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Dynamics and instabilities of an arbitrarily clamped elastic sheet in potential flow SHAI B. ELBAZ, NETHANEL CHEN, AMIR D. GAT, Technion - Israel Institute of Technology — Shape-morphing airfoils have attracted much attention in recent years. They offer substantial drag reduction by comparison to conventional airfoils and a premise of superior aerodynamic performance. In the current work, we model a shape-morphing airfoil as two, rear and front, Euler-Bernoulli beams connected to a rigid support. The setup is contained within a uniform potential flow field and the aerodynamic loads are modelled by thin airfoil theory. The aim is to study the dynamics and stability of such soft shape-morphing configurations and specifically the modes of interaction between the front and rear airfoil segments. Initially we present several steady-state solutions which are validated by numerical calculations based on commercially available software. We then examine stability and transient dynamics by assuming small deflections and applying multiple-scale analysis to obtain a stability condition. The condition is attained via the compatibility equations of the orthogonal spatial modes of the first-order correction. The results yield the maximal stable speed as a function of elastic damping, fluid density and location of clamping. The results show that the interaction between the front and rear segments is the dominant mechanism for instability for various discrete locations of clamping.

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