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**Aeroelastic Mode Transition in Self-Induced Vibration of Flexible Membrane Wings** GUOJUN LI, BOO CHEONG KHOO, Mechanical Engineering, National University of Singapore, RAJEEV JAIMAN, Mechanical Engineering, University of British Columbia — Strong fluid-structure coupling of the unsteady flow with a flexible membrane wing excites intertwined aeroelastic modes, thus forming the complex self-excited vibration characteristics. Using fully-resolved numerical simulations, the unsteady coupled dynamics and the aeroelastic mode transition phenomenon are examined as a function of Reynolds number and mass ratio for a 3D flexible membrane wing. To gain further insight into the aeroelastic mode transition, we adopt an effective global mode decomposition method to isolate the frequency-ranked dominant aeroelastic modes from the nonlinear coupled fluid-membrane fields. The contribution of each mode to the overall membrane responses is quantitatively calculated with the aid of the proposed mode decomposition method. Based on the aeroelastic modal analysis, we discover that the dominant aeroelastic modes are strongly influenced by mass ratio and Reynolds number. We propose an interaction cycle to establish a direct connection between the unsteady flow features and the membrane vibrations. As the change of mass ratio and Reynolds number, the original mode synchronization process is interrupted, and then the aeroelastic mode transition is triggered to form a new mode synchronization state.

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