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Nonlinear Adaptive Burn Control in ITER Based on Two-Temperature Response Model[1] VINCENT GRABER, EUGENIO SCHUSTER, Lehigh University — By using robust burn control approaches, ITER will be the first reactor capable of confining plasmas with reactivities suitable for energy production. An adaptive nonlinear control scheme that employs planned actuators for ITER is synthesized from a 0-D plasma model with uncertain parameters. Because the temperature of the ions and electrons could differentiate significantly in ITER, the model considers separate ion and electron temperature response models. The control scheme relies on neutral beam injection (NBI) for the bulk of the plasma heating. Electron and ion cyclotron heating are exploited to independently regulate the electron and ion temperatures, respectively. The dynamics of fast NBI beam ions and fusion alpha particles are modeled by including state-dependent thermalization delays and fractional heating to the ions and electrons. The dynamics of the pellet injector, used for density control, is modeled as flight-delayed pellets that are discretely deposited into the plasma. The model contains uncertainty in the particle recycling from the walls, confinement properties, and the heating shared between the ions and electrons. The adaptive control scheme successfully stabilizes the system despite the various time delays, actuator dynamics, and model uncertainties.

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