Saldanha da Gama, Rogério Martins
Existence, uniqueness and construction of the solution of the energy transfer problem in a rigid and nonconvex black body. (English) Zbl 0742.73005

The paper deals with the problem of steady heat conduction of a rigid, radiating black body. The radiation is by the well-known Stefan-Boltzmann law. The body is assumed to be nonconvex so that there exists a direct radiant energy exchange between the points on the boundary of the body. The heat conduction in the body is governed by a linear partial differential equation generated by Fourier’s law. The boundary condition is represented by a nonlinear integro-differential operator acting on the temperature at the boundary whose kernel depends on the shape of the body and vanishes for convex bodies. It is shown by employing a variational principle that the solution for a nonconvex body is obtainable through a Cauchy sequence of solutions obtained by omitting radiant energy transfer. However, on evaluating the $i - 1$st element of the sequence the $i$th element plays the part of a source term due to the nonconvexity of the body. By using some results of functional analysis it is proved that the sequence is convergent and there exists a unique limit function. Hence the author provides an iterative scheme for solving such problems.

Reviewer: E.S. Suhubi (İstanbul)

MSC:
74A15 Thermodynamics in solid mechanics
74S30 Other numerical methods in solid mechanics (MSC2010)
74P10 Optimization of other properties in solid mechanics
35Q72 Other PDE from mechanics (MSC2000)
35K05 Heat equation

Keywords:
radiative heat transfer; existence and uniqueness of physical solution; Stefan-Boltzmann law; linear partial differential equation; Fourier’s law; nonlinear integro-differential operator; variational principle; Cauchy sequence of solutions

Full Text: DOI

References:

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