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Stability and bifurcation of a freely-rotating discontinuity in a symmetrically driven square cavity GONGQIANG HE, FTN Associates, Ltd., Baton Rouge, LA, 70808, CHENGUANG ZHANG, Massachusetts Institute of Technology, KRISHNASWAMY NANDAKUMAR, Louisiana State University, & The Energy Research Institute, Jinan, PRC — Using a direct-forcing immersed boundary method at fully resolved grid resolutions, we study the interaction between the fluid in a symmetrically driven square cavity (i.e., top and bottom lids sliding at identical velocity), and the response of a rectangular block inside. The block is made thin enough to approximate an ideal discontinuity; it is fixed at the cavity center but can freely rotate. We scanned up to moderate Reynolds numbers using different block length L, and a phase diagram (Re, L) is created. For a fixed Reynolds number, a short block stabilizes at the vertical orientation (theta = 90 degree). As the block becomes longer, the vertical orientation losses stability and bifurcates into a pair of new stable orientations that are symmetric regarding the vertical direction. The critical lengths for different Reynolds numbers are found, and the reason for the loss of stability is explained by energy argument and analysis of the flow patterns.

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