Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

A Dimensionality Reduction Algorithm for Mapping Tokamak Operation Regimes Using Variational Autoencoder (VAE) Neural Network[1] Y. WEI, J.W. BROOKS, R. CHANDRA, J.P. LEVESQUE, BOTING LI, A. SAPERSTEIN, I.G. STEWART, M.E. MAUEL, G.A. NAVRATIL, Columbia Univ, C. HANSEN, University of Washington — Variational autoencoder (VAE) is a type of unsupervised neural network which is able to learn meaningful data representation in a reduced dimension. We present an application of VAE for analyzing plasma discharges. Comparing to disruption prevention algorithms using supervised learning approaches, VAE maps the input signals onto a lower dimensional latent space by their similarities with neighboring samples. This creates a smooth operation space map in which individual discharges form continuous trajectories as they evolve from stable toward unstable regions in latent space, and information of latent space topography can be useful for steering discharge away from impending disruptive event using relevant actuators in addition to issuing warning to terminate discharge. This algorithm has been implemented using a dataset consisting of over 4000 discharges from HBT-EP tokamak. Training result shows smoother latent space and better separation of stable and unstable plasma states comparing to linear PCA-based dimensionality reduction scheme. A proof-of-principle actuator control experiment using open-loop applied vertical field pulse to control plasma position has also been conducted and analyzed. This work represents the first machine learning-based study on HBT-EP tokamak.

[1]Supported by U.S. DOE Grant DE-FG02-86ER53222.

Yumou Wei
Columbia Univ

Date submitted: 29 Jun 2020 Electronic form version 1.4