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Nonlinear Control and Online Optimization of the Burn Condition in ITER[1] EUGENIO SCHUSTER, Lehigh University, MARK D. BOYER, Lehigh University/Princeton Plasma Physics Laboratory, ANDRES PAJARES-MARTINEZ, Lehigh University — Regulation of the fusion power through modulation of fueling, external heating sources and non-axisymmetric magnetic fields, referred to as burn control, is one of the fundamental problems in burning plasma research. Active control will be essential for achieving and maintaining desired operating points, responding to changing power demands, and ensuring stable operation in ITER. A volume-averaged nonlinear model for the evolutions of the density of energy, deuterium and tritium fuel ions, alpha-particles, and impurity ions has been used to synthesize a multi-variable nonlinear burn control strategy that can reject large perturbations and move between operating points. The control approach makes use of the different possible actuators for altering the fusion power, including auxiliary heating sources, isotopic fueling, in-vessel coils, and impurity injection. Adaptive control techniques are used to account for uncertainty in model parameters, including particle confinement times and recycling rates. Furthermore, a model-based constrained optimization scheme is proposed to drive the system as close as possible to desired fusion power and temperature references.

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