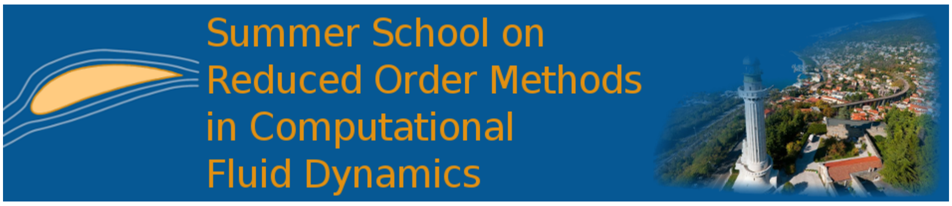

Contribution ID: **88** Type: **Poster**

A data-driven reduced order modeling framework for shape optimization of marine propellers

The project here presented is in collaboration with Fincantieri S.p.a. and aims to find the optimal shape of the propellers' blades in a cruise ship. The goal of the project is to improve the efficiency of the propeller, to reduce noise, vibration and consumption, and to avoid the cavitation phenomenon, which can lead to erosion and damage of the machinery.
In this work, we extend the numerical pipeline presented in [1, 2, 3, 4] to efficiently treat our shape optimization problem, making use of non-intrusive Reduced Order Models (ROMs) to reduce the computational effort of fluid dynamic simulations.
The first challenge faced in the project is the setting of the Full Order Model (FOM) of open water tests, which is simulated making use of the open-source software OpenFoam. The FOM has been built in an iterative way comparing the results of the simulations with the experimental measures.
A preliminary step for the construction of the ROM is the geometric parametrization of a single propeller blade. The variation of the blade parameters is exploited to design different deformed blades and the FOM mesh is deformed accordingly to the deformed shapes using a Radial Basis Function (RBF) interpolation technique.
As usual in the ROM framework, an offline-online procedure is computed.
The offline part is dedicated to the construction of the ROM database. Thus, a large number of open water tests corresponding to the deformed blades is simulated in order to obtain the high-fidelity snapshots. In the online stage the shape optimization is performed making use of a Genetic Algorithm (GA), by which the best individual in the parameters' space is predicted exploiting the ROM and the resulting efficiency is validated with the OpenFoam full order simulation.

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Session Classification: Poster blitz