A Wavelet Approach on Estimating the Number of Signal Sources Based on Virtual Dimensionality in Magnetoencephalography

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Abstract

Magnetoencephalography (MEG) is an imaging technique used to measure the magnetic field outside the human head produced by the electrical activity inside the brain. The MEG inverse problem, identifying the location of the electrical sources from the magnetic signal measurements, is ill-posed; that is, there are an infinite number of mathematically correct solutions. The typical MEG data involves a 306-channel time series collection of the magnetic field. It has not been easy to estimate the number of electrical sources in the MEG data. Common methods include principal component analysis (PCA) and factor analysis which make use of the eigenvalue distribution to determine the number of sources. Other methods involve information criterion (IC) and minimum description length (MDL). Unfortunately, all these methods are very sensitive to signal-to-noise ratio (SNR) and not useful for hyperspectral image data. In this paper, first, we consider a wavelet approach to estimate the noise at each sensor of the data. Second, a Neyman-Pearson detection theory-based eigentresholding method is used to decide the number of signal sources in the data. We apply our method for simulation data by varying the number of sources and SNRs. A real MEG dataset from empty MEG room is also tested. Our method allows us to estimate the noise more accurately for MEG data and is robust in deciding the number of signal sources.