

## Introduction

**Objective:** demonstrate the feasibility of novel finger-tapping exercises administered through a multimodal dialog agent for assessment of motor function in Parkinson's Disease (PD) and other movement disorders.

**Methods:** analysis of finger tapping measures extracted from a web-based conversational assessment of people with PD (pPD).

**Implications:** finger tapping measures extracted through a multimodal dialog agent allow to distinguish PD patients and controls.

## Methods and Materials

- 46 sessions were recorded from 7 pPD and 12 controls (Table I) using a cloud-based multimodal dialog platform<sup>1</sup> (illustrated in Figure 1).
- The virtual agent engages participants in a conversation consisting of structured conversational exercises designed to elicit speech, facial, and limb motor behaviors.
- Each conversation includes three finger tapping tasks that differ based on the goal of the tap, i.e. participants are told to make the movement as (1) wide, (2) fast, or (3) both wide and fast as possible.
- For all finger tapping tasks participants are instructed to hold either their right or left hand up to the camera and perform a tapping motion for five seconds.
- Anatomical landmarks of the participants' hands are derived from the recorded video frames (Figure 2).
- The positions of the tips of the thumb and index finger are then used to calculate the metrics in Table II.

Group	Controls	pPD
Sex	11F / 1M	3F / 4M
Age (years)	68.5; 67.31 (5.99)	65.75; 66.02 (14.04)
MoCA score	27; 27.25 (1.6)	27; 26.57 (2.15)
Years since diagnosis	n/a	5; 8.56 (7.47)

Table I. Participant demographics, MoCA scores and years since diagnosis are presented as: median; mean (standard deviation)

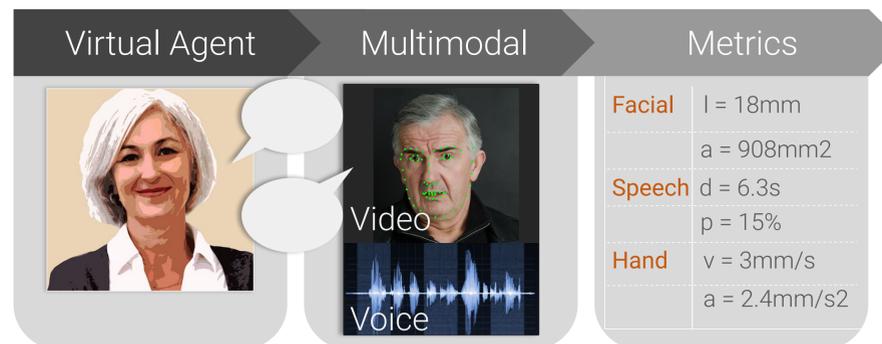


Figure 1. Modality.AI dialog platform.

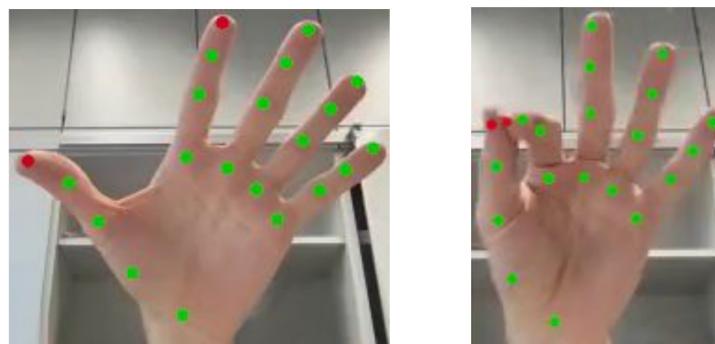


Figure 2. Illustration of the 21 obtained and 2 used (shown in red) hand landmarks for the two key points of interest, i.e. (a) fingers open and (b) fingers closed.

Metrics	Description
Velocity / Acceleration	Maximum and difference between first half and second half of each task
Jitter	Cycle-to-cycle variation of time period
Shimmer	Cycle-to-cycle variation of amplitude

Table II. Overview of the extracted finger tapping metrics.

## Results and Discussion

- A binary classification between pPD and controls was conducted through a 5-fold cross-validation with a random forest classifier.
- The mean Unweighted Average Recall (UAR) was  $0.53 \pm 0.15$  (Figure 3) indicating that the extracted finger metrics can be used to distinguish between pPD and controls.

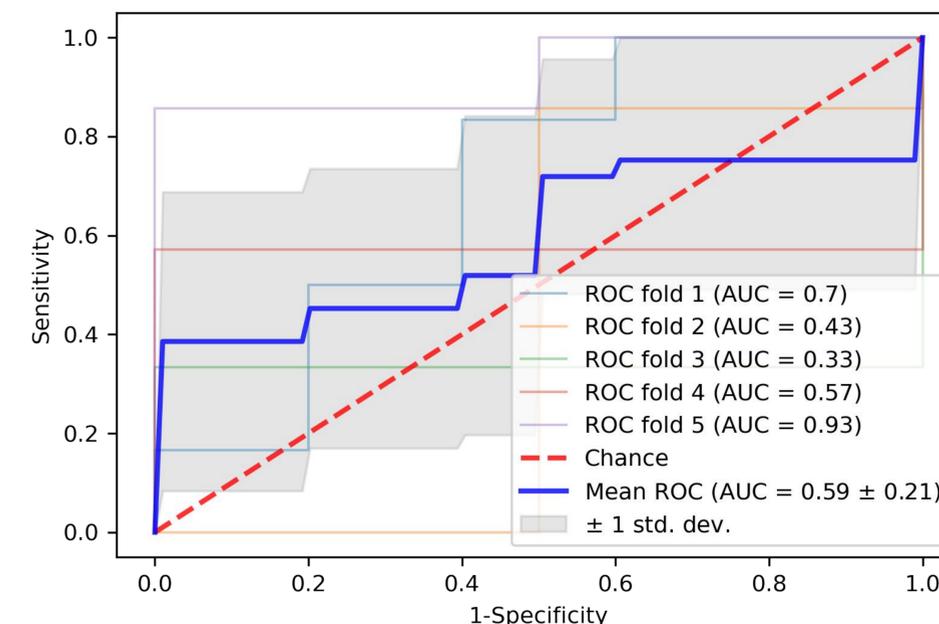


Figure 3. Receiver Operating Characteristics (ROC) curve displaying the performance of binary classification with 5-fold cross-validation. for all finger tapping metrics (N = 46).

- During finger tapping tasks using the left hand, pPD showed lower acceleration, perhaps indicative of motor rigidity.

## Conclusions

- The presented finger tapping exercises administered through a virtual dialog agent can be used for remote monitoring of motor function in PD and other movement disorders.
- Preliminary results suggest that extracted finger tapping metrics can be used to distinguish between pPD and controls.

## Future Work

- To investigate the robustness of the findings, data from more participants will be analyzed in a future study.
- Information about participants' handedness was not available for this analysis, thus, it will be taken into consideration in future studies to better understand finger tapping behavior in pPD.