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Circulation based analysis of an axisymmetric, deformable, jetting-cavity body[1] MICHAEL KRIEG, KAMRAN MOHSENI, University of Florida — Here a methodology for calculating pressure distribution internal to a generic, deformable, axisymmetric, body with an internal cavity region is presented. The pressure distribution is derived by integrating the momentum equation along the axis of symmetry, and then along the cavity boundaries where the velocities are prescribed. Unknown velocity integrals are extracted from the total circulation of characteristic regions, and basic modeling is provided to relate the circulation in these regions to deformation parameters. From the pressure distribution, the total instantaneous jetting force is calculated along with total work required to drive the fluid motion. A prototype jet actuator was designed and tested to determine the circulation in and around the device as well as the actual forces. The total instantaneous forces acting on the actuator are observed to be well modeled by the pressure analysis during both expulsion and refilling phases of the jetting cycle. The functional dependence of total forcing on both jet velocity and acceleration is presented. It was observed that for all phases of the jetting cycle total required work is lower for impulsive velocity programs with fast accelerations than sinusoidal velocity programs with smoother gradual accelerations. Sinusoidal programs result in a peak in pressure (force) at the same instant when the manipulator driving fluid motion is at its maximum velocity; for the impulsive programs these peaks are out of phase and overall energy consumption is reduced.

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