Hindawi Publishing Corporation
Mathematical Problems in Engineering
Volume 2015, Article ID 827042, 2 pages
http://dx.doi.org/10.1155/2015/827042

Editorial

Numerical Simulation of Radiative Transfer

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Received 10 March 2015; Accepted 10 March 2015

Radiative transfer is an important or a dominant mode of energy transport in the nature and many applications such as light propagation through a turbulent atmosphere or biological tissue, heat transfer in high-temperature participating media, combustion process, neutron transport, optical tomography, laser interaction with matter, energy transport in plasma, and stellar atmospheres. In most cases, it is very difficult to obtain analytical solutions of radiative transfer, and numerical simulation is becoming a powerful tool in the study of radiative transfer.

This special issue will publish research in the following aspects.

(1) Numerical Methods for Radiative Transfer. A reproducing kernel particle method is developed for radiative heat transfer in 1D participating media; a dynamic region Monte Carlo method (DRMC) is proposed to simulate radiative heat transfer, and by DRMC the computing time and storage capacity under the same solution precision for radiative transfer in optically thick medium are reduced obviously; in zonal method the reduced integration scheme (RIS) is further extended to calculate direct exchange areas (DEAs) of a 3D rectangular system with nonscattering media, and by RIS the singularities of DEAs can be decomposed and weakened obviously.

(2) Inverse Problems of Radiative Transfer. A maximum a posteriori (MAP) estimation based on Bayesian framework is applied to image reconstruction of two-dimensional highly scattering inhomogeneous medium, and the finite difference method and conjugate gradient algorithm are served as the forward and inverse solving schemes; the standard particle swarm optimization, the stochastic particle swarm optimization, and the hybrid differential evolution-particle swarm optimization are applied to solve the inverse transient radiation problem in 2D turbid media irradiated by the short pulse laser, and the time-resolved radiative signals simulated by finite volume method are regarded as input data for the inverse analysis.

(3) Infrared Optical Property of Particles. Numerical simulation research is carried out on the infrared radiation characteristics of diffused coal dust in fully mechanized working faces based on the optical monitoring problem of dust particles in mine atmospheric environments; the CFD method is applied to obtain the law of dust transport and distribution in typical fully mechanized working face, and the optical constants of coal particles are determined according to their metamorphic degree.

(4) Coupled Nongray-Gas Radiation and Convection. The effects of nongray-gas radiation on double diffusive convection are analyzed, in a square differentially heated cavity filled with air-CO_2 mixtures, when the buoyancy forces are cooperating or opposing. The radiative source term in the energy equation is evaluated by the discrete ordinate

method for solving the radiative transfer equation and the SLW spectral model for real radiative properties of absorbing species.

(5) The Influence of Aerosol on the Atmospheric Radiation. A numerical investigation for the influence of aerosol on the atmospheric radiation transfer is conducted. Based on P_N-approximation model of atmospheric radiation transfer, the effects of species, concentration, and height distribution of aerosols on atmosphere radiation are examined.

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