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Bifurcations and Chaos in the Fluid-Structure Interaction Dynamics of a Dipteran Flight Motor CHHOTE LAL SHAH[1], DIPANJAN MAJUMDAR[2], SUNETRA SARKAR[3], Indian Institute of Technology Madras (IITM) — The flapping dynamics of a Dipteran flight motor have been studied numerically by using a discrete forcing type Immersed Boundary Method (IBM) based in-house fluid-structure interaction (FSI) solver at a Reynolds number of 100. A bifurcation study has been performed considering the amplitude of the wing actuation force as the control parameter. At lower values of the bifurcation parameters, the wake structures and the aerodynamic loads are similar to that of a rigid foil under the sinusoidal plunge. Further increment in the bifurcation parameter results in multiple harmonic frequencies in the structural response, which results in unequal speeds between the up and down strokes of the wing. Consequently, an asymmetric flow-field is obtained, which is also reflected in the aerodynamic loads. Eventually, the system response exhibits chaos at even higher values of the bifurcation parameter. Interesting dynamical behaviors such as quasi-periodicity, transient chaos, and intermittent transitions between chaotic and quasi-periodic states have also been observed. This study will help in understanding the physics during the transition in Dipteran flight, which can be crucial in developing the futuristic flapping-wing micro air vehicles.

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