Neuroscience 2015

Presentation Abstract

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Program#/Poster#:	815.05/Z7
Presentation Title:	Nonlinear dynamical features for improving computational sleep models using Delay Differential Analysis
Location:	Hall A
Presentation time:	Wednesday, Oct 21, 2015, 1:00 PM - 5:00 PM
Presenter at Poster:	Wed, Oct. 21, 2015, 1:00 PM - 2:00 PM
Topic:	++E.08.e Sleep: Systems
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Abstract:	Cortical network models based on ionic mechanisms have many parameters that must be chosen to match cortical recordings. One measure is comparison of the local field potentials generated by simulations of the

	model with electrocephalogram (EEG). Here, we use delay differential analysis (DDA), which is a time domain classification framework based on embedding theory in nonlinear dynamics to make the comparison. An embedding reveals the nonlinear invariant properties of an unknown dynamical system (here the brain) from a single time series (here EEG data). The embedding in DDA serves then 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 (such as filtering) is not necessary. DDA yields a low number of features (around 4), far fewer than traditional spectral techniques. This greatly reduces the risk of overfitting. A model that was trained on a single EEG channel from one subject can be applied to a wide range of data from different subjects, channels, and recording systems. In this project, we varied the network's thalamocortical fan-out to simulate networks with different levels of connectivities. Then, we apply DDA to construct a set of non-linear features for the real human sleep EEG data and each network simulation. Finally, the cross correlation between each network simulation and the real sleep data is computed. Our results show that within the connection range we simulated, networks with medium levels of fan-out rate have the highest correlation with real sleep data. This implies that there is an optimum level of connection between the thalamus and the cortex. A too narrow or too broad fanout will disrupt the simulation dynamic from that of real sleep. (Lainscsek, C. Sejnowski, T. J. Delay Differential Analysis of Time Series, Neural Computation, 27, 594-614, 2015)
Disclosures:	**W. Lin:** None. **C. Lainscsek:** None. **G.P. Krishnan:** None. **M. Bazhenov:** None. **S. Mednick:** None. **T.J. Sejnowski:** None.
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	nonlinear dynamics
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