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Radiative Heat Transfer and Turbulence-Radiation Interactions in a Heavy-Duty Diesel Engine[1] C PAUL, A. SIRCAR, S FERREYRO, A IMREN, D.C. HAWORTH, Penn State, S. ROY, W. GE, M.F. MODEST, U.C. Merced — Radiation in piston engines has received relatively little attention to date. Recently, it is being revisited in light of current trends towards higher operating pressures and higher levels of exhaust-gas recirculation, both of which enhance molecular gas radiation. Advanced high-efficiency engines also are expected to function closer to the limits of stable operation, where even small perturbations to the energy balance can have a large influence on system behavior. Here several different spectral radiation property models and radiative transfer equation (RTE) solvers have been implemented in an OpenFOAM-based engine CFD code, and simulations have been performed for a heavy-duty diesel engine. Differences in computed temperature fields, NO and soot levels, and wall heat transfer rates are shown for different combinations of spectral models and RTE solvers. The relative importance of molecular gas radiation versus soot radiation is examined. And the influence of turbulence-radiation interactions is determined by comparing results obtained using local mean values of composition and temperature to compute radiative emission and absorption with those obtained using a particle-based transported probability density function method.

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