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Diagnosis of turbulence radiation interactions in turbulent premixed flames under high-pressure and high-Ka conditions BIFEN WU, XINYU ZHAO[1], University of Connecticut — Predicting thermal radiation is crucial for prediction of wall heat transfer for aeronautical combustors. Intense turbulent fluctuations result in strong fluctuations of temperature and composition, which leads to highly nonlinear behavior in the radiative source terms that is conventionally referred to as to turbulence-radiation interactions (TRI). An a priori study of the TRI is performed using datasets from Direct Numerical Simulation (DNS) of strongly turbulent premixed n-dodecane/air flames with three Karlovitz numbers (Ka) ranging from 100 to 10000, under pressurized conditions that are relevant for engine operations. Here, a line-by-line database derived from HITEMP2010 and HITRAN2008 is employed to calculate the radiative properties of radiative species. The database is extrapolated to high-pressure conditions using the Voigt profile. The influence of various interactions in the radiative emission source term is investigated and their impact is evaluated in the context of large eddy simulations (LES) through explicit filtering with different filter sizes. Sub-grid scale TRI models of different fidelities, such as no-TRI, partially-TRI, are assessed. Different levels of soot volume fractions are also artificially introduced to investigate the influence of soot on TRI.

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