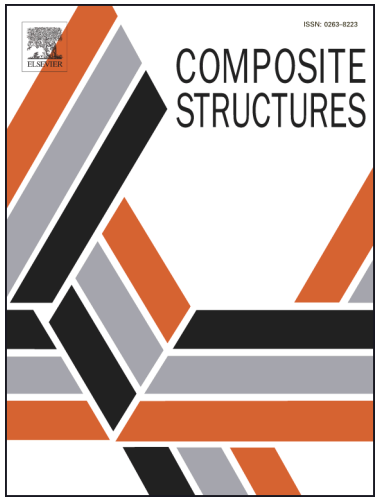

Time to Flutter Theory for Viscoelastic Composite Aircraft Wings

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Time to Flutter Theory for Viscoelastic Composite Aircraft Wings

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Abstract

Many general aviation aircraft and commercial aviation aircraft are manufactured from high-polymer composite materials. The increasing use of polymer composite materials adds a time dimension to existing flutter analyses of an aircraft wing. Polymer composites exhibit viscoelastic material behaviors such as energy dissipation and a memory effect that influence the physical response of a wing. The proposed theory, derived from Lyapunov stability principles, predicts the time component of flutter, and provides a set of conditions for viscoelastic structural instabilities in general. The addition of the load history in the stability analysis of a structure is a significant change compared to elastic materials, and no standards exist for assessing the lifetime stability of a viscoelastic structure. Rigorous comparisons to the Goland wing, wings with and without stores, and a flying wing illustrate the practical applications of the theory during aircraft design. Further, the theory predicts the time to flutter of each wing for a range of representative viscoelastic materials and flow conditions. The existence and prediction of the time to flutter is the key, original contribution of the theory because no other method is