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An experimental study of pulsatile flow through compliant tubes

VICTORIA STURGEON, OMER SAVAS, University of California, Berkeley, DAVID SALONER, University of California, San Francisco — An experimental investigation is made into transitional behaviors and instability of oscillatory input flows through elastic tubes, a problem with applications to hemodynamics and flows in the pulmonary system. Sinusoidal input flow is driven through a compliant silicone model in a series of experiments to investigate the effects of wall motion. A novel mechanism allows active control and feedback over the pressure on the tube exterior. By comparing the pressure within and outside of the tube and modifying the exterior pressure accordingly, the tube is inflated in a controlled manner without altering the input flow. In these experiments, the tube wall is deformed sinusoidally with an amplitude of approximately ten percent of its radius. Experiments are conducted using varying values of the parameters $\alpha = a\sqrt{\frac{\omega}{\nu}}$ and $\beta = \Delta x\sqrt{\frac{\omega}{\nu}}$ where a is the tube radius, ω the angular velocity of the input flow, ν the kinematic viscosity, and Δx the cross-stream averaged periodic displacement of a fluid particle undergoing pulsatile motion. For a given α, it is found that indications of conditional turbulence appear in this flow through elastic tubes at far lower values of β - and thus at lower amplitudes of oscillation - than are reported in the literature for flows through rigid tubing.

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