Presentation Abstract

Presentation Title: Non-linear dynamical analysis of EEG time series distinguishes patients with Parkinson's disease from healthy individuals

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Topic: ++D.17.b. Finger and grasp control: Age, pathology, and physiology

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Abstract: Objective, automatic methods of classifying, assessing, and tracking the progression of Parkinson's disease (PD) could prove of great use in the clinic. The pathophysiology of PD is known to involve altered patterns of neuronal firing and synchronization in cortical-basal ganglia circuits. Rather than using spectral-based methods, we used data models based on delay differential equations (DDE) as non-linear time-domain classification tools to distinguish resting state electroencephalographic (EEG) recordings from PD patients on and off dopaminergic therapy and healthy individuals. Two sets of 50 1-s segments of 64-channel EEG activity were recorded from nine PD patients on and off medication and 9 age-matched controls. The 64 EEG channels were grouped into 10 clusters covering frontal, central, parietal, and occipital brain regions for analysis. DDE models were fitted to individual trials, and model coefficients and error were used as features for classification. Classification performance was measured using 3-fold cross validation across subjects. We found that even short segments of resting state EEG in PD patients and controls contained dynamical structure, and, moreover, that PD patients exhibited a greater dynamic range than controls. DDE model output on the means from one set of 50 trials provided nearly complete separation of PD patients off medication from controls: across brain regions, the

area under the receiver operating characteristic curves, A [[unable to display character: ́]], varied from 0.97 - 1.0. For distinguishing PD patients on vs. off medication, classification performance (A [[unable to display character: ́]]) ranged from 0.86 - 1.0 across brain regions. Moreover, the generalizability of the model to the second set of 50 trials was excellent, with A [[unable to display character: ́]] ranging from 0.74 - 0.92 across brain regions for controls vs PD off medication, and from 0.62-0.82 for PD on medication vs off. Finally, model features significantly predicted individual patients' motor severity, as assessed with standard clinical rating scales.