

## DETECTING CAUSAL RELATIONS BETWEEN TIME SERIES WITH NEURAL NETWORKS

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### Abstract

In fusion devices, as in many other experiments, time series are the typical form of the signals produced by the measuring systems. The detection of causality between time series is therefore of great interest, since it can give a unique contribution to the understanding, modelling, and prediction of phenomena still not fully understood. However, detecting and quantifying the causal influence between complex signals remains a difficult task, not solved yet in full generality. This contribution presents a new causality detection method based on Time Delay Neural Networks (TDNNs). The architecture of TDNNs is sufficiently flexible to allow predicting one time series, on the basis of its past and the past of others. With suitable statistical indicators, it is possible to detect and quantify the mutual influence between signals. Some of the most common and critical systems will be analyzed in this work, and the great performances and competitive advantages of this new method will be discussed. The proposed approach has also been tested varying the noise of the signals and the number of data to perform the analysis, in order to provide a comprehensive assessment of the limits and potentialities of TDNNs.