

Gender-dependent GMM-UBM for tracking Parkinson's disease progression from speech

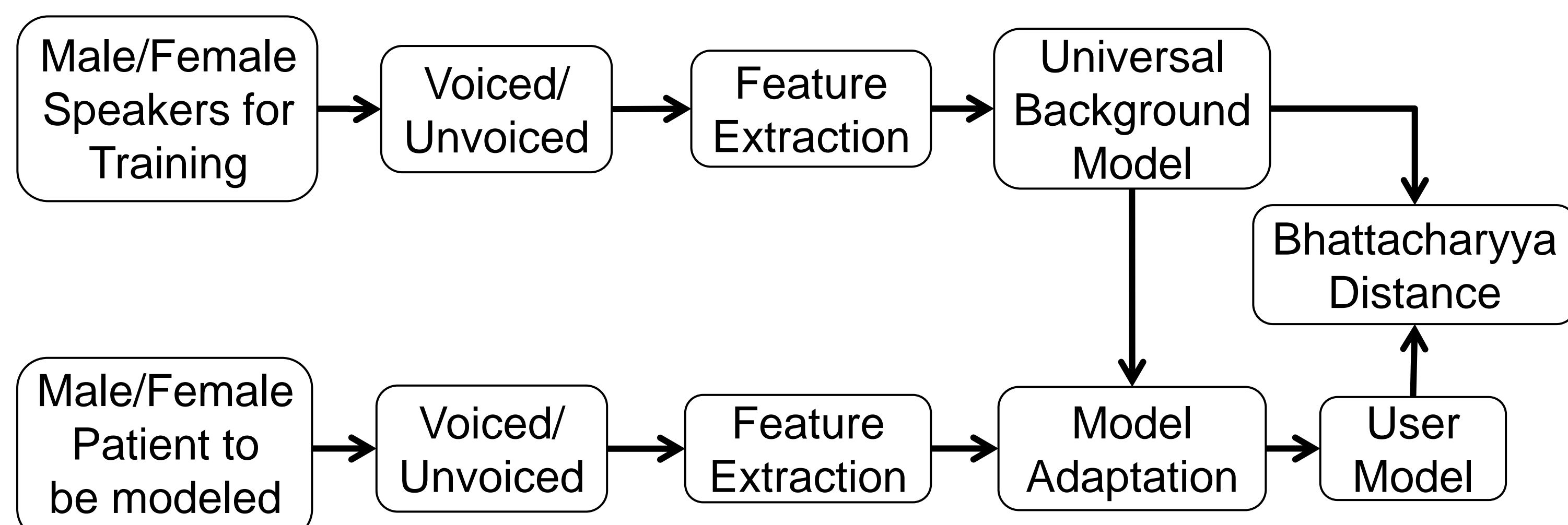
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Parkinson's disease (PD) severity is evaluated by neurologist experts using the Movement Disorder Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS). The main hypothesis is that changes in the speech of PD patients (PP) reflect changes in their neurological state. The Gaussian Mixture Model-Universal Background Model (GMM-UBM) approach is used to track the disease progression of 3 male and 4 female patients. Information from healthy controls (HC) is also considered to train the models.

Introduction

- The progression of PD and the symptoms vary among the patients.
- We propose a method to track the PD progression from speech signals collected in three recording sessions (2012, 2014, 2015), following a user-modeling approach.
- Some work suggests that gender separability can be used as a preprocessing stage for a more accurate design of gender-dependent pathology detection systems.

