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Rich Dynamic Behaviors of Self-excited Oscillation of Collapsible Channel[1] QIUXIANG HUANG, FANG-BAO TIAN, JOHN YOUNG, JOSEPH C. S. LAI, The University of New South Wales, FLOW SCIENCE LAB TEAM — Fluid-structure interaction (FSI) in collapsible channel flow is numerically studied with an immersed boundary-lattice Boltzmann method. Compared with previous studies, current method is able to simulate nonlinear fully coupled FSI in two-sided collapsible channel and high Reynolds numbers flow (Re up to 2000). The stability of the hydrodynamic flow and collapsible channel walls are examined for a wide range of Reynolds numbers, structure-to-fluid mass ratio, external pressure and wall thickness. Based on the numerical simulations, we (i) explore the physical mechanisms responsible for the onset of self-excited oscillations, and (ii) characterise the chaotic behavior of the collapsible channel walls. Rich dynamic behaviors of self-excited oscillation are observed. Regarding point (i), we identify that the flow bifurcate to bistable mode at Re=320 due to the symmetry breaking as the increase of Reynolds number. Besides, the external pressure applied on the elastic beams plays an important role in triggering the self-excited oscillation of the beam. And then for point (ii), the existence of chaotic behavior of the collapsible channel walls is confirmed by a very positive dominant Lyapunove exponent and the chaotic attractor in the velocity-displacement phase portrait.

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