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Self-propulsion of a pitching foil ANIL DAS, RATNESH SHUKLA, RAGHURAMAN GOVARDHAN, Indian Institute of Science — Undulatory motions serve as a fundamental mechanism for bio-locomotion at moderate and high Reynolds numbers. An understanding of the interactions between self-propelling undulatory motions and the surrounding fluid, not only provides insight into the efficiency of bio-locomotion, but also yields valuable pointers for the design of autonomous under-water and micro-aerial vehicles. Here, we investigate a simplified model of a self-propelling pitching foil that undergoes time-periodic oscillations about its quarter chord. We consider two-dimensional configurations in which the foil is free to propel along only longitudinal and both transverse and longitudinal directions. In both the configurations, the time-averaged self-propelling velocity increases monotonically with the Reynolds number Re (based on trailing edge speed and chord as the characteristic velocity and length). The rate of increase is particularly pronounced in the low Re regime (Re <400) over which the closely-spaced wake vortices dissipate within a few chord lengths. At moderate and high Re, the wake exhibits increasingly complex structure in both the configurations. For a fixed Re, the foil with a single translational degree of freedom propels at a higher speed for a higher input power requirement. Differences between the two configurations will be discussed within the context of undulatory self-propulsion observed in nature.

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