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TRAJECTORY AND DEFORMATION COUPLING CALCULATION MODEL FOR PLANE MOTION OF A SLENDER BODY

Abstract

The plane motion of a slender body is large displacement and small deformation motion containing rigid displacement and elastic deformation, but trajectory and deformation of the slender body is traditionally calculated by Kineto-elastodynamic method in which the coupling of trajectory and deformation is neglected. In this paper, a trajectory and deformation coupling calculation model is established based on the theory of multibody dynamics. Firstly, aircraft structure is simplified to unrestrained and axisymmetric slender body. For the plane motion of this body, integral differential dynamic equations are derived by floating frame method. Secondly, the slender body is divided using Euler beam elements, and dynamic equations are established with nodal displacement as the independent variable. Then, the model is verified by comparing nodal position and body attitude numerical results computed by applying load which will cause translation and rotation motion with that results computed with centroid movement theorem and the momentum theorem. Finally, the effect of the rigid flexible coupling term in the calculation of trajectory and deformation is discussed and the scope of application of the decoupling method is presented.