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Model Predictive Control Design for q-profile Shaping in EAST<sup>1</sup> ZIBO WANG, HEXIANG WANG, EUGENIO SCHUSTER, Lehigh University, YAO HUANG, ZHENGPING LUO, QIPING YUAN, BINGJIA XIAO, Institute of Plasma Physics, Chinese Academy of Sciences, DAVID HUMPHREYS, General Atomics — Extensive studies have shown that control capabilities for shaping the spatial profile of the toroidal current density, or equivalently the safety factor qor the gradient of the poloidal magnetic flux, are essential for achieving advanced modes of operation, which are characterized by confinement improvement and possible steady-state operation. In this work, a model predictive control (MPC) design approach has been followed to further develop such control capabilities at EAST. A first-principles-driven, control-oriented model for the poloidal magnetic-flux profile evolution is used to design the MPC controller, which has the capability of simultaneously regulating the q profile and the plasma stored energy W by controlling the plasma current Ip and the individual powers of four neutral beam injectors (NBI1L, NBI1R, NBI2L, NBI2R) and two lower hybrid wave sources (2.45 GHz, 4.60 GHz). Nonlinear simulations show that the controller can effectively regulate the q profile and W. The proposed control law has been implemented in the recently developed Profile Control category in the EAST Plasma Control System (PCS) with the ultimate goal of testing them experimentally. Both simulation and experiment results will be reported to assess the effectiveness of the proposed control capability.

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