General methodology

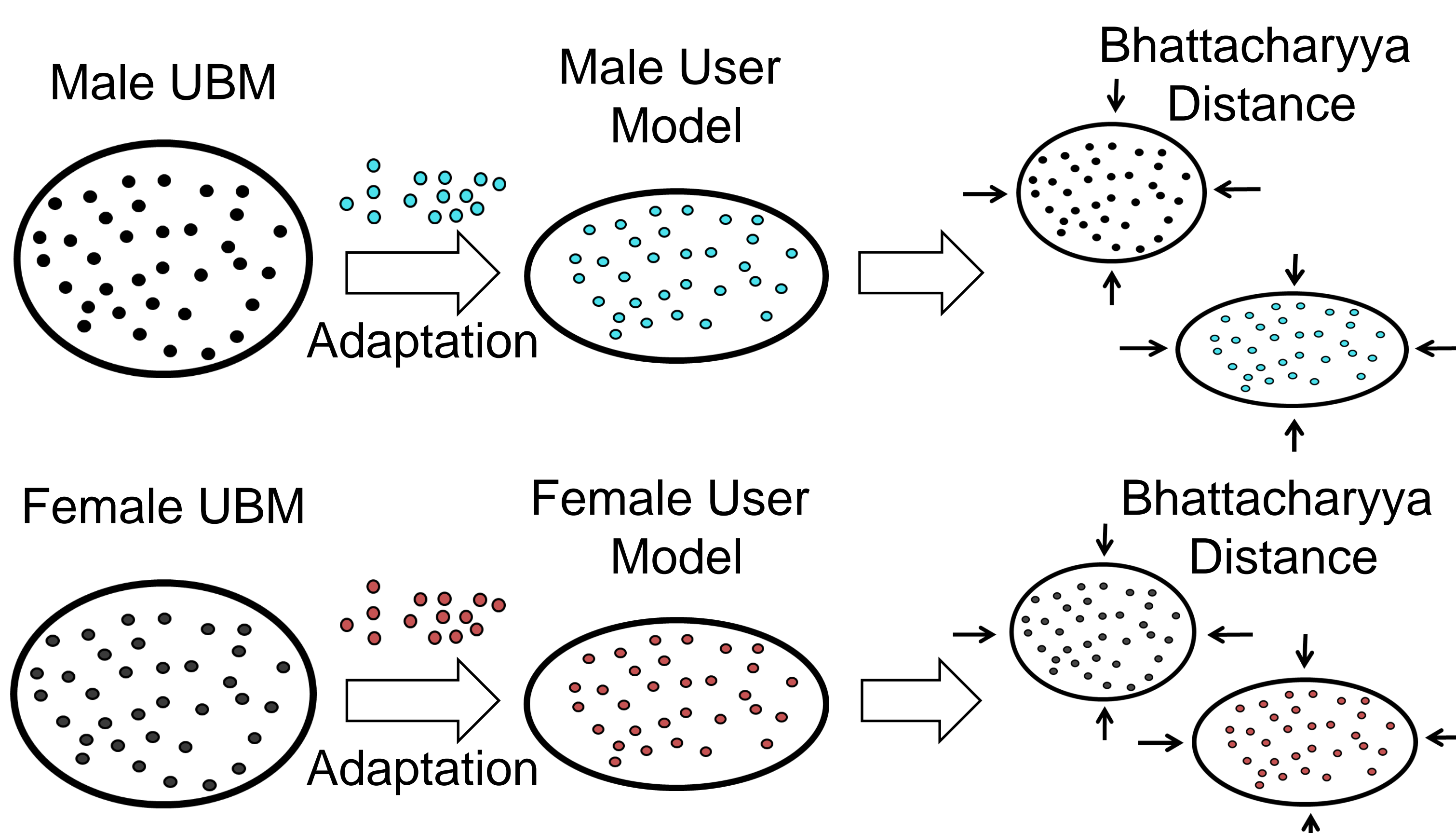


Data description

The UBMs are trained considering { 62 PP (34 male, 28 female)
50 HC (25 male, 25 female)

| Patient | Age | Gender | MDS-UPDRS-III | | |
|---------|-----|--------|---------------|-----------|-----------|
| | | | Session 1 | Session 2 | Session 3 |
| P1 | 64 | M | 28 | 19 | 13 |
| P2 | 69 | M | 6 | 8 | 24 |
| P3 | 68 | M | 14 | 25 | 7 |
| P4 | 55 | F | 29 | 26 | 26 |
| P5 | 56 | F | 43 | 10 | 19 |
| P6 | 51 | F | 38 | 49 | 44 |
| P7 | 57 | F | 41 | 35 | 33 |

