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Bendable ring flapping in a uniform flow[1] BO YOUNG KIM, SOO JAI SHIN, HYUNG JIN SUNG, KAIST — To understand flow-induced flapping motions of bendable objects, we numerically investigate dynamics of a pressurized elastic ring pinned at one point within a uniform flow by using an improved version of the immersed boundary method. The boundary of the ring consists of a flexible filament with bending stiffness, which can be modeled as a linear spring with spring constant k and initial unstretched length. The internal area of the ring is conserved through the penalty method. The flapping motion of the ring is decomposed into two parts: a pitching motion that includes flexible bending motion in the transverse direction, and a tapping motion in the longitudinal direction. For the Reynolds number of 100, resonance is observed at k $\sim$11, where k is normalized by the diameter of the undeformed ring, the speed of the upcoming flow and the fluid density. Across the resonance region, an abrupt jump in terms of the motion amplitudes as well as the hydrodynamic loads is recorded. In our simulation we observe bistable states, one stationary and another oscillatory, that coexist over a range of flow velocities.

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