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Parallelization of LSODE in PIES Using NVIDIA's CUDA Architecture for GPGPU PAUL THOMPSON, Western Michigan University, STEPHANE ETHIER, Princeton Plasma Physics Lab — The Princeton Iterative Equilibrium Solver (PIES) is a powerful tool for computing three dimensional MHD equilibria, without making assumptions about the form of the magnetic field. Part of its strength comes from its ability to handle equilibria with islands and stochastic regions. However, a high-resolution PIES calculation often takes several hours to complete, spending most of its time in the Livermore Solver for Ordinary Differential Equations (LSODE) to follow field-line trajectories. This work examines the feasibility of speeding up these calculations by taking advantage of the parallel computing resources of programmable Graphic Processor Units (GPUs). To this end, the LSODA variant version of LSODE is converted to NVIDIA's C for CUDA application programming interface and tested against its original Fortran version on an NVIDIA Tesla Cluster. Run times are compared between the serial and parallel versions, with special attention given to different scaling options. The new code is also analyzed for bottlenecks and opportunities for additional speedups, with the ultimate goal of developing a PIES-based MHD solver capable of running between experimental shots.

Paul Thompson
Western Michigan University

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