Implicit Fluid-Structure Interaction Analysis using Realistic Structural Modeling for Insect-like Flapping Wing

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ABSTRACT

Recent advance in MAVs having biomimetic wing, i.e., flapping wing MAVs, has led to greater attention being paid to the interaction between the structural dynamics of the wing and its aerodynamics, both of which are closely related to the performance of the wing. In this paper, FSI analysis for the flapping wing is developed. For structural analysis, nonlinear finite elements based on the co-rotational formulation is developed. Multi-components approach using three-dimensional beam and shell elements is then developed in order to consider a realistic insect-like flexible wing. And computational fluid dynamics based on three-dimensional preconditioned Navier-Stokes equation is employed for the FSI analysis. To couple the fluid and structural solvers, implicit coupling scheme is used. Finally, FSI analysis for the three-dimensional realistic insect-like wing configuration is accomplished. In this procedure, it is found that the present structural analysis shows improved efficiency and reliable accuracy. Then, various physical characteristics induced by the flexible flapping wing are demonstrated by using the present FSI analysis.

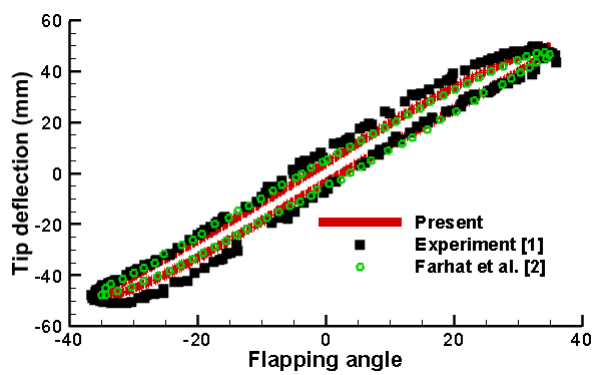

Figure 1: Comparison of the present result with the experimental observation and the previous numerical results regarding the tip response of Zimmerman wing

REFERENCES

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