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Effect of kinematics and flexibility on the pumping dynamics of an array of oscillating plates[1] FARHAD SAFFARAVAL, KEN KIGER, Dept. of Mech. Engr., Univ. of Maryland — A robotic array of two-dimensional oscillating plates was constructed to examine the net pumping produced over a transition from viscous to inertia dominated flows. The actuators consist of single rigid plates or multiple rigid segments connected with a thin polymer film to provide for a specified degree of flexibility. The parameters for the study include: 1) inter-gill phase difference, 2) asymmetry of the protraction/retraction stroke speeds, and 3) the presence of a one-way elastic hinge. PIV measurements were conducted to examine the unsteady two-dimensional flow field at a sufficient resolution to provide measurements of the net pumped flow rate, energy dissipation, and pumping efficiency. Preliminary results at a Reynolds number of 15 show that the introduction of asymmetric flexibility under synchronous actuation of a sinusoidal waveform provides an increasing flow rate with increased flexibility. Introduction of an asymmetric stroke kinematics, however, appears to nullify the improvement effect of flexibility, with rigid and flexible gills providing comparable levels of pumping performance when using the same stroke pattern. Using a combination of stroke phasing and asymmetric kinematics shows further enhancement beyond the use of either individually.

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