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Time-series classification of ELMs on NSTX with machine learning analysis[1] DAVID SMITH, R. FONCK, G. MCKEE, Univ of Wisconsin, Madison, NSTX TEAM — The linear peeling-ballooning model can describe onset conditions for edge-localized modes (ELMs), but understanding saturation mechanisms and transport dynamics requires nonlinear models and experimental validation. Here, we examine time-series data of ELM bursts on NSTX to identify representative ELM groups with similar evolution characteristics. We apply hierarchical cluster analysis, an unsupervised machine learning technique popular in genomics, to beam emission spectroscopy (BES) measurements of ELM bursts. The application of cluster analysis to time-series data requires metrics to quantify the similarity or dissimilarity among time-series data. We find that both correlation and dynamic time warping similarity metrics reveal 2 groups of ELM events: fast, non-oscillatory ELMs ($\sim$ 200 micro-s) and slow, oscillatory ELMs ($\sim$ 1 ms). We also report on progress with wavelet-based similarity metrics. The identification of representative ELM groups with cluster analysis can establish validation scenarios for simulations, facilitate the automatic identification of ELMs in data, prepare ELM measurements for subsequent supervised machine learning analysis, and, more broadly, demonstrate the applicability of machine learning analysis to fusion plasma data.

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