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Nonlinear Modelling and Analysis of Piezoelectric Smart Thin-Walled Structures in Supersonic Flow

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Abstract : Thin-walled structures are used more and more widely in modern aircrafts and some other structures in aerospace field nowadays. Accompanied by the wider applications, the vibration of the structures has been a bigger problem. Because of the direct and converse piezoelectric effect, piezoelectric materials combined to host thin-walled structures, named as piezoelectric smart structures, can be an effective way to suppress the vibration. So, an accurate model for piezoelectric thin-walled structures in air flow is necessary and important. In our recent work, an electromechanical coupling nonlinear aerodynamic finite element model of piezoelectric smart thin-walled structures is built based on the Reissner-Mindlin plate theory and first-order piston theory for aerodynamic pressure of supersonic flow. Von Kármán type nonlinearity is considered in the present model. Finally, the model is validated by experimental and numerical results from the literature, which can describe the vibration of the structures in supersonic flow precisely.

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