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Advanced Plasma Shape Control to Enable High-Performance Divertor Operation on NSTX–U[1] PATRICK VAIL, EGEMEN KOLEMEN, Princeton University, MARK BOYER, Princeton Plasma Physics Laboratory, ANDERS WELANDER, General Atomics — This work presents the development of an advanced framework for control of the global plasma shape and its application to a variety of shape control challenges on NSTX–U. Operations in high-performance plasma scenarios will require highly-accurate and robust control of the plasma poloidal shape to accomplish such tasks as obtaining the strong-shaping required for the avoidance of MHD instabilities and mitigating heat flux through regulation of the divertor magnetic geometry. The new control system employs a high-fidelity model of the toroidal current dynamics in NSTX–U poloidal field coils and conducting structures as well as a first-principles driven calculation of the axisymmetric plasma response. The model-based nature of the control system enables real-time optimization of controller parameters in response to time-varying plasma conditions and control objectives. The new control scheme is shown to enable stable and on-demand plasma operations in complicated magnetic geometries such as the snowflake divertor. A recently-developed code that simulates the nonlinear evolution of the plasma equilibrium is used to demonstrate the capabilities of the designed shape controllers. Plans for future real-time implementations on NSTX–U and elsewhere are also presented.

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