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A machine learning technique for dynamic aperture computation

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Currently, dynamic aperture calculations of high-energy hadron colliders are generated through computer simulation, which is both a resource-heavy and time-costly process.
The aim of this research is to use a reservoir computing machine learning model in order to achieve a faster extrapolation of dynamic aperture values. In order to achieve these results, a recurrent echo-state network (ESN) architecture is used as a basis for this work. Recurrent networks are better fitted to extrapolation tasks while the reservoir echo-state structure is computationally eective. Model training and validation is conducted on a set of "seeds" corresponding to the simulation results of dierent machine congurations. Adjustments in the model architecture, manual metric and data selection, hyper-parameter tuning (using a grid search method and manual tuning) and the introduction of new parameters enabled the model to reliably achieve target performance on examining testing sets. Alternative readout layers in the model architecture are also tried.

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