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2.47 High-Speed Visible Image Diagnostics System for Real-time Plasma Boundary Reconstruction of EAST Tokamak

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Fast plasma boundary reconstruction is usually used for real-time control of tokamak plasma. In EAST experiment, the time consuming for boundary reconstruction should be within 1ms to meet the need of real-time control. Fast evolution of cameras in recent years has made them promising tools for diagnostics of Tokamak. The solution presented in this paper consists of a prototype of high-speed visible image acquisition and processing system(HVIAPs) dedicated for EAST tokamak shape and position control. Using the compute unified device architecture (CUDA) framework, a GPU and FPGA based parallel algorithm for plasma boundary reconstruction with visible imaging diagnostics is developed. Compared to the reconstruction of EFIT, the average error is 1.5cm. In particular, the parallelization of the visible image plasma boundary reconstruction for the NVIDIA Quadro GP100 can complete calculation within 0.3ms, achieving the speedup of 14 and 90 for an image size of 544×680, when compared with parallel C with OpenMP extensions and parallel MATLAB. Furthermore, when the camera sensor is not saturated, the algorithm is robust for different intensities of the plasma discharge image.

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