

Evolving wavelet networks

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Abstract

In this article we will construct a class of statistical models for prediction using the recently introduced idea of "wavelet networks", artificial neural networks based upon wavelet theory. For analyses of time series with singularities and irregular regime changes, wavelets are in fact increasingly important, both for theory and applications. Using wavelet theory to construct statistical models is principally motivated in the underlying methodological choice: this approach allows one to decompose complex phenomena into components with a simple structure with known properties. Currently, Fourier analysis represents an important approach to signal analysis, permitting the study of a corrupted signal by decomposing it into elementary oscillations and noise components, and transforming a time-dependent function into a frequency-dependent function. However, this approach is restricted to dynamics that are linear and stationary. To have a series decomposition into elementary components that can yield information both on its oscillatory frequencies and their temporal localization we will then consider the wavelet analysis. The wavelet function oscillates around zero and is temporally localized. It is characterized by two parameters, one of which controls the frequency, the other its localization. The so-called mother wavelet function generates a family of wavelets with different parameters that comprise the building blocks with which a very wide class of functions may be represented. We will construct feedforward neural networks with combinations of wavelet basis functions. The choice of the parameters of frequency and location will be realized with the approach of the evolutionary computation. We will build a genetic algorithm that will evolve the parameters of the wavelet functions and then selects the statistical model. Comparison with other approaches will be also realized.