

Extreme Event Transition – Chaotic Dynamics Scenario

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Abstract: An innovative approach using visibility graph and machine learning to predict extreme events in time series of chaotic dynamical systems is presented. The research focuses on the time series of chaotic maps. The method consists of identifying time windows that anticipate extreme events, using visibility graph and convolutional neural networks (CNNs) to classify the system states. By reconstructing attractors and classifying regimes (normal and transitional), the model shows high accuracy in predicting normal regimes, although forecasting transitional regimes remains challenging, particularly for longer intervals and rarer events. The method presents a outstanding performance for predicting the transition regime up to 3 steps before the occurrence of the extreme event. This approach opens avenues to enhance forecasting capabilities in regard to extreme events transition.

keywords: Extreme events, machine learning, nonlinear time series analysis