DISCRETE VS CONTINUUM LEVEL SIMULATION OF RADIATIVE TRANSFER IN SEMITRANSPARENT TWO-PHASE MEDIA

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ABSTRACT

The rigorous mathematical formulation of the continuum approach to radiative transfer modeling in two-phase semi-transparent media is numerically validated by comparing radiative fluxes computed for selected types of media using (*i*) direct, discrete-scale and (*ii*) continuum-scale approaches. The analysis is limited to media with the individual phases in the range of geometrical optics. The discrete-scale approach uses Monte Carlo ray tracing applied directly to tomography derived geometry information. The continuum-scale approach is based on rigorously derived continuum-scale radiative transfer equations, incorporating rigorously derived definitions of radiative properties, and employs Monte Carlo ray-tracing. The model media investigated are reticulate porous ceramics and packed beds of semitransparent calcium carbonate particles. Continuum-scale scattering coefficients, and scattering phase functions are presented. Discrete-scale and continuum-scale simulations agree well, within the limits imposed by finite sample size. The continuum-scale approach leads to massive savings in computational time as compared to the discrete-scale approach, and thus is suited to treat radiative transfer problems in two-phase media in a wide range of engineering applications.