Exploiting Parallelism on Shared Memory in the QED Particle-in-Cell Code PICADOR with Greedy Load Balancing

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State-of-the-art numerical simulations of laser plasma by means of the Particle-in-Cell method are often extremely computationally intensive. Therefore there is a growing need for development of approaches for efficient utilization of resources of modern supercomputers. In this paper, we address the problem of a substantially non-uniform and dynamically varying distribution of macroparticles in a computational area in simulating quantum electrodynamic (QED) cascades. We propose and evaluate a load balancing scheme for shared memory systems, which allows subdividing individual cells of the computational domain into work portions with subsequent dynamic distribution of these portions between OpenMP threads. Computational experiments on 1D, 2D, and 3D QED simulations show that the proposed scheme outperforms the previously developed standard and custom schemes in the PICADOR code by 2.1 to 10 times when employing several Intel Cascade Lake CPUs.

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