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Improving Performance and Extending Simulation Domain of hPIC Particle-In-Cell Code by Incorporating PUMI Based Non-uniform Mesh[1] MD FAZLUL HUQ, University of Illinois at Urbana-Champaign, VIGNESH VITTAL-SRINIVASARAGAVAN, ONKAR SAHNI, MARK SHEPHARD, Rensselaer Polytechnic Institute, DAVIDE CURRELI, University of Illinois at Urbana-Champaign — To resolve large gradients in the plasma sheath region, the mesh of the hPIC Particle-In-Cell code has been modified from a classical uniform mesh to a non-uniform block-structured implicit mesh using the Parallel Unstructured Mesh Infrastructure (PUMI) library. The implicit nature allows to define a mesh with a minimal number of parameters and to generate all mesh quantities on-the-fly. The algorithm allows to split the entire domain into a number of submeshes either of uniform or boundary layer type. A boundary layer submesh employs a geometric gradation in element size starting from one side. The performance measurement of the multi-block PUMI mesh incorporated in hPIC has been done for different domain sizes and mesh configurations. For a small domain size of 500 Debye lengths, a speed-up of up to 16 times with respect to a uniform grid is achieved, maintaining the global error on the solution at about 1%. For a large plasma domain (1.5 m), a speed-up of more than 100 times is achieved with respect to the uniform grid. This demonstrates the ability, thanks to the non-uniform mesh, of simulating a large plasma domain (meters long) at fusion relevant conditions with a finite-orbit PIC in a reasonable computational time.

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