A hydrodynamic toy model for fish locomotion

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The social interaction of fish has been mainly studied in 2D without hydrodynamic interactions [1,2] or with hydrodynamic interactions in the limit of the far-field [3]. As a fish swims, it affects the flow around its body in a complex manner at distances much larger than the typical fish scale. Thus, it could compete with cognitive interaction. Some efforts have been done to describe precisely the flow generated around a fish [4,5]. But, the high cost of hydrodynamic simulations prevents the use of such models to study schools of fish.
We propose a toy model , that is able to generate the vortex wake induced by the fish locomotion (Fig. 1) and which is light compare to solving the fish tail flapping. We describe the fish as a rigid body by a penalty method and achieve the description of the tail flapping by exerting a torque in the fluid compensated in the body. The trajectory of the fish is determined by the position of the tail in relation to the body. We perform a full characterization of the toy model and compare it to the scaling found in the animal kingdom [6].

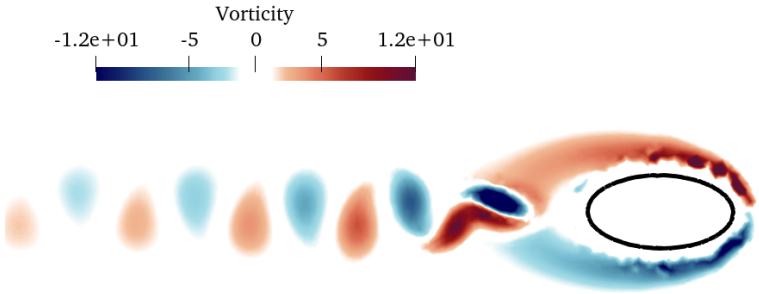

Figure 1. Illustration of the vortex wake behind a rigidbody with the minimal model developed.

Références

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