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Stabilization control of a hovering model insect: lateral motion

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Abstract Our previous study shows that the lateral disturbance motion of a model drone fly does not have inherent stability (passive stability), because of the existence of an unstable divergence mode. But drone flies are observed to fly stably. Constantly active control must be applied to stabilize the flight. In this study, we investigate the lateral stabilization control of the model drone fly. The method of computational fluid dynamics is used to compute the lateral control derivatives and the techniques of eigenvalue and eigenvector analysis and modal decomposition are used for solving the equations of motion. Controllability analysis shows that although inherently unstable, the lateral disturbance motion is controllable. By feeding back the state variables (i.e. lateral translation velocity, yaw rate, roll rate and roll angle, which can be measured by the sensory system of the insect) to produce anti-symmetrical changes in stroke amplitude and/or in angle of attack between the left and right wings, the motion can be stabilized, explaining why the drone flies can fly stably even if the flight is passively unstable.

Keywords:

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