Comparison of hydrodynamic parameters of 2D and 3D models of monofin through a model of fluid-structure interaction

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ABSTRACT

The modeling of a monofin aims at determining the hydrodynamic parameters, such as thrust and lift that are considered to be the most relevant parameters to evaluate its efficiency propulsive.

In a recent study [1] - [2], we built a 2D model of monofin where various couplings have been considered, in particular a model where the fluid is described using the acoustic approximation. This study has helped highlight the links between different parameters in the model, such as added mass, material properties of the monofin and the kinematics imposed on it. This work deals with the 3D model and consists of two parts.

The first part deals with the linear model corresponding to a slow swimmer, where the speed of propulsion is very low compared to the speed of shear waves in the material of the monofin. This assumption leads to the approximation for the acoustic fluid. The dynamic problem is introduced by placing the frame linked to the swimmer's foot, using kinematics proposed in [6].

The second part focuses on modeling of a swimmer whose speed propulsion is quite significant. For this, the acoustic model is not more appropriate and will be replaced by the model of Navier-Stokes. The coupling becomes stronger and the problem becomes nonlinear coupled. Its resolution requires the use of the ALE method in the case of large deformation hypothesis for monofin.

In each part, we compare the variation of hydrodynamic parameters of 2D and 3D models.

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