The University of Chicago

Department of Statistics

Seminar

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"The SLEX Analysis of Non-Stationary Time Series"

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ABSTRACT

Many time series datasets are non-stationary in nature. As examples, brain waves, seismic waves and speech signals have amplitudes (variance) that change over time. Moreover, the waves oscillate at frequencies that vary over time. In this talk, we will present an analysis of non-stationary time series using the SLEX transform (Smooth Localized Complex EXponentials). The SLEX transform forms a collection of orthogonal bases. Every basis consists of the SLEX vectors that are time-localized versions of the Fourier complex exponentials. Hence, they are ideal at representing processes with statistical properties that evolve over time. In view of the above, the SLEX analysis for non-stationary time series is a generalization of the traditional Fourier analysis for stationary time series.

The SLEX analysis consists of the following sequential steps. We first build a family of SLEX models, each of which has a spectral representation in terms of a unique SLEX basis. Then we select the best model from the family using a criterion that is based on the Kullback-Leibler divergence. We implement the computationally efficient Best Basis Algorithm of Coifman and Wickerhauser (1992) in selecting the best model. Finally, estimates of the time-dependent spectrum and coherence can be obtained by smoothing the SLEX periodograms using a simple span selection method that is based on generalized cross validation. We will apply the SLEX analysis to a speech recording of the word greasy and to a bivariate brain waves dataset recorded during an epileptic seizure. Finally, we will briefly discuss current work which includes SLEX domain principal components analysis and discrimination and classification of non-stationary time series using the SLEX approach.
