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Design of GPU-based Parallel Computation Architecture of Thomson Scattering Diagnostic in KSTAR

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Thomson Scattering (TS) System is a diagnostic system to measure electron temperature and density profiles of tokamak plasma. TS Data Acquisition (DAQ) system converts analog optic signals to digital data in order to calculate the profiles. In this poster, we propose a design of architecture for GPU-based parallel computation to accelerate the diagnostic calculation with a large amount of TS raw data (1024 data per channel * 140 channels). First, we applied the machine learning technique of artificial neural network to the calculation of the electron temperature profile which established method had been the χ-square test by referencing lookup table of the calibrated data. The learned neural networks can maintain accuracy of the outputs as well as their computation time can be significantly reduced. Second, we implemented the learned neural networks on the GPU-based parallel computation architecture. Each point of output values on the profile can be independently calculated by the corresponding neural network; thus, the parallel computation for each neural network is appropriate. Furthermore, we integrated the GPU-based parallel computation architecture into EPICS which has been the main framework of control and DAQ systems in KSTAR. The TS diagnostic data with the proposed architecture can be used for an online streaming services during plasma shot operation as well as development of a plasma feedback control algorithm.

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