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## Deep Learning Analysis of Postural Sway to Distinguish People with Early Parkinson's Disease from Healthy Controls

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### Keywords

Parkinson's Disease, Postural Sway, Balance Control, Machine Learning, Deep Learning

### Abstract

#### Introduction

Postural impairments constitute a common motor symptom of Parkinson's disease (PD). While there is evidence that they might already be present pre-clinically, they are often associated with later stages of the disease. This is because current clinical assessments are insensitive to mild impairments and can only detect symptoms when the disease has progressed. Hence, this study aims at providing a sensitive objective measure of postural instability that is easy to obtain and might facilitate earlier clinical detection.

#### Methods

We assessed postural sway in 37 newly-diagnosed individuals with PD and 54 age-matched healthy controls while they were standing quietly for 60 s on a firm surface with their eyes open and their feet together. We recorded their medio-lateral body motion with a single accelerometer placed on the Lumbar spine. Acceleration data was transformed into time-frequency-spectrograms (frequency range: 0-5 Hz) which were then fed into a custom-built convolutional neural network. 70 % of data samples were used to train the network to distinguish between both groups based on the frequency information in the signals. The remaining 30 % of samples were used for evaluation.

#### Results

We trained 10 independent models, each using data from different participants for training and evaluation. After training, all models reached excellent classification performance on the respective evaluation data with an average accuracy of 97.4 % (ROC-AUC=  $0.99 \pm 0.04$ ).

## Conclusion

Our deep learning approach suggests that there may be a characteristic feature in the frequency content of postural sway during quiet stance which distinguishes individuals with early PD from healthy controls that has currently not been detected by other means. Given the simple nature of our recordings and the excellent classification performance, this method bears great potential to help clinicians in their assessment of postural impairments in early stages of PD.