6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

NUMERICAL ANALYSIS OF UNDERWATER UNDULATORY SWIMMING HYDRODYNAMICS IN HUMAN SWIMMING

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Keywords: *Underwater Undulatory Swimming, Biofluiddynamics, Computational Fluid Dynamics*

In three of the four competitive swimming styles, the underwater undulatory swimming (UUS) mode is used by swimmers to maximize the swimming performance and minimize the time to finish. In recent years, professional swimmers are allowed to spend extended periods of time underwater performing UUS at the start and after turns in competitive swimming. Therefore, an understanding of the hydrodynamic mechanisms of thrust generation and drag inducement would be beneficial in guiding professional swimmers how their UUS strokes can be optimized. Most works on computational analysis of swimming hydrodynamics focus on underwater gliding motion of the swimmer. The Literature on the hydrodynamics of unsteady swimming motion is limited. To this end, we present an unsteady computational fluid dynamics analysis of forward and backward UUS modes using constraint based immersed boundary method [1]. The numerical method is validated with experimental data of Vennel [2] by performing simulations of swimmers in glide motion. The input data for the numerical simulations were obtained by experimental measurements. Experiments, in which video measurement of professional swimmers performing UUS, were carried out to obtain the undulatory motion data of the UUS mode. And, 3D scanners were used to generate 3D morphological data of each of the swimmers for whom UUS video measurement was made. The hydrodynamic forces and flow signatures from the results of numerical simulations of the swimmers during forward and backward UUS mode will be presented.

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