A LINEAR STABILITY ANALYSIS FOR NONLINEAR, 1-D, GRAY IMPLICIT MONTE CARLO CALCULATIONS

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We present a new linear stability analysis of a commonly-used time-discretization and Monte Carlo interpretation of the nonlinear, 1-D, gray thermal radiative transfer (TRT) equations. Using a spatial Fourier analysis of the Implicit Monte Carlo (IMC) equations that are linearized about an equilibrium solution, we show that the IMC equations are unconditionally stable (undamped perturbations do not exist) if α, the IMC time-discretization parameter, satisfies $0.5 \leq \alpha \leq 1$. However, we also show that for sufficiently large time steps, unphysical damped oscillations can exist, and that these correspond to the lowest-frequency Fourier modes. Our stability theory provides new conditions on the time step to guarantee monotonicity of the solution. Also, we test and confirm the predictive capability of the theory with a series of numerical IMC experiments.