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Adaptive Machine Learning for Quench Prediction

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Superconducting (SC) magnets deployed at any accelerator complex must reach exceptionally high currents to accurately control particle trajectories. During operation, superconducting magnets occasionally experience a spontaneous transition from the superconducting to the normal state while operating at several kiloamps (quenching). Quenches may significantly damage the magnet, preventing SC magnets from conducting their intended maximum operational current. Using data from surrounding sensors, we present a machine learning interface that trains and performs inference for anomaly detection in SC magnet data with the potential for real time quench prediction. The algorithm extracts energy and flux changes from acoustic and quench antenna respectively, while altering the quench prediction inference based on changes in latent space. The result is a model that localizes anomalies in space and time that may be further investigated to understand the physical origin of the quench, and eventually aid in a real time quench prediction system.

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