Automated prediction of MDS-UPDRS III score from skeletal data for PD Assessment

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1. Introduction

The Movement Disorder Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS) is most commonly used in the clinical evaluation of Parkinson's disease (PD) [1, 2]. However, instead of an infrequent clinical assessment with a neurologist, research efforts are being made to create a way of automatically and continuously evaluating PD symptoms to produce fine-grained and ecologically valid outcome measures [3].

We present a unique deep learning framework that uses skeletal data representations of the human body to automatically assess MDS-UPDRS III scores by observing sit-to-stand activity in a contact-free way and achieving performance more in line with experienced neurologists.

Figure 1: Visualization of skeletal data for sit-to-stand activity

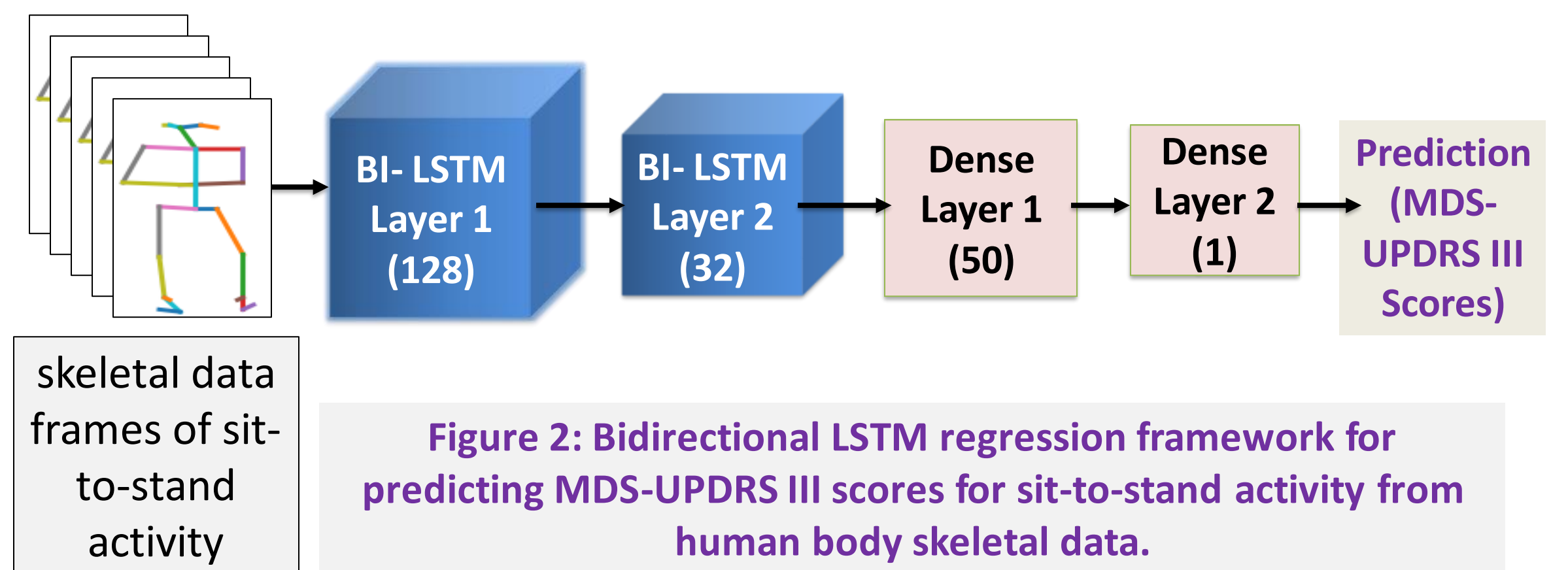
skeletal data frames of sit-to-stand activity

Figure 2: Bidirectional LSTM regression framework for predicting MDS-UPDRS III scores for sit-to-stand activity from human body skeletal data.

2. Results

We experimented with our framework on 365 sit-to-stand activity samples collected from RGB-D sensor for PD assessment. For training the network, 332 samples were used. As shown in figure 3, we achieved a mean absolute error of 0.521 on 332 trained samples for predicting MDS-UPDRS III Scores.

The framework was tested on 32 sit-to-stand activity samples and we achieved the results with a mean absolute error of 1.84 for predicting MDS-UPDRS III scores. Test results show that the framework is effective in automatically predicting the MDS-UPDRS III scores for sit-to-stand activity from skeletal data.

