Department of Mathematical Sciences

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Colloquium Series
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Stationary Subspace Analysis & Brain-Computer Interface

Stationary subspace analysis (SSA) is a recent time domain technique for classification of brain-computer interface nonstationary data. It finds linear transformations of nonstationary multivariate processes which are stationary in the limited sense that the first two moments or means and covariances are time-invariant. The key optimization problem is that of finding a matrix minimizing the Kullback-Leibler divergence between Gaussian distributions measuring the non-constancy of the means and covariances across several segments. We present a frequency domain alternative to SSA for general multivariate second-order nonstationary processes. Using the asymptotic uncorrelatedness of the discrete Fourier transform of a stationary time series, a measure of departure from stationarity is introduced and minimized to find the stationary subspace. The dimension of the subspace, the key parameter, is estimated using a sequential testing procedure and its asymptotic properties are studied. We illustrate the broader applicability and better performance of the frequency domain method in comparison to time domain SSA methods through simulations and an application in analyzing EEG data from brain-computer interface experiments.

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