Asociación Argentina de Mecánica Computacional

Mecánica Computacional Vol XXXI, págs. 3291-3291 (resumen)
Alberto Cardona, Paul H. Kohan, Ricardo D. Quinteros, Mario A. Storti (Eds.)
Salta, Argentina, 13-16 Noviembre 2012

ERROR ESTIMATION IN THE INVERSE HEAT CONDUCTION PROBLEM APPLIED TO THE SIMULATION OF HEAT TREATMENT

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Abstract. Computational models are used more frequently each day in academia and industry, as they help to understand and visualize how they develop different forms of heat transfer in conjunction with the microstructural changes in heat treatment processes. In this way, through simulation of the process, it can be known how will be the temperature distribution on the workpiece under study, as well as other material properties such as hardness, allowing in turn at a later stage to assess deformations and residual stresses of the process.

The inverse heat conduction problem has been studied in a large amount of works in recent years. The optimization of the unknown boundary conditions from the identification of process parameters have been widely investigated. However and paradoxically, the literature on the estimation of errors in this problem is not numerous. In this sense, Beck and Arnold present in their book Parameter estimation in engineering and science a general comparison of some methods, we propose to analyze in the heat conduction problem.

A reliable evaluation of the cooling power of quenchants is relevant for the computer simulation of heat treating processes. A heat flux or heat transfer coefficient is used as the boundary condition to simulate the cooling process of the workpieces, so accurate values must be provided. In this work, a comparison of the performance of different optimization algorithms (Gauss-Newton, Box-Kanemasu, Levenberg-Marquardt Methods) to estimate the heat transfer coefficients (HTC) implemented in HT-Mod software is presented and confidence intervals of the estimates are also provided.