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

3D INFLUENCE ON PROPULSIVE FLAPPING AT LOW REYNOLDS NUMBER

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Key words: *Computational Fluid Dynamics, Boundary Data Immersion Method, Flapping foil*

Many of the 2D approximations used for flapping studies at low Reynolds number are questionable. In 2D, the predictions of power are overpredicted in reduced frequency[1]. In this work, the 3D fluid effects of oscillating foils are studied extensively through the comparison of their thrust force, power and propulsive efficiency. The objective of this study is to find out which characterics nature gives to get the best propulsion and how these characteristics can be useful for biomimetic robots.

In this work, we simulate the unsteady flow with the Boundary Data Immersion Methods, which is documented to accurately predict low Re stationary and dynamic foils up to Re 10^5[2]. As the first step, a single flapping foil with heaving-pitching combination is studied to see where the 3D starts to be important. This work shows that as the amplitude is decreased, the 3D fluid effects become more and more critical to the foil performance. The following step is to study finite wing span geometries, like mostly natural shapes of wings, and motions by varying the aspect ratio and the vertical plane kinematics. The change in 3D flow features over the variation of aspect ratio and the change from heaving to rolling motion is presented, as well as the integrated properties such as propulsive efficiency.

REFERENCES

[1] Kinsey, T., Dumas, G. Computational Fluid Dynamics Analysis of a Hydrokinetic Turbine Based on Oscillating Hydrofoils.*Journal of Fluid Engineering.* (2012) **134**.

[2] Maertens, P. A. and Weymouth, G. D. Accurate Cartesian-grid simulations of near-body flows at intermediate Reynolds numbers.*Computer Methods in Applied Mechanics and Engineering.* (2015) **283**, pp. 106–129.