THERMAL ANALYSIS OF A CONVECTIVE-RADIATIVE FIN WITH TEMPERATURE-DEPENDENT PROPERTIES BY THE COLLOCATION SPECTRAL METHOD

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ABSTRACT

In this study, our aim is to demonstrate the applicability of the collocation spectral method (CSM) to solve the nonlinear heat transfer problem in a convective-radiative fin. In this fin, temperature dependent internal heat transfer, thermal conductivity, heat transfer coefficient and surface emissivity are considered. The spatial profile of fin temperature is discretized with spectral collocation points and Chebyshev polynomials. Accordingly, the differential form of the energy equation is transformed to a matrix form of algebraic equation. To validate the CSM model, results are compared with the analytical solution in literature. It is found that the CSM is a very simple and effective approach for a rapid assessment of nonlinear physical problems, and the node convergence rate of the CSM approximately follows an exponential law. In addition, effects of thermal conductivity, heat transfer coefficient, surface emissivity, convection-conduction parameter, radiation-conduction parameter, and dimensionless ambient temperature on the fin temperature and the fin efficiency are comprehensively analyzed.