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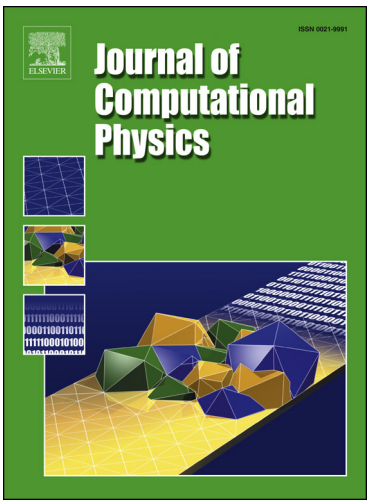

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AN IMPROVED RANDOM WALK ALGORITHM FOR THE IMPLICIT MONTE CARLO METHOD

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Abstract

In this work, we introduce a modified Implicit Monte Carlo (IMC) Random Walk (RW) algorithm, which increases simulation efficiency for multigroup radiative transfer problems with strongly frequency-dependent opacities.

To date, the RW method has only been implemented in "fully-gray" form; that is, the multigroup IMC opacities are group-collapsed over the full frequency domain of the problem to obtain a gray diffusion problem for RW. This formulation works well for problems with large spatial cells and/or opacities that are weakly dependent on frequency; however, the efficiency of the RW method degrades when the spatial cells are thin or the opacities are a strong function of frequency.

To address this inefficiency, we introduce a RW frequency group cutoff in each spatial cell, which divides the frequency domain into optically thick and optically thin components. In the modified algorithm, opacities for the RW diffusion problem are obtained by group-collapsing IMC opacities below the frequency group cutoff. Particles with frequencies above the cutoff are transported via standard IMC, while particles below the cutoff are eligible for RW. This greatly increases the total number of RW steps taken per IMC time-step, which in turn improves the efficiency of the simulation. We refer to this new method as Partially-Gray Random Walk (PGRW).

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