H2 optimal control techniques for resistive wall mode feedback in tokamaks

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Abstract. DIII-D experiments show that a new, advanced algorithm improves resistive wall mode (RWM) stability control in high performance discharges using external coils. DIII-D can excite strong, locked or nearly locked external kink modes whose rotation frequencies and growth rates are on the order of the magnetic diffusion time of the vacuum vessel wall. The VALEN RWM model has been used to gauge the effectiveness of RWM control algorithms in tokamaks. Simulations and experiments have shown that modern control techniques like Linear Quadratic Gaussian (LQG) control will perform better, using 77% less current, than classical techniques when using control coils external to DIII-D's vacuum vessel. Experiments were conducted to develop control of a rotating n = 1 perturbation using an LQG controller derived from VALEN and external coils. Feedback using this LQG algorithm outperformed a proportional gain only controller in these perturbation experiments over a range of frequencies. Results from high N experiments also show that advanced feedback techniques using external control coils may be as effective as internal control coil feedback using classical control techniques.