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Performance predictions for valveless impedance pumps in the microscale: wave speed and time response considerations for the Liebau phenomenon[1] JOHN MEIER, MORTEZA GHARIB, California Institute of Technology — Valveless pumping through periodic excitation of a pliant tube with geometric asymmetry was first noted by Liebau in 1954. Studies by Hickerson and Gharib (J. Fluid Mech. 2006) and Avrahami and Gharib (J. Fluid Mech. 2008) highlight the role of wave dynamics and resonance in valveless impedance pumps that exploit the Liebau phenomenon. While pulse propagation in fluid filled elastic tubes has been studied for centuries, there are fundamental scaling investigations missing from the literature that are necessary to understand impedance pump behavior. The pump has been shown to function down to scales of 250 μm in tubular systems by Rinderknecht et al. (J. Micromech. Microeng. 2005). We have recently shown that the pump also functions in a planar manifestation, fabricated using multilayer soft lithography, with pump thicknesses on the order of 200 μm. In this study we look at wave propagation and time response in both tubular and planar systems and discuss the effects of the scaling parameter λ/L in the pumping element and its affects on performance and fundamental impedance pump behavior.

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