

SAILBOAT KEEL OPTIMIZATION

Prof. Giovanni Lombardi¹, Eng. Marco Maganzi^{1,2}

¹University of Pisa, ²CUBIT S.c.ar.l.

giovanni.lombardi@unipi.it

marco.maganzi@cubitlab.com

ABSTRACT

The Sport at high level is a powerful engine for the Research, in particular for Aerodynamics. The purpose of this work is optimization of the keel in order to reduce the drag of a sailboat during the race.



1. Goal

Redution of drag for the keel in order to obtain the best compromise during the race.



2. Strategy

Two optimization steps were required:

1. 2D optimization in order to define the Fin section.
2. 3D optimization in order to define the shape of the keel (Fin and Bulb)



3. 2D optimization

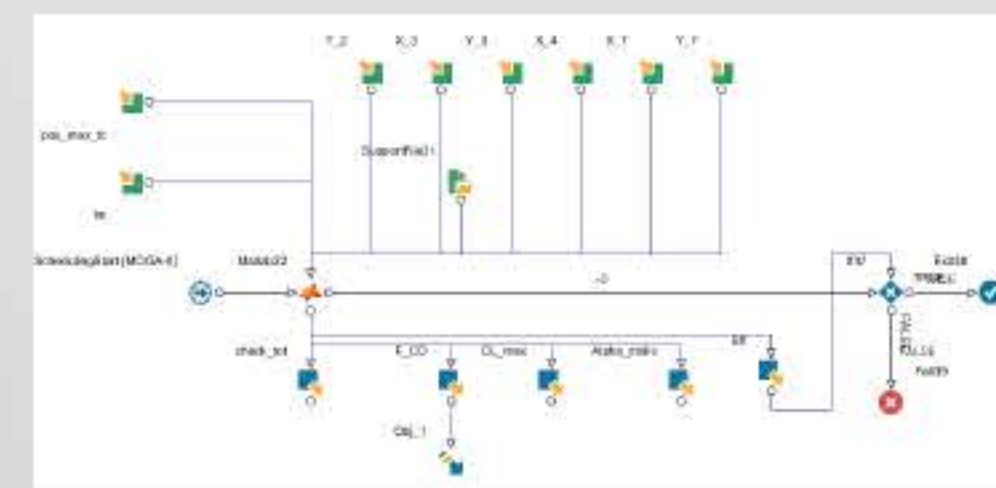
In order to define the fin section a 2d optimization was performed.

Mode-frontier, Matlab and X-foil are used to define strategy.

The objectev was to minimize F_{obj} .

$$F_{obj} = 0,4 * Cd_{downwind} + 0,6 * Cd_{upwind}$$

8 parameters to define the section by a Bezier curve are selected.



4. 3D optimization

The 3d optimization was performed in order to define the fin and bulb shape .

Mode-frontier, Matlab Catia V5 and StarCCM+ are used to define strategy. We allocated 1024 cores of our cluster to CFD step.

The objectev was to minimize F_{obj} .

$$F_{obj} = 0,4 * Cd_{downwind} + 0,6 * Cd_{upwind}$$

A total of 21 parameters are used and 1 constraint on bulb volume.



5. Results

2D

3D

