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Solving the Nonlinear Heat Conduction in a Spherical Coordinate with Electrical Simulation

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Abstract : Numerical approach based on the electrical simulation method is proposed to solve a nonlinear transient heat conduction problem with nonlinear boundary for a spherical body. This problem represents a strong nonlinearity in both the governing equation for temperature dependent thermal property and the boundary condition for combined convective and radiative cooling. By analysing the equivalent electrical model using the electrical circuit simulation program HSPICE, transient temperature and heat flux distributions at sphere can be obtained easily and fast. The solutions clearly illustrate the effect of the radiation-conduction parameter Nrc, the Biot number and the linear coefficient of temperature dependent conductivity and heat capacity. On comparing the results with corresponding numerical solutions, the accuracy and efficiency of this computational method are found to be good.

Keywords : convective and radiative boundary, electrical simulation method, nonlinear heat conduction, spherical coordinate
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