Neuroscience 2015

Presentation Abstract

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Program#/Poster#:	493.04/F21
Presentation Title:	Delay differential analysis: a framework for the analysis of large-scale epileptic electrocorticography recordings
Location:	Hall A
Presentation time:	Tuesday, Oct 20, 2015, 8:00 AM -12:00 PM
Presenter at Poster:	Tue, Oct. 20, 2015, 11:00 AM - 12:00 PM
Topic:	++C.07.i. Human Studies
Authors:	***J. WEYHENMEYER**[1,2], C. LAINSCSEK[2,3], S. S. CASH[4,5], T. J. SEJNOWSKI[2,3]; [1]Indiana Univ. Sch. of Med., Indianapolis, IN; [2]Howard Hughes Med. Institute, Computat. Neurobio. Lab., Salk Inst. for Biol. Studies, San Diego, CA; [3]Inst. for Neural Computation, Univ. of California San Diego, San Diego, CA; [4]Harvard Med. Sch., Boston, MA; [5]Massachusetts Gen. Hosp., Boston, MA
Abstract:	High density electrocorticogram (ECoG) electrodes are capable of recording neurophysiological data with high temporal and reasonable spatial resolution. Such recordings are a window to understanding how the human brain processes information and subsequently

	behaves in healthy and pathologic states. At present, many of the computational methods utilized in the analysis of ECoG recordings are strictly linear, require significant pre-processing, and fail to provide high-level information with respect to the state of the neurological system. In the following study, we describe and implement delay differential analysis (DDA) for the characterization of ECoG data obtained from human patients with intractable epilepsy. DDA is a time domain analysis framework based on embedding theory in nonlinear dynamics. An embedding reveals the nonlinear invariant properties of an unknown dynamical system (here the brain) from a single time series (ECoG signals). The DDA embedding serves as a low-dimensional nonlinear functional basis onto which the data are mapped. Since the basis is built on the dynamical structure of the data, preprocessing of the data, e.g. filtering, is not necessary. DDA yields a low number of features (four or less), far fewer than traditional spectral techniques. This greatly reduces the risk of overfitting and improves the method's ability to fit classes of data. One single three term DDA is shown to qualitatively discriminate between different neurologic states and epileptic events for a set of 13 patients from the raw ECoG data. Singular value computation across the feature space is shown to delineate global and local dynamics. The global and local dynamics differentiate electrographic and electroclinical seizures while also providing insight into a highly localized seizure onset and diffuse seizure termination. Thus, DDA is shown as a new form of computational analysis for ECoG data obtained from the epileptic patient.
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