Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

On the Numerical Dispersion of the Electromagnetic Particle-In-Cell Code: Finite Grid Instability M.D. MEYERS, Los Alamos National Laboratory, University of California Los Angeles, C.-K. HUANG, Y. ZENG, S. YI, B.J. ALBRIGHT, Los Alamos National Laboratory — The widely used Particle-In-Cell (PIC) method in relativistic particle beam and laser plasma modeling is subject to numerical instabilities that can render unphysical simulation results or even destroy the simulation. For electromagnetic relativistic beam and plasma modeling, the most relevant numerical instabilities are the finite grid instability and the numerical Cherenkov instability. We rigorously derive the faithful 3D PIC numerical dispersion relation, and specialize to the Yee FDTD scheme. The manner in which the PIC algorithm updates and samples the fields and distribution function, along with any temporal and spatial phase factors, is accounted for. Numerical solutions to the 1D dispersion relation are obtained for parameters of interest. We investigate how the finite grid instability arises from the interaction of the numerical modes admitted in the system and their aliases. The most significant interaction is due critically to the correct placement of the operators in the dispersion relation. We obtain a simple analytic expression for the peak growth rates due to these interactions.

Michael Meyers
Univ. of California - LA

Date submitted: 11 Jul 2014 Electronic form version 1.4