Locomotion of the fish-like foil under own effort

Yaroslav A. Dynnikov*, Galina Ya. Dynnikova*, Tatyana V. Malakhova*

* Lomonosov Moscow State University
Institue of Mechanics,
Michurinsky pr. 1, 119192, Moscow, Russia
e-mail: Yaroslav.dynnikov@gmail.com, dyn@imec.msu.ru, tatyana.malakhova@gmail.com

ABSTRACT

A large number of works have been devoted to the study of forces arising from the flow around flapping plates, foils, and wings (see, for example, [1], [2], review [3]). In the most of the works on this topic, the law of motion of bodies in a constant incoming flow is set. The forces resulting from the movement are investigated. However, such formulation of the problem differs from the real situation, where the speed in a quasi-stationary motion is the result of applied efforts, the average horizontal hydrodynamic force is zero, and the vertical component balances the force of gravity if the density of the body exceeds the density of the medium. In addition, the speed of the body is not constant. In this case it is necessary to solve the flow-structure problem of the fluid and bodies coupled motion. An effective method for solving such problems in a two-dimensional formulation based on the meshless method of viscous vortex domains (VVD) was developed in [4, 5]. The method allows calculating the coupled motion of fluid and body systems with elastic connections.

The model of a fish is represented by a foil consisting of three sections, which are connected by hinges (see fig. 1). The moment of force is applied between the first and second sections by harmonic law, resulting in the bending of the fish body. This simulates the muscular effort of a fish. The second hinge is elastic and passive. The moment of forces in it obeys Hooke's law. The angles between the sections are determined by the equations of the dynamics of the sections under hydrodynamic forcing. At the initial moment the fish begins bending in the unmoved medium. This leads to the forward movement. The influence of parameters on the speed of steady motion is investigated.

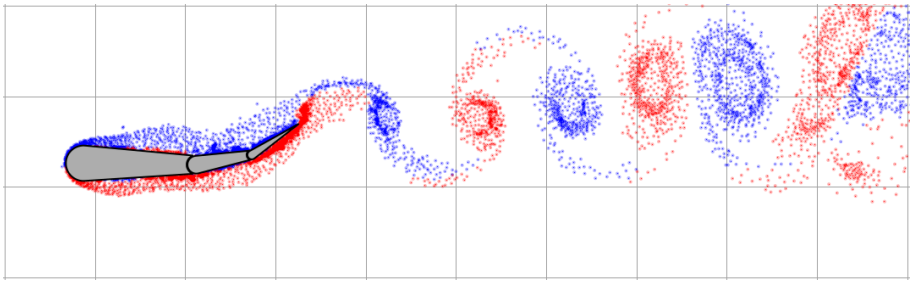

Figure.1 The vortex pattern around the self-moved fish-like foil

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