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Aerodynamic stability analysis of the dual-wing flapping flight for the large birds TENGYU HOU, School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai, 200240, China, YANG XIANG, HONG LIU, J. C. Wu Center for Aerodynamics, School of Aeronautics and Astronautics, Shanghai Jiao Tong University, Shanghai, 200240, China — By dual-wing flapping, large birds obtain lift and thrust to sustain flight. Insects obtain good maneuverability and dynamic stability through high frequency flap. The airliners show good performance based on the principle of steady aerodynamics. Different from the two examples before, birds have a lower flapping frequency to maintain their stability for forward flight. Through the observation of bird flap behavior and human speculation, we can easily generate the idea that the bird's flap can show stability only within a certain range of flapping frequency. In this article, we model birds based on a quasi-steady mathematical model, and observe the stability of the mathematical model by applying different perturbation excitations to the model. The results of theoretical analysis show that for a given parameter model, it is possible to maintain stable flight only within a certain range of flapping frequency. Moreover, we find that the model can resist disturbances of different degree in different frequency ranges. Then, we compare the dual-wing to the single-wing model. Our work shows that the flight stability of birds and the flapping frequency are closely related, which may provide effective theoretical guidance for the design of flapping wing air vehicles.

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