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Experimental investigation of the elastic flag spontaneous flapping in water flow YONGXIA JIA, LICHAO JIA, ZHUANG SU, YIDING ZHU, HUIJING YUAN, CUNBIAO LEE, Peking Univ — The flapping stability and the response of a thin two-dimensional flag of low bending rigidity to the Reynolds number was investigated. The three relevant non-dimensional parameters governing fluid-structure problems that concern the interaction of elastic flags with high-speed fluid flows are the structure-to-fluid mass ratio, the non-dimensional bending rigidity and the Reynolds number. To study the mechanisms of the transition from the periodic flapping to chaotic flapping, we use PIV and flow visualization techniques to obtain the whole flow field around the midspan of the immersed elastic flag interacting with fluid in both periodic and chaotic states. A moving interface detection technique is used to determine the flag position and velocity. Virtual particle images are imposed in the flag region in the PIV algorithm, of which the displacements are evaluated by the flag movement. We find that the value of St is constrained in the narrow range of $0.2 < \mathrm{St} < 0.31$ based on the flapping amplitude.We find that the transition to chaos occurs at a critical Reynolds number $\mathrm{Re} = 60800$. For the larger Reynolds number, the high-strength vortices are distributed in a detached region away from the free end of the flag during the intermittent snapping events in the chaotic regime.

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