User modeling

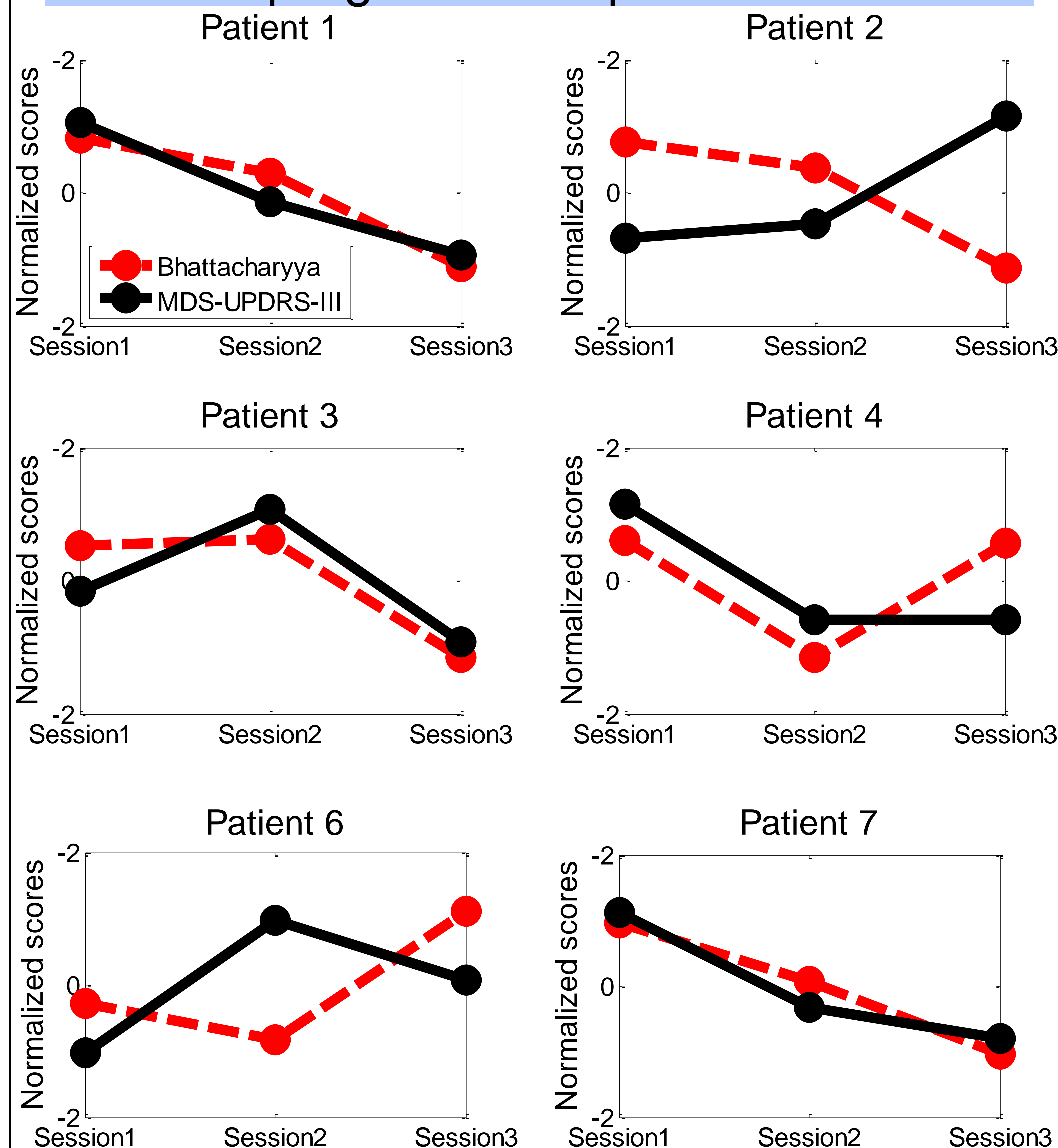


Experiments

The performance is evaluated estimating the Pearson's correlation between the computed distance and the MDS-UPDRS-III for each patient.

| UBM | Seg | Male speakers | | | Female speakers | | | |
|-------|----------|---------------|-------|------|-----------------|-------|------|------|
| | | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
| PP | Voiced | 0.90 | -0.79 | 0.44 | 0.51 | -0.05 | 0.14 | 0.68 |
| | Unvoiced | 0.96 | -0.91 | 0.78 | 0.61 | -0.05 | 0.65 | 0.90 |
| HC | Voiced | 0.80 | -0.99 | 0.89 | -0.98 | -0.28 | 0.80 | 0.90 |
| | Unvoiced | 0.99 | 0.94 | 0.72 | -0.51 | 0.48 | 0.39 | 0.42 |
| PP+HC | Voiced | 0.93 | -0.99 | 0.82 | 0.52 | -0.22 | 0.70 | 0.94 |
| | Unvoiced | 0.95 | 0.45 | 0.78 | -0.82 | -0.99 | 0.23 | 0.61 |

PD progression representation



Conclusions

- A methodology to assess Parkinson's disease progression from speech using the GMM-UBM approach is presented.
- The gender-dependence of the proposed approach is analyzed training separate models both for male and female speakers.
- In general the best results were obtained for the male patients.
- For female patients there is strong variation in the MDS-UPDRS that can not be tracked with the proposed approach.
- This paper is a step forward in the development of computer aided tools for the continuous and unobtrusive monitoring of people with Parkinson's disease.

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