# VISCOUS EFFECTS ON THE HYDRODYNAMIC PERFORMANCE OF SEMI-ACTIVE FLAPPING PROPULSOR

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## ABSTRACT

A fully-active flapping foil is a propulsion system where the foil heave and pitch kinematics are directly prescribed. This system generally requires two actuators in order to drive both motions separately. Otherwise, an actuator with complex mechanism can be used instead to simultaneously drive the two motions. In order to simplify the mechanical drive system, the use of semi-active flapping propulsor has been suggested [1, 2]. This system possesses only one actuator driving the foil heave motion while the foil pitch motion is passively adjusted by interactions between hydrodynamic forces and a torsional spring attached to the foil hinge.

A numerical tool based on Lattice Boltzmann Method is used to investigate the performance of a semi-active flapping propulsor in comparison with that obtained by a potential flow code. It is found that both numerical tools give a qualitatively good trend agreement of the open water performance at high equivalent advance numbers. However, the results obtained using the viscous solver are slightly lower than that of potential flow in the region where flow separation is not observed. In case of small equivalent advance numbers, serious flow separation occurs due to high angle of attack, and hence the viscous results yield significantly lower efficiency. In spite of the mentioned deviation in the performance predictions, the LBM results confirm that the semi-active flapping propulsor is efficient over a wide range of operating conditions. This shows a possibility to practically use such self-pitching foil as a propulsion system.

## REFERENCES

[1] Thaweewat, N., Phoemsapthawee S. and Juntasaro V. Semi-active flapping foil for marine propulsion. *Ocean Engineering* (2018) **147**:556–564.

[2] Phoemsapthawee S., Thaweewat, N. and Juntasaro V. Influence of resonance on the performance of semi-active flapping propulsor. *Ship Technology Research* (Article in Press).