Master Thesis: Causality Inference in Complex Nonlinear Ecosystems

Abstract:

The inference of interactions between species or between a specie and an environ- mental factor, using time series data, is a highly interesting area of research with several beneficial and useful applications in the real world. Looking at complex ecosystems, such as the motivating example of the Guadalquivir river estuary in the South West of Spain, the data presents several difficulties to overcome. The time series are usually fairly noisy, have a seasonal pattern and are relatively short (the data from the Guadalquivir river estuary is about 240 data points long, this is very long for ecological time series but relatively short for most time series methods). The problem of inferring interactions between species/environment has previously been addressed by a variety of methods including Convergent Cross Mapping (CCM) which has it's shortcomings. This project will consider a method based on Echo State Networks (ESNs), a type of Recurrent Neural Networks (RNNs). After looking at how ESNs compare to CCM, it will be applied to several data sets of increasing complexity.