Numerical investigation into the choice of gait parameters in 2D anguilliform swimmers

David Gross[1,2], Médéric Argentina[1] & Yann Roux[2]

[1] Université Nice Sophia-Antipolis, Institut non linéaire de Nice, CNRS UMR 7335, 1361 route des lucioles, 06560 Valbonne, France
[2] K-Epsilon SARL, 300 route des crêtes , 06902 Valbonne, France

Fish and swimmers in general exhibit a wide variation in amplitudes and frequency, but have been found to follow a general scaling law defined by Swimming number which captures the relation between these two parameters and the swimming speed and swimmer length (Gazzola1). While this scaling law defines the product of these two parameters, the exact selection of each individually is not clearly defined. The swimmer must choose a gait which maximizes propulsive efficiency, while permitting it to obtain a reasonable speed within the limits of its muscular capacity. This research looks at the influence of the imposed frequency, amplitude and wavelength of the traveling wave used to propel a 2D anguilliform swimmer on its propulsive efficiency. Comparison of the obtained Swimming number relations are compared with those presented in (Gazzola1). The rigid body motions of the swimmer are resolved in forward and transverse motions utilizing ARA, a finite element structural solver as a rigid body solver and coupled to an unsteady 2D thin vortex panel code with a wake particle method. The coupling between these two is accomplished using a quasi-monolithic FSI coupling (Durand2). Results of this coupling were compared to those of a coupling of ARA with a 2D URANS fluid solver. It was found that the viscous drag acting on the body strongly determines the behavior of the scaling law and must be included in some form to successfully reproduce the correct behavior. To this end, a drag force equivalent to that of a Blasius flat plate was included to account for this force, leading to the correct Reynolds number and Strouhal number behavior.

Références

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