Abstract Submission for ICDDPS 2019

Speaker:
Julian Kates-Harbeck

Title:
Disruption Prediction in Tokamak Fusion Reactors via Deep Learning at Scale

Abstract:
The prediction and avoidance of large-scale plasma instabilities called “disruptions” is a crucial step towards successful power generation from magnetic confinement fusion in tokamaks. Inspired by the recent success of deep learning (DL) algorithms in generalizing and learning from multi-modal and high-dimensional data across diverse domains, we present a new approach to forecast disruptions based on deep learning that extends the capabilities of past work in key ways. In particular, our method for the first time (i) delivers reliable predictions on machines other than the one it was trained on — a crucial requirement for large and powerful future reactors that cannot afford “training” disruptions; (ii) utilizes high-dimensional training data such as profiles to add new physics information and boost predictive performance; and (iii) engages supercomputing at the largest scale to deliver solutions with improved accuracy and speed. Trained on experimental data from the largest tokamaks in the US (DIII-D) and the world (JET), our algorithm moreover can be tuned for physics-specific tasks such as prediction with long warning times, and opens up possible avenues for moving forward the goal from passive disruption prediction to active reactor control and optimization.