A Current-Vorticity Model for FRC plasma control SERGEI A.
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A current-vorticity MHD model and code have been developed for FRC plasma control applications in the C-2W device [1]. The model uses a flexible filtering technique to restrict the frequency bandwidth of the simulations to the control bandwidth of interest. For dynamic systems written in the state space form $dx/dt = f(t, x)$, we propose an algorithm based on a frequency domain eingenvalue analysis to remove frequency components above a certain desired frequency threshold of interest, typically determined by the desired control bandwidth. For small systems of a few states this filtering technique works effectively. For systems with a large number of states, a direct calculation of the Jacobian and its eigenvalues becomes impracticable, so we have developed a modified method which reduces the number of states (shrinking to a small system), filters and reconstructs the original high order system using a Gaussian Process inversion technique. The main purpose of the plasma model is to be applied to control system design, whose function is to maintain macroscopic plasma parameters such as shape, position, elongation, etc. at prescribed values. Details of the model and simulations will be presented. [1] H. Gota et al., Nucl. Fusion 59, 112009 (2019).

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Date submitted: 02 Jul 2019   Electronic form version 1.4