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Simulation of C-start and S-start of fishes by an ALE-GFD method and a curvature-wave backbone model

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Summary

This paper presents the application of an Arbitrary Lagrangian Eulerian (ALE) and Singular Value Decomposition (SVD) based Generalized Finite Difference (GFD) method to simulate the C- and S-starts of a carangiform-type fish. The numerical model incorporate fluid-structure interaction (FSI) and computation is carried out on a hybrid grid comprising meshfree nodes around the undulating/deforming swimming fish and Cartesian nodes in the background. The meshfree nodes convect with the deformation and motion of the swimmer. A curvature-wave model of the backbone is used to generate the C- and S-start actions of the fish from the experimental data of Spierts and Leeuwen (1999). The curvature model provides a power tool to describe complex deformations of the fish backbone. The present study is probably the first to apply a curvature approach to reproduce the elegant and realistic manoeuvring kinematic actions of a carangiform-type fish.