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Real-time plasma electron density feedback control system based on FPGA on J-TEXT

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The J-TEXT newly deployed three-wave polarimeter-interferometer system provides a better time and spatial resolution of the plasma electronic density than the old HCN interferometer system. The plasma electronic density feedback control system is implemented on the already existing polarimeter-interferometer DAQ system which is based on FlexRIO FPGA. This DAQ system is able to acquire 16 channels of intermediate frequency signal from the polarimeter-interferometer diagnostic at 120 MS/s rate. Another FlexRIO board with an output module is added to implement the feedback control algorithm and feed the output to the piezoelectric crystal valve. The density feedback control system is able to extract the phase shift information from the intermedia frequency signal using FFT, calculate density of multiple channels and output control signal to the piezoelectric crystal valve in real-time. NI P2P technology is used to transfer processed data from a FlexRIO board to another in real-time without using the CPU. This assures the required deterministic performance. The control system is fully implemented on FlexRIO FPGA and does not affect the original function of the polarimeter-interferometer DAQ system. This system is also able to calculate density profile for future plasma control system.

Keywords: polarimeter-interferometer, density feedback control, phase shift detection, FlexRIO, LabVIEW FPGA, fusion, J-TEXT tokamak

Primary author: Dr ZHENG, Wei (Huazhong University of Science and Technology)

Co-authors: Mr HU, Feiran (Huazhong University of Science and Technology); Prof. ZHUANG, Ge (Huazhong University of Science and Technology); Prof. ZHANG, Ming (Huazhong University of Science and Technology); Mr YUAN, Tao (Huazhong University of Science and Technology); Ms ZHAO, Xueqing (Huazhong University of Science and Technology); Mr LIU, Yang (Huazhong University of Science and Technology); Prof. PAN, Yuan (Huazhong University of Science and Technology)

Presenter: Dr ZHENG, Wei (Huazhong University of Science and Technology)

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