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Real-time resonant magnetic perturbations feedback control system for tearing mode suppression on J-TEXT

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Tearing Modes (TMs) degrade the performance of tokamak plasma, and can even lead to disruption. Using externally exerted resonant magnetic perturbations (RMP) to suppress tearing mode is a promising and effective way. In order to suppress 2/1 tearing mode, 2/1 rotating RMP applied in given phase region to stabilize magnetic island and accelerate island rotation. The RMP feedback control system acquires 15-channels Mirnov poloidal signals, processes the acquired data and calculates the phase in real-time; outputs RMP power supply control signal by comparing with the given phase to drive RMP coil. The feedback control system is based on NI C-RIO and mainly using LabVIEW to develop. The typical 2/1 mode magnetic island on J-TEXT rotates at a frequency from 2 KHz to 10 KHz. To ensure the control precision within 2 degrees, the control period must be within 500 ns. Due to acquired signals are noisy, the feedback control system uses a series of error correction methods in real-time to obtain accurate phase. The feedback control system also need to control the output waveform duty cycle to protect the pulse power supply. The system has been set up on J-TEXT tokamak and has given a good result.

Keywords: Tearing mode suppression, RMP, feedback control, C-RIO, LabVIEW FPGA, fusion, J-TEXT tokamak

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