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Propulsive performance of pitching foils with variable chordwise flexibility. SAMANE ZEYGHAMI, KEITH MOORED, Lehigh University, LEHIGH UNIVERSITY TEAM — Many swimming and flying animals propel themselves efficiently through water by oscillating flexible fins. These fins are not homogeneously flexible, but instead their flexural stiffness varies along their chord and span. Here we seek to evaluate the effect stiffness profile on the propulsive performance of pitching foils. Stiffness profile characterizes the variation in the local fin stiffness along the chord. To this aim, we developed a low order model of a functionally-graded material where the chordwise flexibility is modeled by two torsional springs along the chordline and the stiffness and location of the springs can be varied arbitrarily. The torsional spring structural model is then strongly coupled to a boundary element fluid model to simulate the fluid-structure interactions. Keeping the leading edge kinematics unchanged, we alter the stiffness profile of the foil and allow it to swim freely in response to the resulting hydrodynamic forces. We then detail the dependency of the hydrodynamic performance and the wake structure to the variations in the local structural properties of the foil..

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