

Abstract Submitted
for the GEC15 Meeting of
The American Physical Society

Verification of particle-in-cell simulations against exact solutions of kinetic equations¹ MILES TURNER, Dublin City University — Demonstrating correctness of computer simulations (or verification) has become a matter of increasing concern in recent years. The strongest type of verification is a demonstration that the simulation converges to an exact solution of the mathematical model that is supposed to be solved. Of course, this is possible only if such an exact solution is available. In this paper, we are interested in kinetic simulation using the particle-in-cell method, and consequently a relevant exact solution must be a solution of a kinetic equation. While we know of no such solutions that exercise all the features of a typical particle-in-cell simulation, in this paper we show that the mathematical literature contains several such solutions that involve a large fraction of the functionality of such a code, and which collectively exercise essentially all of the code functionality. These solutions include the plane diode, the neutron criticality problem, and the calculation of ion energy distribution functions in oscillating fields. In each of these cases, we can show the the particle-in-cell simulation converges to the exact solution in the expected way. These demonstrations are strong evidence of correct implementation.

¹Work supported by Science Foundation Ireland under grant 08/SRC/I1411

Miles Turner
Dublin City University

Date submitted: 19 Jun 2015

Electronic form version 1.4