Integrated plasma control in DIII-D

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Abstract. The integrated plasma control approach provides a systematic method for
designing plasma control algorithms with high reliability and for confirming their
performance offline prior to experimental implementation. This approach includes
construction of plasma and system response models, validation of models against
operating experiments, design of integrated controllers which operate in concert with one
another as well as with supervisory modules, simulation of control action against off-line
and actual machine control platforms, and iteration of the design-test loop to optimize
performance. Using this approach, required levels of robustness to model uncertainties
and off-normal events can be quantified and incorporated in the design process. The
DIII-D digital plasma control system (PCS) enables application of this method by
providing a flexible programming environment and an architecture for realtime parallel
operation of a set of computers that executes the large set of control algorithms needed
for exploration of the advanced tokamak (AT) regime. The present work describes the DIII-D PCS and the approach, benefits, and progress made in integrated plasma control as applied to the DIII-D tokamak, with implications for the ITER design and other next-generation tokamaks.

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