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Nonlinear Burn Control and Operating Point Optimization in ITER[1] MARK BOYER, EUGENIO SCHUSTER, Lehigh University — Control of the fusion power through regulation of the plasma density and temperature will be essential for achieving and maintaining desired operating points in fusion reactors and burning plasma experiments like ITER. In this work, a volume averaged model for the evolution of the density of energy, deuterium and tritium fuel ions, alpha-particles, and impurity ions is used to synthesize a multi-input multi-output nonlinear feedback controller for stabilizing and modulating the burn condition. Adaptive control techniques are used to account for uncertainty in model parameters, including particle confinement times and recycling rates. The control approach makes use of the different possible methods for altering the fusion power, including adjusting the temperature through auxiliary heating, modulating the density and isotopic mix through fueling, and altering the impurity density through impurity injection. Furthermore, a model-based optimization scheme is proposed to drive the system as close as possible to desired fusion power and temperature references. Constraints are considered in the optimization scheme to ensure that, for example, density and beta limits are avoided, and that optimal operation is achieved even when actuators reach saturation.

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