

Public Abstract

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Department:Mechanical & Aerospace Engineering

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Title:Positive Displacement Fluid Flutter using Plate Strain Energy Deflection

In nature, there exist highly evolved mechanical systems which exploit passive mechanical compliance and material property transients to impart hydraulic actuation and fluid motion. The human heart generates blood flow through periodic geometric chamber contraction and expansion. Delicate red blood cell corpuscles transport oxygen and nutrient requirements throughout the body. Applying a cyclical impulse pressure transient, the heart squeezes this incompressible fluid through the vascular network. No such current state fluid flow device exists that is capable of replicating nonlinear fluid particle motion without severely damaging the fragile oxygen-carrying red blood cells. A new type of pump mechanism is provided to demonstrate flow pressure and mass transport that can be utilized as to replicate the cardiac cycle fluid motion. The concept of fluid flutter using shell mechanical pre-compression strain energy is provided as a viable method for actuation of fluid particles in a nonlinear periodic cycle. Using commercially available software and implicit numerical solver schemes, a fluid-structural interaction problem is formulated. Simple flask container geometry is developed to illustrate symmetric chamber halves undergoing simultaneous fluid contraction and expansion. Passive valve actuation is employed as a means to regulate the induced fluid chamber ejection pressure.