Variable time step symplectic integrators for PIC applications

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There are good reasons for using variable time steps to improve the accuracy of particle integrators for PIC codes while preserving the positive aspects of symplectic integration schemes such as leapfrog (Verlet). With a reasonable error estimator, it is possible to choose time steps that minimize the total error along an orbit (equidistribution). Several authors have investigated variable time step integrators for schemes such as leapfrog or Crank-Nicolson, which are symplectic for fixed time steps. The results have been disappointing. Even for bona-fide symplectic schemes with $h = h(t)$ there can be problems, and we have identified these as involving parametric instabilities between the time step oscillation and the particle motion. We describe two different approaches for obtaining symplectic integration schemes with $h = h(x(t), v(t))$, and test their effectiveness for various systems. We also discuss their implementation in PIC codes.

5. Numerical Methods & High Performance Computing.

Poster preferred