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**Valveless Impedance Pumping: Scaling and Viscous Effects**[1]
JOHN MEIER, DEREK RINDERKNECHT, MORTEZA GHARIB, California Institute of Technology — Valveless pumping through the periodic compression of a pliant tube with geometric asymmetry was first noted by Liebau in 1954. Recent studies by Hickerson and Gharib (J. Fluid Mech. 2006) and Avrahami and Gharib (J. Fluid Mech. 2008) highlight the role of resonance in generating flow in valveless impedance pumps. The pump has also been shown to perform down to scales of at least 250 $\mu$m by Rinderknecht, Hickerson, and Gharib (J. Micromech. Microeng. 2005). The impedance pump holds great promise for micro-scale applications such as lab-on-chip and biomedical devices where it could encounter a wide range of fluid viscosities. A thorough investigation of the pump under viscosity scaling is a critical step in understanding its potential. We experimentally investigated a 2 mm diameter pump in open and closed loop configurations with a fluid viscosity range of 1-50 cS and excitation frequency range of 1-150 Hz. This corresponds to a Womersley Number range of $\alpha$ = 0.3-30. The pump showed robust performance with increasing viscosity. The closed loop system showed flow rates as high as 20 mL/min corresponding to Reynolds Number up to Re = 300.

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