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Efficient Electromagnetic Fourier Basis Particle Simulation MATTHEW MITCHELL, MATTHEW MIECNIKOWSKI, GREG BEYLKIN, SCOTT PARKER, University of Colorado, Boulder — The standard particle-in-cell algorithm suffers from grid heating and numerical instabilities. There exists a gridless alternative which bypasses the deposition step and calculates each Fourier mode of the charge and current densities directly from the particle positions. We show that a gridless method can be computed efficiently through the use of an Unequally Spaced Fast Fourier Transform (USFFT) algorithm. After a spectral field solve, the forces on the particles are calculated via the inverse USFFT (a rapid solution of an approximate linear system). We provide an implementation of this algorithm in one spatial and two velocity dimensions with an asymptotic runtime of $O(N_p + N_m^D \log N_m^D)$ for each iteration, identical to the standard PIC algorithm (where N_p is the number of particles, N_m is the number of Fourier modes, and D is the spatial dimensionality of the problem). We demonstrate superior energy conservation and reduced noise, as well as convergence of the energy conservation at small time steps.

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