3. Conclusions

We investigated the possibility of automatically predicting MDS-UPDRS III score for Parkinson's disease using skeletal data of sit-to-stand activity samples. The test findings imply that our framework has the potential to predict the MDS-UPDRS III scores closer to the experienced neurologists and would ease the burden of in-person PD assessment at clinics on doctors and patients.
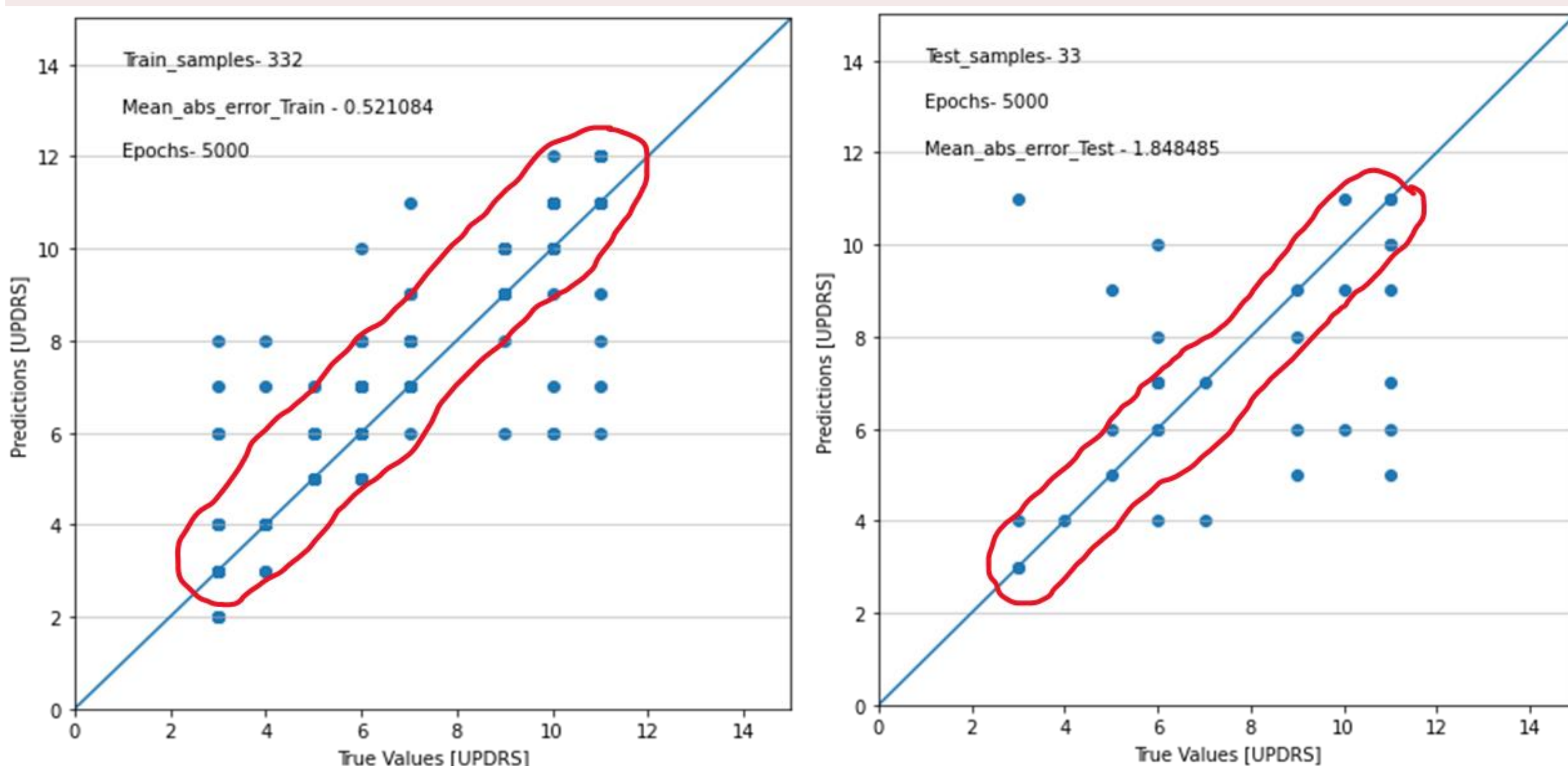

Figure 3: Results - LEFT: Prediction of MDS-UPDRS III scores on trained samples with mean absolute error of 0.52. RIGHT- Prediction of MDS-UPDRS III scores on test samples with mean absolute error of 1.84.

References

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[3] Mahadevan, Nikhil, et al. "Development of digital biomarkers for resting tremor and bradykinesia using a wrist-worn wearable device." NPJ digital medicine 3.1 (2020): 1-12.