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Numerical investigation of vortex ring formation through a moving valve LUCAS FARRAR, XUDONG ZHENG, QIAN XUE, None — Impulsively started, low-speed, incompressible jets observed in nature, are commonly found as starting flows through a moving valve. Similar flows are found the human heart where blood is transported from the left atrium, through the mitral valve, and into the left ventricle. During this process, a vortex is formed around the lip of the moving valve before propagating into the left ventricle. We use numerical simulations to investigate the vortex dynamics of starting flows through an axisymmetric nozzle with time varying exit geometry. Following the experimental work of Dabiri & Gharib (J. Fluid Mech., 2005, vol. 538, pp. 111-136), volumetric flow rate is held constant at the nozzle inlet, while the nozzle is treated as a rigid body with motion independent of fluid forces. We show that nozzle motion affects both vortex formation time and pinch-off time as well as the circulation and energy associated with the leading vortex ring. By parametrically ranging over a variety of prescribed flow rates and exit diameter frequencies, the independent contributions of the nozzle motion to the developing vortex structure are assessed.

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