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P2.044 Hazard function exploration of tokamak tearing mode stability boundaries

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It is possible to decompose an event prediction problem into a hazard function (event rate model) and a phase space trajectory (dynamical system evolution). In contrast to typical event prediction approaches (such as those attempted in present tokamak disruption systems) the hazard function has two significant advantages. First, it has a time localized and quantitative interpretation (events per time) which can block spurious future-to-past statistical associations. Second, event rate models can be used to generate event predictions for arbitrary look-ahead horizons conditioned on future controls with respect to a dynamical systems model. In principle, this property allows a formalized approach to control design for high tokamak performance with dynamic avoidance of operation near the (hazardous) parameter regions where the event risk is significant. To be able to exploit these advantages, we are first required to develop the necessary tools to effectively learn (correct) hazard function models from data.

Previous results with hazard function models have been obtained from DIII-D at reduced scale (about 200 shots) for particular ITER-similar baseline scenario plasmas for tearing mode onset events. Extending this, we report the first hazard function analysis at large scale applied to tokamak data for tearing mode onset characterization. Newly developed (and massively parallelized) shot-database searching and feature extraction tool-chains at the DIII-D tokamak are exploited. Multiple methods for understanding and visualizing the properties of the estimated hazard function(s) are applied, including partial dependence plots, and verification of statistical calibration, which is a prerequisite for plausible application to control designs.

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