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Optimal Closed-Loop Control of the Azimuthal Velocity Profile in HELCAT by E×B Actuation[1] ZEKI ILHAN, DAVID HUXLEY-COHEN, JASON BARRY, EUGENIO SCHUSTER, Lehigh University, MARK GILMORE, University of New Mexico, ANDREW WARE, University of Montana — The cross-field turbulence-driven particle transport in magnetically confined plasmas can be reduced by adequate shaping of the azimuthal flow profile. An open-loop extremum-seeking controller has been designed earlier to identify radial azimuthal flow profiles associated with low RMS fluctuations in a magnetized laboratory device (HELCAT). In this work we propose a model-based feedback controller that can regulate the radial azimuthal velocity profile around a prescribed low-fluctuation profile. The governing partial differential equation for the azimuthal flow is reformulated into a reduced-order, control oriented model by using truncated Taylor Series expansion. State-space and linear quadratic control methods are then used to come up with an optimal, feedback control law that can minimize both the tracking error and the control energy. Computer simulations reflect the effectiveness of the proposed controller as a tool to clarify the physics of laboratory plasmas.

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