

# REDUCTION OF NOISE GENERATED BY PROPELLERS

*Shape optimization of naval propellers in order to reduce the hydro acoustic noise*

H2020 SOCIETAL CHALLENGES: Smart, green and integrated transport

PRODUCTIVE SECTOR: Mechanics and Mechatronics

## PROBLEM DESCRIPTION

CETENA S.p.A., a Fincantieri company, was interested in reducing the hydro acoustic noise generated by propeller blades within the project PRELICA “Advanced methodologies for hydro-acoustic design of naval propulsion”, supported by Regione FVG, POR-FESR 2014-2020, Piano Operativo Regionale Fondo Europeo per lo Sviluppo Regionale.

## CHALLENGES AND GOALS

- Efficient prediction of noise given a propeller geometry
- Reliable shape parametrization and morphing tool
- Reduction of noise of an actual propeller

## MATHEMATICAL AND COMPUTATIONAL METHODS

We had to implement a bottom-up approach to parametrize and then morph a single propeller blade given the radial distribution of chord, pitch, rake, and skew. Modifying the displacement of some control points defining the aforementioned radial distribution functions we are able to generate a wide range of different propeller designs in both CAD files as iges and stl, and PROCAL files as ppg. Due to the high number of possible geometrical parameters we exploited the active subspaces property of the target functions describing the hydro acoustic performance and numerical simulations based on potential theory in order to reduce the parameter space dimensionality and assess the most relevant parameters. This resulted in only few promising geometrical configurations. Finally more accurate numerical simulations based on RANS and LES were performed by the company to assess the effectiveness of the selected propeller and find the best candidate.

PPTC benchmark  
propeller



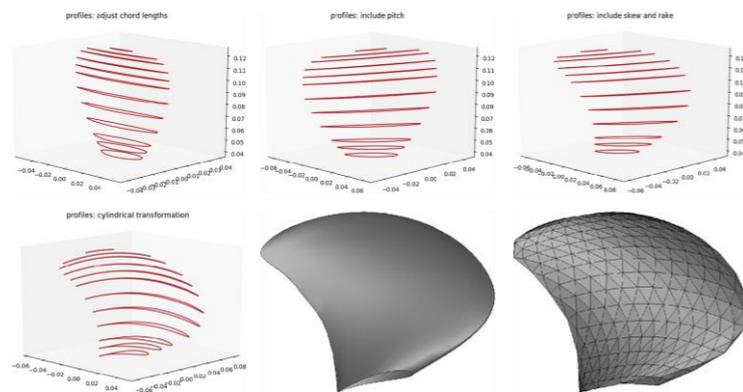
# REDUCTION OF NOISE GENERATED BY PROPELLERS

*Shape optimization of naval propellers in order to reduce the hydro acoustic noise*

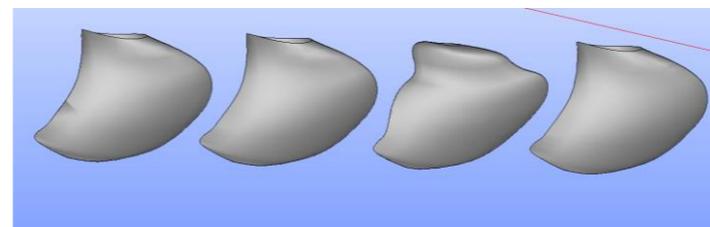
## Results and Benefits

The results of this collaboration are: the creation of BladeX, an open source Python package, to generate, morph, and export different propeller geometries, with a dedicated web app for the company to use; the identification of the most important parameters affecting the hydro acoustic noise; the identification of the most promising design shapes. The collaboration resulted also in several scientific works in preparation and some already submitted.

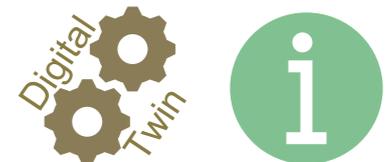
The company has a **computational methodology** to **parametrize** and **morph** propeller geometries, resulting in **different geometrical configurations**. So it is able to **design and optimize** the **acoustic behavior** of their naval propellers



Construction of a propeller blade and CAD representation



Deformations of a PPTC benchmark propeller blade



SISSA mathLab group - Innovating with mathematics  
[mathlab.sissa.it](http://mathlab.sissa.it)

