HIGH-PERFORMANCE SELF-CONSISTENT ELECTROMAGNETIC MODELING OF BEAMS

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Abstract

This talk will review some of the recent advances of electromagnetic modeling with the inclusion of charged particles, as is important for beam physics and plasma physics. Important advances include methods for accurately treating boundaries for accelerator cavities, beam pipes, etc.; increasing the maximum stable time step; and algorithms that work well on parallel architectures. Higher-order algorithms with good properties are also of interest. Early cut-cell approaches failed to result in a symmetric linear system and, as a result, can be weakly damped or unstable. Later cut-cell approaches were shown to be symmetric, but they suffered from a reduction of the stable time step. Now available are cut-cell methods that can accurately model curvilinear boundaries with no reduction in stable time step. With Richardson extrapolation, these methods can give frequencies accurate to 1 part in 10^6 with less than 100 cells in each direction. The use of these new algorithms in VORPAL,* a flexible, object-oriented, massively parallel modeling application, will be presented. VORPAL has been used for a number of applications** involving the self-consistent interaction of charged particles with electromagnetic fields. Finally, we will discuss the needs for improvements to self-consistent EM modeling.

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