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8.43 Real-time Dispersion Interferometry for Density Feedback in Fusion Devices

Tuesday, 17 April 2018 16:01 (120)

Interferometry as one of the most common core fusion diagnostics has traditionally suffered from incomplete vibration compensation. Dispersion interferometry promises a more complete compensation of vibrations. For this reason it is being employed in an increasing number of experiments. However, thus far none of them have shown reliable real-time low-latency processing of dispersion interferometry data. Nonetheless this is a necessity for most machines when trying to do density feedback control, most notably in long discharges like the ones planned at the W7-X stellarator and ITER. In this paper we report the development of a new phase extraction method specifically developed for real-time evaluation using FPGAs. It has been shown to operate reliably during the OP1.2a operation phase at W7-X and is now routinely being used by the W7-X density feedback system up to very high densities above $1.4e20 \ 1/m^2$ without 2π -wraps. During the development of the method new insights into the signal composition of a dispersion interferometer have been gained leading to a new signal calibration relevant to other phase evaluation methods.

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