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Flow-induced oscillations of non-uniform pipes conveying fluid GARY HAN CHANG, YAHYA MODARRES-SADEGHI, University of Massachusetts, Amherst — We study the influence of non-uniformity in the pipe cross-section and flow velocity on the oscillations of a pipe conveying fluid. A plain pipe conveying fluid loses its stability by buckling or flutter, depending on the pipe's boundary condition and the system parameters. A uniform plain cantilevered pipe loses its stability by a Hopf bifurcation, leading to either planar or non-planar flutter for flow velocities beyond the critical flow velocity. By attaching a spring or an extra mass at the tip of the pipe, secondary instabilities are observed leading to quasiperiodic and chaotic oscillations. In this study, Hamilton's principle is used to derive nonlinear equations of motion for a pipe with non-uniform system properties along its length. The pipe cross-section and material properties as well as its flow velocity can vary along the length. The resulting equations are then solved using the Galerkin technique. The model can be used to study a tapered pipe or a pipe with a sudden change in geometry and also the effect of local stiffening, narrowing, and pressure drop. The effect of continuous external damping can also be considered. It is shown that these non-uniformities can have significant impact on the observed instabilities.

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