Abstract Submitted
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Performance Assessment of Model-Based Optimal Feedforward and Feedback Current Profile Control in NSTX-U using the TRANSP Code[1] Z. ILHAN, W.P. WEHNER, E. SCHUSTER, Lehigh University, M.D. BOYER, D.A. GATES, S. GERHARDT, J. MENARD, PPPL — Active control of the toroidal current density profile is crucial to achieve and maintain high-performance, MHD-stable plasma operation in NSTX-U. A first-principles-driven, control-oriented model describing the temporal evolution of the current profile has been proposed earlier by combining the magnetic diffusion equation with empirical correlations obtained at NSTX-U for the electron density, electron temperature, and non-inductive current drives. A feedforward + feedback control scheme for the regulation of the current profile is constructed by embedding the proposed nonlinear, physics-based model into the control design process. Firstly, nonlinear optimization techniques are used to design feedforward actuator trajectories that steer the plasma to a desired operating state with the objective of supporting the traditional trial-and-error experimental process of advanced scenario planning. Secondly, a feedback control algorithm to track a desired current profile evolution is developed with the goal of adding robustness to the overall control scheme. The effectiveness of the combined feedforward + feedback control algorithm for current profile regulation is tested in predictive simulations carried out in TRANSP.

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