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Transfer Today's Disruption Prediction Model to Future Tokamaks

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Disruption is a major obstacle for tokamaks to be commercially viable reactors. Accurately predicting an incoming disruption and deploying disruption mitigation system is one of the keys to solve this problem. Today's machine learning based disruption predictors do have great performance if given good enough data to train. But future tokamak will not provide good enough data before damaging itself. The way to exploit the limited data from future machines and the abundant data from existing machines is the key to solve this problem. This work presents multiple attempts to leverage on the transfer learning technique to solve the above problem. Firstly, a transferable deep neural network tokamak diagnostic feature extractor is proposed and demonstrated on 2 tokamaks. Secondly, a domain adaptation method called covariance alignment was applied to manually extracted features to align feature spaces from 2 tokamaks. Thirdly, an adaptive anomaly detection method was introduced to bootstrap a pre-trained disruption prediction model on a new machine. Lastly, we tried to transfer a model trained with low performance discharges to high performance scenarios. Those above methods displayed variant degrees of success. The results and the models was analyzed and revealed some hints about transferring existing disruption prediction models to new tokamaks.

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