Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Real-time error field control via rotation optimization in DIII-D
M. CAPELLA, UCSD, M.J. LANCTOT, GA — DIII-D experiments have demonstrated a new approach to tokamak error field control based on maximizing the toroidal angular momentum. The technique uses extremum seeking control theory to optimize the error field in real time without inducing instabilities. Slowly-rotating n=1 fields (the dither), generated by non-axisymmetric coils, are used to perturb the angular momentum, monitored in real-time using a charge-exchange spectroscopy diagnostic. Signal processing of the rotation measurements is used to extract information about the rotation gradient with respect to the control coil currents in order to identify the control currents that minimize the relevant error fields. Previous results show the algorithm identifies the optimal control currents during a single plasma discharge; however, the timescale for convergence projects poorly to devices with seconds long angular momentum confinement times. Here, we report on the development of parameter estimation methods which, when used in conjunction with extremum seeking, allow improved algorithm performance.

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Date submitted: 19 Jul 2015 Electronic form version 1.4