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Flexibility and Resonance in Thrust Production of a Mechanical Swimming Lamprey MEGAN LEFTWICH, ALEXANDER SMITS, Princeton University, PRINCETON UNIVERSITY TEAM — We use a robotic lamprey as a means of investigating the influence of flexibility on the wake structure and thrust production during anguilliform swimming. A programmable microcomputer actuates 11 servomotors that produce a traveling wave along the length of the lamprey body. The waveform is based on kinematic studies of living lamprey. The shape of the tail is taken from CT scan data of the silver lamprey, and it is constructed of flexible PVC gel. Plastic inserts allow the the degree of flexibility to be changed. PIV measurements in the wake of the robot with three different flexible tails show that a 2P structure dominates the flexible wake. However, the large structure is composed of several small vortices (as opposed to the large coherent vortex seen behind a stiff tailed robot). Furthermore, the wake loses coherence as flexibility is increased. Additionally, momentum balance calculations indicate that increasing the tail flexibility yields less thrust. Finally, we find that changing the cycle frequency to match the resonance frequency of the tail increases the thrust production. The project is supported by NIH CNRS Grant 1R01NS054271.

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