Abstract Submitted
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Optimum Energy Extraction from Coherent Vortex Rings Passing Tangentially Over Flexible Plates[1] ALIREZA PIRNIA, EMILY A. BROWNING, Clarkson Univ, SEAN D. PETERSON, Waterloo Univ, BYRON D. ERATH, Clarkson Univ — Coherent vortical structures can incite self-sustained oscillations in flexible membranes. This concept has recently gained interest for energy extraction from ambient environments. In this study the special case of a vortex ring passing tangentially over a cantilevered flexible plate is investigated. This problem is governed by the Kirchhoff-Love plate equation, which can be expressed in terms of a non-dimensional mass parameter of the plate, non-dimensional pressure loading induced by the vortex ring, and a Strouhal (St) number which expresses the duration of pressure loading relative to the period of plate oscillation. For a plate with a fixed mass parameter immersed in a fluid environment, the St number specifies the beam dynamics and the energy exchange process. The aim of this study is to identify the St number corresponding to maximum energy exchange between plates and vortex rings. The energy exchange process between the vortex ring and the plate is investigated over a range of $0.3 < St < 0.7$ for various non-dimensional mass parameters. Investigations are performed for both discrete and periodic vortex ring loadings, as well as varying vortex ring to plate distances. The optimum value of St number that maximizes energy transfer is reported in each case and an empirical correlation is provided for predictive purposes.

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