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Numerical stability of pseudo-spectral PIC code generalizations[1]

BRENDAN B. GODFREY, University of Maryland, JEAN-LUC VAY, Lawrence Berkeley National Laboratory — Laser Plasma Accelerator (LPA) particle-in-cell (PIC) simulations are computationally demanding, because they require beam transport over times and distances long compared with the natural scales of the acceleration mechanism and because they are prone to numerical instabilities. To provide greater flexibility in LPA PIC simulations, we have generalized the Pseudo-Spectral Time Domain (PSTD) algorithm to accommodate arbitrary order spatial derivative approximations and substantially longer time steps. Here, we show that, by extending approaches developed by us for other PIC algorithms, numerical Cherenkov instabilities can be suppressed for the generalized PSTD algorithm. We also illustrate the relationships between the generalized PSTD and other PIC algorithms, such as Finite Difference Time Domain (FDTD) and Pseudo-Spectral Analytical Time Domain (PSATD) algorithms. Background information can be found at http://hifweb.lbl.gov/public/BLAST/Godfrey/.

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