Assessment of Parkinson's Disease Severity using Machine Learning

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Motor assessment in Parkinson's disease (PD) currently relies on human assessors performing assessments, making it expensive and subjective. A system for the objective assessment of motor dysfunction in PD, that could be deployed at scale, would have applications in clinical trials, treatment management, and in programming Deep Brain Stimulation (DBS) devices, a major recent advance in PD therapeutics.
Machine Medicine's KELVIN-PD platform provides objective, scalable motor assessment using video capture and machine learning techniques, with no dedicated hardware requirements. Here we present results for three tests that assess motor function in the hand and foot.

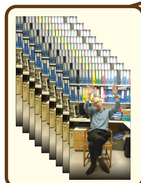
DATA CAPTURE

1. Access KELVIN-PD from any smart device via an app or the website

2. Open the digitised assessment form which has embedded video capture

3. Record the patient perfoming any of the UPDRS* motor function tests

4. The video is analysed frame by frame so that all relevant information is extracted

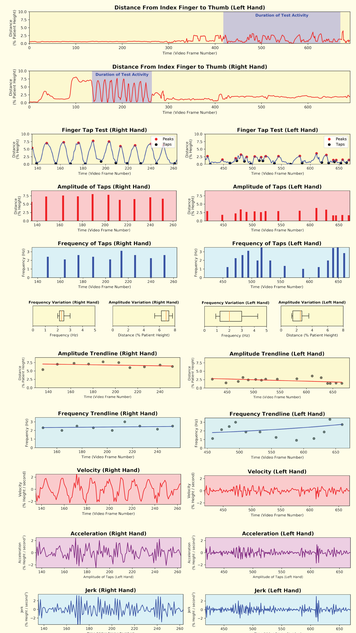


Information extracted from a 23 second video of a patient performing the Finger Tapping test with both hands

***UPDRS: Unified Parkinson's Disease Rating Scale**

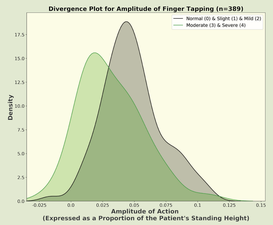
ANALYSIS

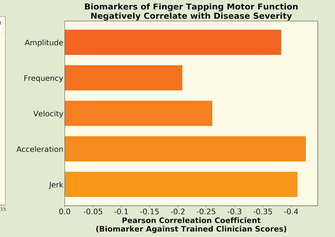
Right Hand: Mild Symptoms | **Left Hand: Severe Symptoms**



FEATURE SELECTION

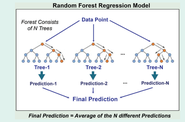
Many features of movement, such as amplitude and frequency of actions, correlate with disease severity

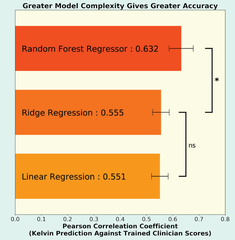




MODEL SELECTION

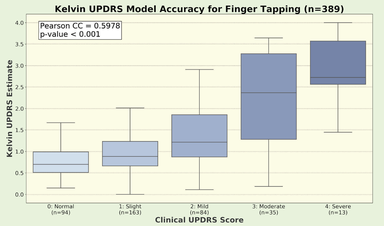
Linear Regression models achieve worse results than the more complex Random Forest Regression

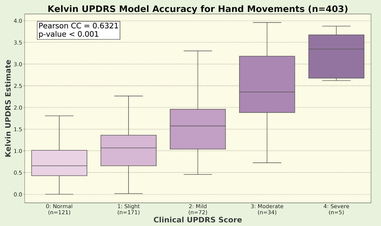


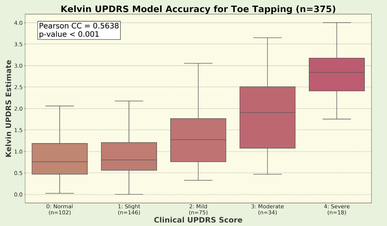


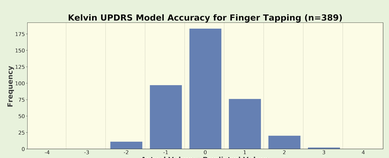
AUTOMATED ASSESSMENT RESULTS

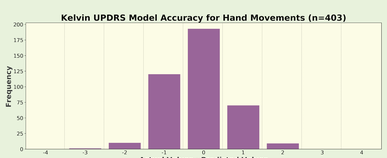
Machine learning models were trained to estimate disease severity from videos of UPDRS motor assessments. For each model presented here the results were highly significant, with over 95% of predictions being close (+/- 1) to the severity score assigned by a trained UPDRS assessor.

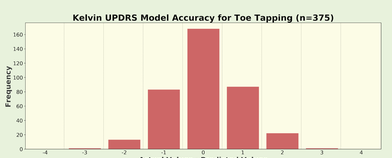






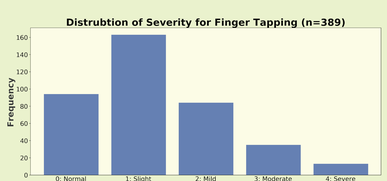


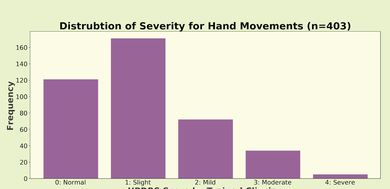


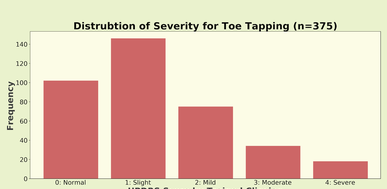


DATASET

The predictive models are developed using videos of patients from across the severity spectrum, recorded by trained UPDRS assessors at a range of institutions.







These results show that KELVIN-PD is able to capture and extract the pathological signal through monocular video clips, demonstrated by highly significant correlations with scores provided by trained human assessors. Furthermore, it was demonstrated that the use of more powerful models enables improved performance over simple approaches, such as linear regression. Future efforts will concentrate on developing superior modelling approaches, across more assessment types, and using larger data sets.

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