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An Electromagnetic Particle-In-Cell Framework with Cut-Cells and Unstructured Mesh Regions[1] COLLIN MEIERBACHTOL, ANDREW GREENWOOD, Air Force Research Laboratory, JOHN VERBONCOEUR, ANDREW CHRISTLIEB, Michigan State University — Many electromagnetic particle-in-cell (EM-PIC) simulations are solved on Cartesian meshes, where curved or slanted metallic boundaries are approximated via staircasing. As a result, numerical errors are introduced in both the field and particle behaviors. Cut-cells inserted near these irregular metallic boundaries can eliminate staircasing, but have difficulty in resolving small geometric features. Unstructured meshes can successfully resolve irregular boundaries and small features via local mesh refinement, but can also increase simulation run time. In order to achieve good geometric representation while minimally increasing the simulation run time, we propose a hybrid mesh EM-PIC framework. The simulation domain is mostly filled with a Cartesian mesh. Slanted or large radius metallic boundaries are represented via cut-cells, while the mesh surrounding any small physical features is unstructured. Electromagnetic fields are updated via explicit finite difference methods in both the Cartesian and cut-cells, and finite element methods within any unstructured mesh regions. Particle positions are updated and tracked throughout the hybrid mesh.

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