Contribution ID: **375** Type: **not specified**

P4.039 Robust control of the current profile and plasma energy in EAST

Thursday, 20 September 2018 11:00 (2 hours)

Integrated control of the toroidal current density profile, or alternatively the q-profile, and plasma stored energy is essential to achieve advanced plasma scenarios characterized by high plasma confinement, magnetohydrodynamics stability, and noninductively driven plasma current. The q-profile evolution is closely related to the evolution of the poloidal magnetic flux profile, whose dynamics is modeled by a nonlinear partial differential equation (PDE) referred to as the magnetic-flux diffusion equation (MDE). The MDE prediction depends heavily on the chosen models for the electron temperature, plasma resistivity, and non-inductive current drives. To aid controller synthesis, control-oriented models for these plasma quantities are necessary to make the problem tractable. However, a relatively large deviation between the predictions by these control-oriented models and experimental data is not uncommon. For this reason, the electron temperature, plasma resistivity, and non-inductive current drives are modeled in this work as the product of an "uncertain" reference profile and a nonlinear function of the different auxiliary heating and current-drive (H&CD) source powers and the total plasma current. The uncertainties are quantified in such a way that the family of models arising from the modeling process is able to capture the q-profile and plasma stored energy dynamics from a typical EAST shot. A control-oriented nonlinear PDE model is developed by combining the MDE with the "uncertain" models for the electron temperature, plasma resistivity, and non-inductive current drives. This model is then rewritten into a control framework to design a controller that is robust against the modeled uncertainties. The resulting controller utilizes EAST's H&CD powers and total plasma current to regulate the q-profile and plasma stored energy even when mismatches between modeled and actual dynamics are present. The effectiveness of the controller is demonstrated through nonlinear simulations.

This work was supported by the US Department of Energy under DE-SC0010537.

Presenter: WANG, Hexiang (Mechanical Engineering and Mechanics Lehigh University)

Session Classification: P4