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Combined Heaving and Pitching Propulsors of Non-Uniform Flexibility[1] AMIN MIVEHCHI, TIANJUN HAN, Lehigh University, MEHDI SAADAT, GEORGE V. LAUDER, Harvard University, KEITH W. MOORED, Lehigh University — Many swimming animals propel themselves efficiently through water by oscillating of their fins with combined heaving and pitching motions. Contrary to most research on flexible propulsors, these fins are not homogenously flexible, but rather their flexibility varies along their chord and span. Here, using a simple flexibility model we experimentally examine the effect of the distribution of flexibility on the performance of a three-dimensional propulsor using combined heaving and pitching motions. We manufacture propulsors with a combination of rigid and flexible materials where their proportion compared to the chord length is determined by the flexion ratio. The experiments are conducted in a recirculating water channel by varying the frequency of motion at $Re = 10^4$, with the pitching motion lagging the heaving motion by 90 degrees. Both the effective flexibility and the flexion ratio of the propulsors are varied independently and force, power and amplitude data are recorded for each experiment. We find peak efficiencies greater than 60% and we detail the dependency of the performance on the variation in the structural properties of the propulsor.

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