



iPIC3d Performance Assessment Summary

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Analysis of iPIC3D executions on a single compute node identified major load imbalance issues in the two main computational kernels resulting in low parallel efficiency which would inhibit scalability. Alternate versions employing OpenMP tasks and MPI_THREAD_MULTIPLE had significantly worse performance.

iPIC3D execution is dominated by two computational kernels, and in each the majority of time is spent in an OpenMP parallel for loop. While these OpenMP loops are relatively well balanced within MPI processes, between processes there are significant imbalances. The most time-consuming kernel shows a three-fold computation imbalance between two sets of processes, whereas the second kernel computation imbalance is 1.5-fold between different sets of processes. Output using MPI parallel file writing accounted for 7% of execution time.

iPIC3D is an implicit Particle-in-Cell code for space weather applications, simulating the interaction of solar wind and storms with the Earth's magnetosphere. In the INTERTWinE project the original C++ code using MPI (primarily non-blocking point-to-point communication) was hybridised with OpenMP including tasks and using MPI_THREAD_MULTIPLE.

A full technical report can be found at

https://pop-coe.eu/sites/default/files/pop_files/pop-ar-ipic3d.pdf

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