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SMILEI, an open source PIC code with focus on load balancing issues

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SMILEI stands for Simulating Matter Irradiated by Light at Extreme Intensities. It is a new open source Particle In Cell (PIC) code, developed jointly by physicists and HPC experts in order to make sure that it performs well on the newest supercomputers architectures. State of the art algorithms are implemented and innovative ones are developed.

Recent simulation campaigns of laser wakefield electron acceleration, showed that, performance-wise, the most urgent concern is to find a way to face the strong load imbalance that arises on very large full 3D simulations. The hybrid MPI-openMP typical implementation performs quite well on systems with a couple hundreds of cores. But the accessible number of openMP threads is limited and, as the number of MPI processes increases, this relatively small number of threads is not able to balance the load anymore. Imbalance issues come back, wasting our precious computation time again. Hence the need for an efficient dynamic load balancing algorithm.

The algorithm we present is based on the division of each MPI domain into many smaller, so called, patches. These patches are used as sorting structures and can be exchanged between MPI processes in order to balance the computational load.

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