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Sliding mode control of an FRC plasma axial position JESUS ANTONIO ROMERO, Tri Alpha Energy, TAE TEAM — We study the problem of controlling the position of an axially unstable FRC configuration by acting on discrete voltage levels applied to radial field coil actuators. Due to the discrete, on/off nature of the actuators, the control problem is treated using sliding mode control theory. In sliding mode control, we don't usually design the controllers (usually based on a hystheresis type control logic), but find instead a function of system states (sliding surface) that will act as the error signal with the desired asymptotically stable (sliding) behavior. A simplified rigid plasma model for axial position including perturbations is developed and used to derive a suitable sliding surface for the system. The asymptotic stability of this surface is demonstrated using Liapunov theory, and is shown to be fairly insensitive to plant parameter values. The result is that the proposed control can be used for both axially stable or unstable plasmas without the need to re-tune the parameters used in the sliding surface. This property is important because the equilibrium may have to transit between an axially stable and unstable equilibria on different phases of the FRC discharge. Numerical simulations show the robustness of the control scheme against plant uncertainties and perturbations.

Jesus Antonio Romero
Tri Alpha Energy

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