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Accelerating Disruption Database Studies with Semi-Supervised Learning

This contribution presents a novel application of a semi-supervised learning algorithm to detect disruption precursors in a large dataset, given a relatively small number of manually labelled examples. Preliminary analysis applying the label propagation [1] and label spreading [2] algorithms for detection of H-L back transitions demonstrates a reasonably high detection accuracy (~70% of transition events detected) when starting with a dataset of hundreds of manually analyzed discharges for which only ~2% of the H-L transitions are labeled. Since the only necessary inputs are a dataset of 0D signals sufficient for manual detection of the event and a few recorded times at which the event occurs, this technique can in principle be applied to detect any arbitrary precursor event in a disruption database. As an example, a first attempt at extending this analysis to detect locked modes with rotating precursors and radiative collapses is shown. This implies that the construction of large event databases using manually-aided detection tools like DIS_tool [3] can be accelerated, automatically detecting new events with increasing fidelity as the user continues to add manually labelled data. This kind of detailed information on disruption precursors can greatly improve the ability to train and interpret machine learning-based prediction algorithms, which rely on datasets that are too large to completely assemble by hand.

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[1] Zhu X. and Ghahramani Z., "Learning from labeled and unlabeled data with label propagation"(2002) URL http://citeseerx.ist.psu.edu/viewdoc/summary
[2] Zhou D. et al., Advances in Neural Information Processing Systems 16, 321-328 (2004)
[3] Pau A. et al., Fusion Eng. Des. 125 139–53 (2017)

Member State or International Organization

United States of America

Affiliation

MIT Plasma Science and Fusion Center

Author: MONTES, Kevin (MIT)

Co-authors: ZHU, Jinxiang (MIT PSFC); REA, Cristina (Massachusetts Institute of Technology); GRANETZ, Robert (MIT)

Presenter: MONTES, Kevin (MIT)

Track Classification: Prediction and Avoidance