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Real-time Stability Analysis for Disruption Avoidance in ITER[1]
ALEXANDER GLASSER, EGEMEN KOLEMEN, Princeton Plasma Physics Laboratory, ALAN GLASSER, Fusion Theory and Computation, Inc. — ITER is intended to operate at plasma parameters approaching the frontier of achievable stability limits. And yet, plasma disruptions at ITER must be kept to a bare minimum to avoid damage to its plasma-facing structures. These competing goals necessitate real-time plasma stability analysis and feedback control at ITER. This work aims to develop a mechanism for real-time analysis of a large and virulent class of disruptions driven by the rapid growth of ideal MHD unstable modes in tokamak equilibria. Such modes will be identified by a parallelized, low-latency implementation of A.H. Glasser's well-tested DCON (Direct Criterion of Newcomb) code, which measures the energetics of modes in the bulk plasma fluid, as well as M.S. Chance's VACUUM code, which measures the same in the vacuum between the plasma and tokamak chamber wall. Parallelization of these codes is intended to achieve a time-savings of 40x, thereby reducing latency to a timescale of order 100ms and making the codes viable for ideal MHD stability control at ITER. The hardware used to achieve this parallelization will be an Intel Xeon Phi server with 77 cores (308 threads).

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