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Prediction of the Thermal Parameters of a High-Temperature Metallurgical Reactor Using Inverse Heat Transfer

Authors : Mohamed Hafid, Marcel Lacroix

Abstract : This study presents an inverse analysis for predicting the thermal conductivities and the heat flux of a high-temperature metallurgical reactor simultaneously. Once these thermal parameters are predicted, the time-varying thickness of the protective phase-change bank that covers the inside surface of the brick walls of a metallurgical reactor can be calculated. The enthalpy method is used to solve the melting/solidification process of the protective bank. The inverse model rests on the Levenberg-Marquardt Method (LMM) combined with the Broyden method (BM). A statistical analysis for the thermal parameter estimation is carried out. The effect of the position of the temperature sensors, total number of measurements and measurement noise on the accuracy of inverse predictions is investigated. Recommendations are made concerning the location of temperature sensors.

Keywords : inverse heat transfer, phase change, metallurgical reactor, Levenberg–Marquardt method, Broyden method, bank thickness
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