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Optimization of Functionally Graded Materials with Temperature Dependent Properties. A Meshfree Solution

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In many applications, such as thermal protection shields or medical implants, the thermo-mechanical loading conditions are non-uniform and complex. The goal of this work is to numerically determine optimal material gradation of the FGM under such conditions. We take into account temperature-dependent material properties for the metal and the ceramic components. We consider points on the volume fraction curve as the design variables. We use a shape-preserving spline to interpolate through these points. The material composition at each point is determined by the spline function. For the local effective properties of the FGM we use the rule of mixtures and the Mori-Tanaka model. We minimize the mass while stresses are used as constraints. The solutions to the nonlinear thermo-elastic problems are obtained using a meshfree method that adds versatility. The design space of material configurations is unrestricted and we study convergence properties when the number of design variables increases.

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