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Cross Tokamak Disruption Prediction with Different Methods and from Different Perspectives

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In large tokamak reactors, one unmitigated disruption will bring intolerable damage to them. Accurate plasma disruption prediction system is needed to trigger the disruption mitigation system. Currently machine learning disruption predictor is the most promising way of solving this problem. But it does need data from the target machine to be trained. However, the future machine will not be able to provide enough data both in quality and quantity to satisfy the training. In this paper we attempt to address this issue from 3 different perspectives. First, we tried to use deep neural networks to learn common representations of disruption, and using fine-tune technique to transfer the learning predictions to new machine. Through different numeric experiment we have proved this method can transfer disruption precursor knowledge from J-TEXT to EAST. The second way is try to extract machine independent features. Similar to the previous method, it attempts to find a feature space that are common among multiple tokamak. But instead using deep learning, here we use expert knowledge. With the right tricks we can achieve high accuracy with little even no target machine data. Lastly, we tried to train a disruption predictor from scratch. This means, using the very first shot to train a predictor and the predictor is put online to trigger the DMS. From here on we continue to train the predictor after each shot. We the right tuning technique, this predictor can protect the machine from the 2nd shot. Although this 3 method is not perfect but it show feasible ways of solving cross tokamak disruption prediction. Moreover, future disruption predictors can be an ensemble of different strategies.

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