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The Flow Dynamics of the Garden-Hose Instability FANGFANG XIE, XIAONING ZHENG, MICHAEL TRIANTAFYLLOU, Massachusetts Institute of Technology, YIANNIS CONSTANTINIDES, Chevron Energy Technology Company, GEORGE KARNIADAKIS, Brown University — We present for first time full simulations of flow-structure interactions in a flexible pipe conveying incompressible fluid. We show that the Reynolds number plays a significant role in the onset of flutter in a fluid-conveying pipe under similar boundary conditions as for the classic garden-hose problem. We investigate the complex interaction between structural and fluid dynamics and obtain a phase diagram of dynamic transition between states as a function of two non-dimensional parameters, the fluid-tension parameter, and the Reynolds number. We observe that the precise flow patterns inside the pipe determine the type of induced motion. For unsteady flow, symmetry along one direction leads to in-plane motion whereas breaking of the flow symmetry results in out-of-plane motion. Above a critical Reynolds number, as the pipe vibrates, complex flow patterns result as there is continuous generation of new vorticity due to pipe wall acceleration, which is subsequently shed in the confined space of the pipe interior.

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