論文の内容の要旨

Nonlinear Time Series Analysis with Recurrence Plots and Its Application to MEG Signals
（リカレンスプロットを用いた非線形時系列解析とその MEG 計測信号への応用）

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Various studies have made on time series analysis. Nonlinear time series analysis is the approach based on the nonlinear dynamical theory. Methods of nonlinear time series analysis can detect features of the system which cannot be detected by conventional linear time series analysis. Recurrence plots, one of the methods of nonlinear time series analysis, are effective visualization tool of time series. It is known that recurrence plots contain almost all of information about the dynamical system which generated the observed time series. In this thesis, we propose two new methods of nonlinear time series analysis using recurrence plots. One is the method that detects change points from observed time series by applying spectral clustering, the graph partitioning method, to recurrence plots. We show the potency of this method by numerical simulation. Our method can detect change points with high accuracy. The other is the method characterizing time-evolving networks by introducing the distance between networks. By introducing the distance, we can construct recurrence plots of time-varying networks and apply various methods to recurrence plots. It is shown that our method can detect features of the dynamics of the time evolution of the network. Finally, we applied these two methods to signals when perceptual alternations occurred measured by magnetoencephalography (MEG). Perceptual alternations are phenomena that the perception alternates to the other perception without changes of external stimuli. As a result of analysis, we detected changes corresponding to perceptual alternations.