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Title: « Inferring dynamic causal time lag: Applications to space weather »

Abstract:
It is often the case with natural and man-made phenomena, that cause and effect are temporally separated i.e. there is a time lag between occurrence of an event and the observation of its consequences. In complex systems, this time lag between cause and effect can be uncertain and dynamic. Mathematically this can be expressed as $y_{t + g(x_{t})} = f(x_{t})$, where x_{t} is a time series representing the causes, y_{t} represents the effects and functions f and g represent the input-output and input-time lag relationships.

In the context of space weather, one can see this when events on the Sun such as coronal mass ejections (CME) or high speed solar wind streams cause disturbances in the Earth's geomagnetic state, several hours, or even days later. To increase the prediction window of space weather forecasting systems, it is important to model the temporal relationship between space weather drivers and geomagnetic quantities in the vicinity of the Earth.

We present ongoing work in learning dynamic causal time lags from noisy time series. Our methodology is based on a neural network which learns the input-output and input-time lag relationships simultaneously. We evaluate our models performance on a set of toy problems as well as on the problem of CME propagation using SDO and OMNI data sets.

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