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Unsteady propulsion in ground effects[1] SUNG GOON PARK, BOYOUNG KIM, HYUNG JIN SUNG, Department of Mechanical Engineering, KAIST
— Many animals in nature experience hydrodynamic benefits by swimming or flying near the ground, and this phenomenon is commonly called 'ground effect'. A flexible fin flapping near the ground was modelled, inspired by animals swimming. A transverse heaving motion was prescribed at the leading edge, and the posterior parts of the fin were passively fluttering by the fin-fluid interaction. The fin moved freely horizontally in a quiescent flow, by which the swimming speed was dynamically determined. The fin-fluid interaction was considered by using the penalty immersed boundary method. The kinematics of the flexible fin was altered by flapping near the ground, and the vortex structures generated in the wake were deflected upward, which was qualitatively analyzed by using the vortex dipole model. The swimming speed and the thrust force of the fin increased by the ground effects. The hydrodynamic changes from flapping near the ground affected the required power input in two opposite ways; the increased and decreased hydrodynamic pressures beneath the fin hindered the flapping motion, increasing the power input, while the transversely reduced flapping motion induced the decreased power input. The Froude propulsive efficiency was increased by swimming in the ground effects

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