# reinforcement learning for nuclear fusion

Jeff Schneider

Carnegie Mellon University

Pittsburgh, Pennsylvania, USA

Email: jeff4@andrew.cmu.edu

The goal of nuclear fusion in tokamaks as a viable energy source requires successful control of the nonlinear and unstable dynamics of plasmas at higher pressures and time scales than has been achieved so far. Existing tokamak control strategies focus on using a collection of single variable control loops tracking hand-crafted target trajectories.

Recently, reinforcement learning algorithms have seen huge improvements in the scale and complexity of problems they can solve, especially in cases where large amounts of training episodes are available. At the same time improved machine learning based modelling of plasma dynamics from tokamak data and improved plasma simulations offer the possibility of being able to provide these quantities training episodes, thus reducing the amount of RL training time needed on real devices to an amount that is feasible.

In this talk I will introduce reinforcement learning and then describe how it can be used to learn policies for joint control of multiple variables and perform trajectory optimization as well. I will show results of doing this on learned dynamics models of DIII-D plasmas and conclude with our plans to test these policies on the real device.