

# Hand-Crafted and Learned Features Fusion for Predicting Freezing of Gait Events in Patients with Parkinson's Disease

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## Abstract

Freezing of Gait (FoG) is a common symptom of Parkinson's disease (PD) that causes intermittent absence of forward progression of patient's feet while walking. Accordingly, FoG momentary episodes are always accompanied with falls. This paper proposes a novel multi-feature model for predicting FoG episodes in patients with PD. The proposed approach considers FoG problem with 3 classes; namely, normal walking, pre-FoG, and FoG events. In this paper two feature extraction schemes have been applied, which are time-domain hand-crafted feature engineering and Convolutional Neural Network (CNN) based spectrogram feature learning. Also, after fusing the two extracted feature sets, Principal Component Analysis (PCA) algorithm has been deployed for dimensionality reduction. Data of three tri-axial accelerometer sensors for patients with PD, in both principle axes and angular-axes, has been tested. Performance of the proposed approach has been characterized on experiments with respect to several Machine Learning (ML) algorithms. Experimental results have shown that using multi-feature fusion with PCA dimensionality reduction has outperformed highlight the impact of using feature fusion of multi-feature sets on the performance of FoG episodes prediction.

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