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INVERSE HEAT TRANSFER PROBLEM FOR THE RECTANGULAR DOMAIN[1]

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For practical purposes, e.g. in the building industry, the knowledge of the thermal properties of materials is of great interest. As it is infeasible to directly measure these quantities, they have to be determined by the measurement of related quantities and solving an inverse problem. Measurements can be executed by the Transient Hot Strip (THS), Transient Hot Wire or the Transient Plane source (TPS) methods.

In [1] a transient hot-strip method has been developed for the simultaneously measuring the thermal conductivity and the thermal diffusivity of solids and fluids with low electrical conductivity. The hot strip (the thin metal foil) is used both as a constant plane heat source and a sensor of the temperature increase. By supplying a constant current to the metal strip the output of power is very nearly constant, and by monitoring the subsequent voltage increase over a short period of time after the start of the experiment, it is possible to get precise information on the thermal transport properties of the material surrounding the heat source. In [2] the general theory of the transient plane source (TPS) technique is outlines in some details with approximations for the two experimental arrangements that may be referred to as "hot square" and "hot disk". In [3] the resulting parameter identification was solved in two ways. On the one hand,in idealized case, an analytical approximation of the solution heat conduction equation is used. On the other hand, for more general cases, a new non-linear identification algorithm based on FEM-solution of the heat conduction equation is introduced. In [4] the analytical solution with additional conditions is proposed.

This paper deals with several mathematical three-dimensional formulation of the THS, TPS methods for the different situations: general case with three heat conducting equations with insulating layer, simplified in z direction problem and problem without insulating layer. Problems are reduced to the two-dimension systems and to the systems with non-classical boundary conditions. The main idea of this paper - to find weaker conditions.

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