

CUDA PIC/MCC implementation in Julia programming language

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This paper presents an original implementation of a Particle-in-Cell (PIC) solver with Monte Carlo Collisions (MCC), fully parallelized on CUDA GPUs and developed entirely in the Julia programming language. By leveraging Julia's capability to write CUDA kernels natively, this implementation effectively addresses the "two-language problem" commonly encountered in high-performance computing. The solver's accuracy was validated using the well-established M. M. Turner's benchmark for capacitively coupled discharges, ensuring the reliability of the results. Performance comparisons against both a sequential CPU version and a state-of-the-art CUDA C implementation reveal that, while the Julia-based solver achieves substantial speedup over the CPU counterpart, it currently falls short of the performance levels attained by the most optimized CUDA C implementations. Further refinements and optimizations are necessary to reach this approach's potential fully.

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