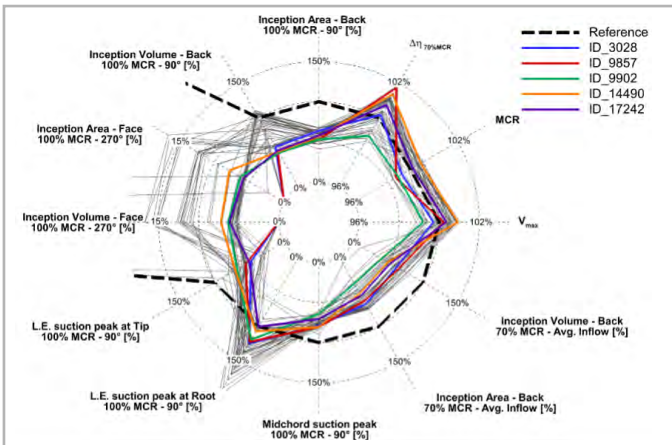


A dedicated full-scale sea trials, performed with propellers manufactured by Detra, showed that the cruise speed achieved with the optimized propeller is 1 kn higher than the baseline propeller speed, geometry by while the cavitating behavior was also significantly enhanced. “The result is remarkable, especially keeping in mind that the **increase of cruise speed**, together with the enhancement of comfort onboard, is crucial to the perception of luxury yacht customers”, said **Francesco Serra, R&D Office, Azimut Benetti Group**.

The modeFRONTIER optimization environment has been selected to build the optimization flow.

Benefits

modeFRONTIER helped build an optimization framework to interact with the parametric description of the geometry to define each new blade shape and employ flow solvers to quantify how each propeller fulfills the constraints and the objectives of the design.



“Starting from a set of 48 blade parameters to alter the reference propeller geometry, the use of MOGA-II algorithm allowed to compute and test 50,000 different geometries in about 5 days to achieve a satisfactory **Pareto convergence** and choose optimal candidates (one for any rake distribution) for RANSE analyses” said **Michele Viviani, Associated Professor at DITEN Department, Genoa University**.

Pareto diagram. Optimization with the modified rake distribution.

About Azimut Benetti

Azimut Benetti Group is the largest network producing megayachts and the world’s leading private group in the luxury yachting industry. The Company operates and produces in its 6 shipyards and with more than 40 models in production, the two brands Azimut e Benetti offer the broadest range in the world. The group accompanies its manufacturing excellence with a particular focus on services for its customers offering financial services, designing, planning and building new tourist marinas, providing customers with a luxury showroom, and training crews. azimutbenetti.it



ESTECO is an independent software company, specialized in numerical optimization and simulation process and data management. With a 20-year experience, ESTECO supports over 300 international organizations (such as Ford Motor Company, Honda, Lockheed Martin, Toyota and Whirlpool), accelerating the decision-making process and reducing development time. esteco.com

modeFRONTIER

VOLTA