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**Towards Current Profile Control in ITER: Potential Approaches and Research Needs**[1] E. SCHUSTER, J.E. BARTON, W.P. WEHNER, Lehigh University — Many challenging plasma control problems still need to be addressed in order for the ITER Plasma Control System (PCS) to be able to successfully achieve the ITER project goals. For instance, setting up a suitable toroidal current density profile is key for one possible advanced scenario characterized by noninductive sustainment of the plasma current and steady-state operation. The nonlinearity and high dimensionality exhibited by the plasma demand a model-based current-profile control synthesis procedure that can accommodate this complexity through embedding the known physics within the design. The development of a model capturing the dynamics of the plasma relevant for control design enables not only the design of feedback controllers for regulation or tracking but also the design of optimal feedforward controllers for a systematic model-based approach to scenario planning, the design of state estimators for a reliable real-time reconstruction of the plasma internal profiles based on limited and noisy diagnostics, and the development of a fast predictive simulation code for closed-loop performance evaluation before implementation. Progress towards control-oriented modeling of the current profile evolution and associated control design has been reported following both data-driven and first-principles-driven approaches. An overview of these two approaches will be provided, as well as a discussion on research needs associated with each one of the model applications described above.

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