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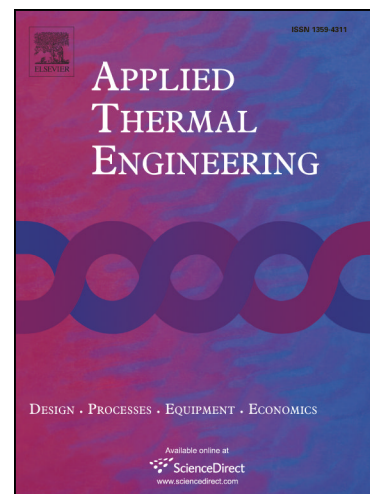
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Inverse analysis for simultaneously estimating multi-parameters of  
temperature-dependent thermal conductivities of an Inconel in a reusable metallic  
thermal protection system

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**Abstract**

Metallic materials such as an Inconel and an alloy steel play very important roles for bearing in the reusable metallic thermal protection system (TPS) for a hypersonic aircraft. Accurate determination of temperature-dependent thermal conductivities of these metallic materials is a key issue for both design and optimization of the TPS, which determines transient temperature field and further thermal stress distribution. However, it is very difficult to directly measure these temperature-dependent thermal conductivities with high temperatures, or analytically calculate them. Inverse problems provide new insights for accurately determining temperature-dependent thermal conductivities of these materials with high service temperatures, by using additional temperature measurements. In the present work, multi-parameters of temperature-dependent thermal conductivities of an Inconel in a reusable metallic TPS are simultaneously estimated by solving a transient nonlinear inverse heat conduction problem (IHCP). The Levenberg-Marquardt (LM) algorithm, the conjugate gradient method (CGM) and the Least-squares (LS) method are employed for the solution. The accuracy, the efficiency, the robustness and the convergence stability of these three methods for estimating temperature-dependent thermal conductivities of the Inconel are investigated in detail. A relaxation factor is introduced into a LM algorithm for the first time, attributed to which the convergence stability of the LM algorithm is improved.

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