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Cross Tokamak Disruption Prediction with Different Methods and from Different Perspectives

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Currently machine learning disruption predictor is the most promising way of solving the disruption mitigation triggering problem. But it does need data from the target machine to be trained. However, the future machine may not be able to provide enough data both in quality and quantity to satisfy the training. In this paper we first explained why just simply mixing limited data from target machine is not the best way to build a cross tokamak disruption prediction model. Then, we attempt to address this issue from 3 different perspectives. First, we try to extract machine independent features with expert knowledge. Combined with domain adaptation method, we can port a disruption predictor to target tokamak with limited data from the target tokamak. Then, we tried to use deep neural networks to learn common representations of disruption instead of using expert knowledge, we fine-tuned the parts of the model with limited data from the target tokamak to transfer the predictor to the target tokamak. This is expected to get better performance if there are large enough data from the existing tokamaks. Finally, anomaly detection method was attempted. This eliminates the need of disruption shots which the future reactor cannot tolerant. However, for future reactors the goal is not just to build a high-performance disruption predictor that works on all the shots the reactor generated. Based of the above 3 different methods we suggested an integrated disruption prediction strategy. The goal of this strategy is to ensure the safety of the reactor though the different stages of the reactor which may have different requirements on the disruption predictors. The preliminary results suggested it's a promising way of building disruption predictors for future tokamak reactors.

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