DEVELOPMENT OF A PARALLEL FINITE ELEMENT PARTICLE-IN-CELL CODE

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Abstract

While electromagnetic field solvers have long progressed from structured to unstructured grids for superior resolution of geometric surfaces, almost all existing Particle-In-Cell (PIC) codes still employ the finite difference (FD) method based on structured grids. More recently, parallel implementations have allowed FD PIC codes to further reduce the mesh size for improved field accuracy, albeit at great computational cost. Under the DOE SciDAC program, SLAC has embarked on the development of a parallel PIC code that is formulated self consistently on the finite element (FE) grid. It uses higher-order basis functions for field representation and quadratic approximation of the boundaries. We will report on the progress of a 2D implementation, the comparison with FD PIC codes in efficiency and accuracy, and its application to the LCLS RF gun for which the effects of space charge and wakefields can be accurately computed for the first time. Parallelization strategies and the extension to the fully 3D case will be discussed.

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