CASE STUDY

A shape optimization pipeline to improve the design of marine propellers

OBJECTIVES

Provide a computational pipeline for the shape optimization of a marine propeller exploiting the speed-up of data-driven Reduced Order Models (ROMs). The aim is to optimize the efficiency, reducing vibrations and noise in the sea environment.

ACTIVITY

A shape optimization process usually provides the optimal configuration by evaluating the target objective function (the efficiency in our case) of a large number of deformed artifacts. A high-fidelity efficiency evaluation can be obtained by means of computational simulations. Such numerical investigation may take a long time (weeks, months) and it is not feasible for practical purposes.

For this reason, the efficiency evaluation is here accelerated using data-driven ROMs, models that are entirely built from data coming from a certain number of high-fidelity simulations. Such models are able to predict with good accuracy the efficiency of an unseen propeller in a few seconds, significantly accelerating the optimization process.

In the first preliminary step, we extracted the main geometrical features of the propeller, in order to modify them to obtain a large number of deformed shapes. The second step consists in running the high-fidelity simulations for all the deformed shapes, in order to collect the data for the ROM.

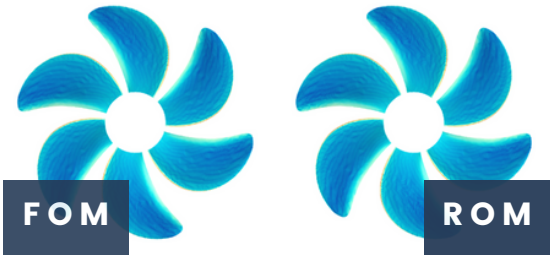
Once the ROM is built, we exploit it in a genetic optimization algorithm, evaluating thousands of different deformations in few minutes.

FOM TIME
~24-48H

ROM TIME
~15S

RESULTS

	efficiency gain
no constraints	**+4%**
structural constraints	**+1%**



Goals

Build a model, which is able to reach a speed-up in the optimization process only using available data and without physics' knowledge.

Benefits

- Fast models for speed-up expensive simulations
- A complete pipeline for shape optimization