A CONSISTENT APPROACH FOR SIMULATING NATURAL CONVECTION WITH RADIATIVE HEAT TRANSFER IN PARTICIPATING MEDIA

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ABSTRACT. Computation of natural convection combined with radiative heat transfer with incompressibility consideration suffers from a drawback of relatively inaccurate results especially at large temperature difference. The present work proposes a unified solver which is capable of handling wide range of temperature difference for simulation of natural convection with radiation in participating medium. The compressibility effects arising due to large temperature difference are considered by applying a low Mach number formulation combined with a pressure based approach. The algorithms are validated with natural convection problem considering radiation. The two algorithms discussed in the current work are distinguished as discretely consistent and discretely conservative; where in the former solves the temperature using the equation of state and there by introducing numerical energy conservation error, while the latter computes the temperature by solving the energy conservation equation discretely. Numerical study shows that discrete conservative algorithm is discretely consistent for closed thermodynamic systems, hence depicting the supremacy over discretely consistent algorithm for solving natural convection with radiation in closed domain.