

HEAT TRANSFER IN SEMITRANSSPARENT MATERIALS, AN ADAPTIVE FINITE ELEMENT APPROACH

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ABSTRACT Simplified P_N (SP_N) approximations to the equation of radiative heat transfer are derived for optically thick materials. The SP_N approximations are obtained by an asymptotic analysis, while the boundary conditions are derived from variational arguments. They offer the possibility to higher order approximations to the radiative transfer model within a system of partial differential equations. The variational structure of these equations is used for a finite element discretization. Furthermore a posteriori error indicators are used for an adaptive finite element method for the SP_N approximations. The method is validated one- and two-dimensional situations and applied to study the influence of internal radiation on the solid-liquid interface in semitransparent materials in a three-dimensional setting.