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Numerical study of insect free hovering flight DI WU, KHOON SENG YEO, TEE TAI LIM, National University of Singapore, FLUID LAB, MECHANICAL ENGINEERING, NATIONAL UNIVERSITY OF SINGAPORE TEAM — In this paper we present the computational fluid dynamics study of three-dimensional flow field around a free hovering fruit fly integrated with unsteady FSI analysis and the adaptive flight control system for the first time. The FSI model being specified for fruitfly hovering is achieved by coupling a structural problem based on Newton's second law with a rigorous CFD solver concerning generalized finite difference method. In contrast to the previous hovering flight research, the wing motion employed here is not acquired from experimental data but governed by our proposed control systems. Two types of hovering control strategies i.e. stroke plane adjustment mode and paddling mode are explored, capable of generating the fixed body position and orientation characteristic of hovering flight. Hovering flight associated with multiple wing kinematics and body orientations are shown as well, indicating the means by which fruitfly actually maintains hovering may have considerable freedom and therefore might be influenced by many other factors beyond the physical and aerodynamic requirements. Additionally, both the near- and far-field flow and vortex structure agree well with the results from other researchers, demonstrating the reliability of our current model.

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