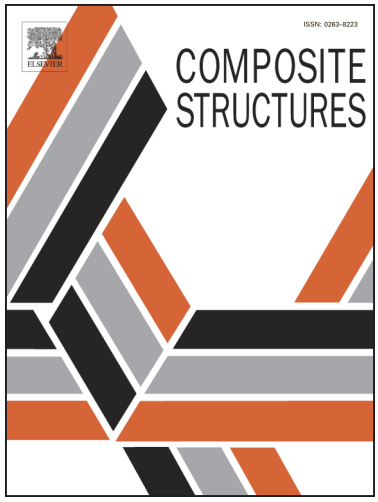

A novel dynamic aeroelastic framework for aeroelastic tailoring and structural optimisation

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A novel dynamic aeroelastic framework for aeroelastic tailoring and structural optimisation[☆]

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Abstract

Driven by a need to improve the efficiency of aircraft and reduce the fuel consumption, composite materials are applied extensively in the design of aircraft. A dynamic aeroelastic framework for the conceptual design of a generic composite wing structure is presented. The wing is discretized in several spanwise sections, where each section has a number of laminates throughout the cross-section, each having their own stiffness and thickness. The model uses a geometrically nonlinear beam model linearized around the nonlinear static aeroelastic equilibrium position coupled to a continuous-time state-space unsteady aerodynamic model to obtain the dynamic aeroelastic response, making the model suitable for dynamic aeroelastic analysis of generic aircraft wings under the assumption of small disturbances with respect to the static aeroelastic equilibrium position. Two optimisations are run for a generic aircraft wing under manoeuvre load conditions and aeroelastic, structural, and aerodynamic constraints: one, a quasi-isotropic wing to serve as a reference solution and two, a fully tailored wing clearly showing the benefit of aeroelastic tailoring and the use of the present framework for conceptual wing design.

Keywords:

Aeroelasticity, Aeroelastic tailoring, Structural optimisation

Nomenclature

$\mathbf{a}$	=	Laminate in-plane compliance matrix (m^2/N)
E	=	Young's modulus (GPa)
E_{11}	=	Longitudinal modulus (GPa)
E_{22}	=	Transverse modulus (GPa)

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