Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Intermittent locomotion of a self-propelled plate.[1] JAEHA RYU, HYUNG JIN SUNG, Department of Mechanical Engineering, KAIST — Many fish and marina animals swim by using a combination of the active bursting phase and the passive coasting phase, which is known as the burst-and-coast swimming. The immersed boundary method is applied to explore the intermittent locomotion of a three-dimensional self-propelled plate. The degree of the intermittent locomotion is captured in a duty cycle ($DC = T_b/T_f$), which is the ratio of the interval of the burst phase (T_b) to the total flapping period ($T_f = T_b + T_c$). Here, T_c is the interval of the coast phase. The averaged cruising speed ($\bar{U}_C$), the input power ($\bar{P}$), and the swimming efficiency (η) are analyzed as a function of the duty cycle (DC). The maximum $\bar{U}_C$ is obtained at $DC = 0.9$, while the maximum η is at $DC = 0.3$. The hydrodynamics by the intermittent locomotion is scrutinized by using the superimposed flag and the phase map. The characteristics of the flapping motion are demonstrated at the bursting and coasting phases, respectively. The modal analysis is performed to examine how the flapping motion plays a role in the propulsion mechanism. The velocity map and the vortical structures are visualized to show the influence of the intermittent locomotion qualitatively and quantitatively.

[1]This work was supported by a grant from the National Research Foundation of Korea (NRF) (No. 2019M3C1B7025091).

Jaeha Ryu
Department of Mechanical Engineering, KAIST

Date submitted: 25 Jul 2019 Electronic form version 1.4