Shape Optimization of the Thermoelastic Body Under Thermal Uncertainties

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We consider shape optimization problems in the framework of the thermoelasticity model under uncertainties on the input parameters in Robin's condition in the heat conduction equation. The purpose of considering this model is to account for thermal residual stresses or thermal deformations, which in case of high environmental temperature may hinder the mechanical properties of the final design. Then, the presence of uncertainty in the external temperature especially must be taken into account to ensure the correct manufacturing process and device performance. The presented theory applies to the minimization of the volume under constraints on the expectation of the the L^2-norm of the von Mises stress. We show that the robust constraints and its gradient are completely determined by low order moments of the random input. We derive a deterministic algorithm based on low-rank approximation and level-set method for the numerical solution and present model cases in shape optimization.

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