Accessibility and Reproducibility of Stable High-$q_{min}$ Steady-State Scenarios by $q$-profile+$\beta_N$ Model Predictive Control\textsuperscript{1} E. SCHUSTER, W. WEHNER, Lehigh University, C.T. HOLCOMB, B. VICTOR, LLNL, J.R. FERRON, T.C. LUCE, General Atomics — The capability of combined $q$-profile and $\beta_N$ control to enable access to and repeatability of steady-state scenarios for $q_{min} > 1.4$ discharges has been assessed in DIII-D experiments. To steer the plasma to the desired state, model predictive control (MPC) of both the $q$-profile and $\beta_N$ numerically solves successive optimization problems in real time over a receding time horizon by exploiting efficient quadratic programming techniques. A key advantage of this control approach is that it allows for explicit incorporation of state/input constraints to prevent the controller from driving the plasma outside of stability/performance limits and obtain, as closely as possible, steady state conditions. The enabler of this feedback-control approach is a control-oriented model capturing the dominant physics of the $q$-profile and $\beta_N$ responses to the available actuators. Experiments suggest that control-oriented model-based scenario planning in combination with MPC can play a crucial role in exploring stability limits of scenarios of interest.

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