Inverse problems in Engineering and practice (99-AM)

Poster

verbal

I. LANGHANS, R. DA SILVA, J. DUMOULIN, A. TROMBE, R. JAVELAS

Laboratoire d'Etudes Thermiques et Mécaniques
INSa - Complexe Scientifique de Rangueil - 31077 Toulouse cedex - FRANCE
Tel : 5 61 55 99 10 - Fax : 5 61 55 99 00 - E mail : trombe@insa-tlse.fr

Abstract

The authors present here the development of an inverse method used to determine the total heat transfer distribution along a vertical heated flat plate, in steady state. Subtracting the local contribution of the radiative heat flux from the total heat flux drives to the identification of the average convective heat flux density, at different heights of the plate.

After a numerical validation based on the use of well-known analytical solution of heat transfer problems, a specific enclosure was built to realize an experimental validation. This validation was made in steady state and for laminar natural convection. The different surfaces of this enclosure present high emissivity coefficients, similar to those ones we can found in houses. The quantity and the position of the temperature sensors in the plate were calculated by using Monte-Carlo simulations.

Then, for several temperature of the plate we make a comparison between the results got from the inverse method and those using thermocouple to investigate the temperature distribution in the boundary layer. Furthermore, we also compare our results to related pre-published materials.

In conclusion, we observe that the inverse method delivers notable satisfactory results for the total heat flux density distribution and for the determination of the surface temperature. Nonetheless, as we calculate the convective heat flux by subtracting the radiative heat transfer from the global one, it adds uncertainty and does not take into account the coupling of those two phenomena. So, when the convective heat flux fall to small values, the uncertainty is rising.