

Sparse grid reconstructions for Particle-In-Cells methods

Thursday, December 15, 2022 2:45 PM (45 minutes)

Based on a mixed discretization (composed of mesh and particles) of the Vlasov-Maxwell system, Particle-In-Cell (PIC) methods are among the most successful models for the simulation of kinetic plasmas. Including simplicity, ease of parallelization and robustness,

PIC schemes still contain a main drawback with the statistical error associated to the particle noise, depending on the average number of particle per cell and leading to a complexity that grows exponentially with the dimension. Though the idea of sparse grids has been studied extensively in applied mathematics for years, Particle-In-Cell's application of the method is only at its beginnings. The use of sparse grids in the Particle-In-Cell method, through the so-called combination technique where a function is approximated on different coarser grids, allows to reduce the particle noise, thanks to the larger cells of the grids, and thus reduces the high run times of simulation.

In this presentation, we first introduce sparse grid reconstructions within PIC methods and discuss some convergence and conservation properties. Then, the performance of the method, as well as its parallelization on both shared memory architecture systems and GPUs for 3d-3v simulations are presented.

Presenter: GUILLET, Clément