Abstract Submitted
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Viscous to inertial pumping transitions in a robotic gill plate array[1] MARY LARSON, KEN KIGER, University of Maryland — Biological oscillating appendage systems are known to exhibit distinct patterns of movement based on their Reynolds number. Flapping kinematics (net flow perpendicular to appendage stroke plane) are associated with Re $>$ 100, while rowing kinematics (flow in the direction of appendage motion) are typically associated with Re $<$ 1. Previous studies of pumping by mayfly nymph gill plate arrays have shown a transition between rowing and flapping at a Re $\approx$ 5. Although the flow generated by the animal could be documented, the limited range of behavior of the animal prevented a detailed study of why and how such a pumping mechanism might be optimized. Towards this end, a two-degree-of-freedom robotic oscillating plate array has been constructed, which allows for the variation of the Reynolds number, plate spacing, plate shape, and stroke/pitch amplitude beyond what is exhibited by the animal system. Using PIV, these combinations allow the individual influence of each feature on the pumping efficiency to be observed, and elucidate how it may be optimized for engineered devices. The current results will compare this simplified system to the flow generated by the typical mayfly, to determine how effectively the model performs in comparison to the more complex animal system.

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