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Numerical investigation of a vortex ring impinging on a coaxial aperture[1] JIACHENG HU, SEAN D PETERSON, University of Waterloo — Recent advancements in smart materials have sparked an interest in the development of small scale fluidic energy harvesters for powering distributed applications in aquatic environments, where coherent vortex structures are prevalent. Thus, it is crucial to investigate the interaction of viscous vortices in the proximity of a thin plate (a common harvester configuration). Hence, the present study systematically examines the interaction of a vortex ring impinging on an infinitesimally thin wall with a coaxially aligned annular aperture. The rigid aperture serves as an axisymmetric counterpart of the thin plate, and the vortex ring represents a typical coherent vortex structure. The results indicate that the vortex dynamics can be categorized into two regimes based on the aperture to ring radius ratio (Rr). The rebound regime (Rr < 0.9) exhibits the classical unsteady boundary layer interaction in a vortex ring-wall collision. The vortex ring is able to slip past the aperture when Rr ≥ 0.9, and an increase in the vortex ring impulse is observed for $1.0 \leq$ Rr ≤ 1.3 due to fluid entrainment. Furthermore, pressure loadings are also compared to elucidate an optimal energy harvesting strategy in vortex impact configurations.

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