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Interaction of a vortex dipole with a deformable cantilevered plate EUGENE ZIVKOV, SERHIY YARUSEVYCH, SEAN PETERSON, University of Waterloo — The coupled interaction of a vortex dipole impacting the tip of a deformable cantilevered plate is investigated both numerically and experimentally. Numerically, a strongly coupled fluid-structure interaction code is used to simulate the impact at three dipole Reynolds numbers, Re = 500, 1500, and 3000. These Reynolds numbers are representative of flows over small-scale energy harvesting devices, and the plate properties model an ionic polymer-metal composite. Of particular interest is the vortex dynamics and the attendant plate response, with the underlying implications to energy harvesting. As the dipole approaches the plate, secondary vortical structures are generated at the plate, with finer structures present at higher Reynolds number. The dipole breaks up after the initial impact, which is followed by complex vortex interactions of secondary structures. The initial impact produces the largest plate deflection, followed by a more complex response attributed to plate interaction with multiple secondary vortices. The plate response to the initial impact is not strongly dependent upon the Reynolds number. However, the secondary vortex dynamics, and the associated plate loadings, exhibit strong Reynolds number dependence. To validate the numerical results, a similar dipole-plate interaction is modelled experimentally and characterized using flow visualization and time resolved, planar particle image velocimetry.

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