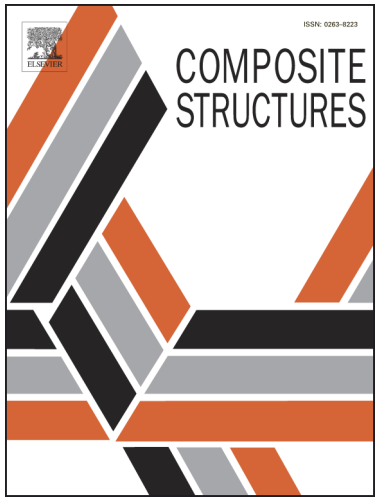

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Geometrically nonlinear thermomechanical analysis of moderately thick functionally graded plates using a local Petrov-Galerkin approach with moving Kriging interpolation

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Abstract

A meshless local Petrov-Galerkin approach based on the moving Kriging interpolation technique is developed for geometric nonlinear thermoelastic analysis of functionally graded plates in thermal environments (prescribed a temperature gradient or heat flux). The Kriging interpolation method makes the constructed shape functions possess Kronecker delta function property and thus special techniques for enforcing essential boundary conditions are avoided. In the thermal analysis, the dependency of thermal conductivity of functionally graded materials on temperature is involved, which gives rise to a nonlinear PDE. The nonlinear formulation of large deflection of the functionally graded plates is based on the first-order shear deformation plate theory in the von Kármán sense by taking small strains and moderate rotations into account. The incremental form of nonlinear equations is obtained by Taylor series expansion and the tangent stiffness matrix is explicitly developed in two different ways within the framework of the local meshless method. The nonlinear solutions are computed using the Newton-Raphson iteration method. Parametric and convergence studies are conducted to examine the stability of the proposed method and then several selected numerical examples are presented to demonstrate the accuracy and effectiveness of the method for nonlinear bending problems of functionally graded plates in thermal environments.

Key words: Geometrically nonlinear analysis, thermoelastic, von Kármán strains, Kriging interpolation, Meshless local Petrov-Galerkin (MLPG), Functionally graded plates, Newton-Raphson method, temperature-dependent thermal conductivity.