COMPUTATIONAL EFFICIENCY OF THE FINITE ELEMENT METHOD BASED ON THE SECOND-ORDER RADIATIVE TRANSFER EQUATION

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ABSTRACT. The second-order radiative transfer equation (SORTE) [Numerical Heat Transfer B, Vol. 51, pp. 391-409, 2007] is in a form like diffusion equation, hence no additional artificial diffusion or upwinding treatment is needed in the numerical discretization for stabilization. The computational efficiency of the finite element method based on SORTE is investigated by comparison with that of the finite element methods based on original first order radiative transfer equation (FORTE). The FORTE based finite element methods considered are the finite element method with Galerkin approach (Galerkin-FORTE) and the finite element method with least-square approach (LS-FORTE). By comparison, the accuracy of the finite element method based on the SORTE is generally better than those based on the FORTE under the same discretization scheme, spatial grid and angular grid. The finite element method based on the SORTE shows the best computational efficiency among the three finite element methods, i.e., to obtain the same target accuracy, the least computational time is required.