Abstract Submitted
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Scaling law for unsteady two-dimensional swimming in ground effect[1] AMIN MIVEHCHI, MELIKE KURT, Lehigh University, QIANG ZHONG, DANIEL B. QUINN, University of Virginia, KEITH W. MOORED, Lehigh University — The underlying physics of oscillatory swimming, in proximity to a substrate, can be modeled with simple models based on the scaling of added mass and circulatory forces. Here, following Moored Quinn (2018) and by considering these forces, we present new scaling relations for unsteady swimming in ground effect. The classic linear theory is augmented by additional nonlinearities and modified for ground effect by considering added mass changes in proximity to the ground for a two-dimensional foil, the circulatory effects from the trailing vortex system, and its image due to the presence of the ground. The scaling relation then is verified using inviscid numerical simulations and experiments over a wide range of variables, including the dimensionless amplitude, dimensionless distance from the ground, reduced frequency, and Strouhal number. The developed relations found to be in excellent agreement with the numerical and experimental data. These scaling laws are then used to identify physical mechanisms that influence thrust and efficiency and as a guide for improving performance.

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