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A Neural Network Version of Multi-Mode Model for Control-oriented Fast Simulations in DIII-D.[1] SHIRA MOROSOHK, EUGENIO SCHUSTER, TARIQ RAFIQ, Lehigh University — Multi-Mode Model (MMM) is a physics-oriented model that is used to predict thermal, particle and poloidal/toroidal momentum transport in tokamak plasmas. It includes a model for ion temperature gradient, trapped electron, kinetic ballooning, peeling, collisionless and collision dominated magnetohydrodynamics modes as well as model for electron temperature gradient modes, and a model for drift resistive inertial ballooning modes [1]. While MMM is a relatively accurate model, it is too computationally intense for control design, which demands a model capable of producing similar predictions with a significantly faster run time. Neural networks offer the potential to replicate complicated calculations with a high level of accuracy while simultaneously producing results with a run time orders of magnitude faster than that of MMM. In this work, a database of predictive TRANSP runs for DIII-D was built using MMM. This database was used to train and test a neural network (MMMnet). The trained network is shown to match the results of MMM with high accuracy while producing results in a run time on the order of microseconds. This allows MMMnet to be used for model-based optimization and control applications with the potential of running in real time. [1] T. Rafiq et al., Phys. Plasmas **20**, 032506 (2013).

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