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Effect of Pitching and Heaving Motions of SD8020 Hydrofoil on Thrust and Efficiency for Swimming Propulsion SUTTHIPHONG SRIGRAROM, Nanyang Technological University, WEE SERN CHAI, Nanyang Technological University, Singapore — The thrust producing performance and efficiency of an SD8020 foil hydrofoil that undergoes rotational and translational oscillating motions was studied and optimized through force and torque measurement and dye flow visualization, in the water tunnel at low Reynolds number of 13,000-16,000. The foil was set into pitching and heaving motion under different oscillation patterns to mimic the flapping and swimming motion of the marine creatures. The force and moment data were collected and used as optimization basis for best flapping motion combination. The propulsive efficiency and thrust coefficient of the pitching foil were determined as a function of the Strouhal number, pitch amplitude and angular frequency. Based on the force and efficiency data collected for the pure pitching motion, increasing pitch amplitude and angular frequency was associated with a decrease in propulsive efficiency and an increase in thrust forces produced. A high propulsive efficiency of 70%, accompanied by a thrust coefficient of order one was found at a pitch amplitude of 30° and angular frequency of 0.873 rad/s, Strouhal number of 0.24, and freestream of 0.1368 m/s (Reynolds number of 16416). This presented the best conditions for thrust production observed at low Strouhal and Reynolds numbers.

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