**Early Biomarkers of Parkinson's Disease**

**Early biomarkers of Parkinson's disease based on natural connected speech**

**Introduction:**

Patients with the neurodegenerative disease Parkinson`s have numerous symptoms ranging from cognitive impairments to motor symptoms. Those symptoms may appear relatively late in the disease when the neurodegeneration has already widely spread in different areas of the brain (mainly Basal Ganglia).

Main symptoms of PD are motor dysfunctions including abnormalities in the production and sound of speech of such patients (up to 90%). These abnormalities in speech and voice are called hypokinetic dysarthria which is characterized by a decreased quality of the speech, where the voice, sound formation as well as the articulation is impaired.

As I mentioned before, often motor impairments are detected relatively late in the disease. To improve diagnostics and to detect the disease in a much earlier stage, the detection of biomarkers related to neurodegeneration could lead to a better prognosis and therapy of PD. Therefore, the investigation of prodromal speech changes could be an appropriate and suitable approach.

To investigate this approach, an automated speech monitoring system was developed, that uses a segmentation method for the precise estimation of voiced and unvoiced segments of speech, respirations and pauses. Further proposed was a set of acoustic speech features based on the segmentation algorithm applicable to connected speech, allowing the description of complex vocal disturbances due to neurodegeneration including respiratory deficits, dysphonia, imprecise articulation and dysrhythmia.

In this data analysis project, the main focus was to explore, if there are any speech patterns that support the usage of an automated speech monitoring system to detect prodromal parkinsonian neurodegeneration based on natural connected speech.

130 subjects were tested. 30 subjects with early, untreated Parkinson`s disease (PD) where the disease is already manifested. 50 subjects with REM sleep behaviour disorder (RBD), which is a disease where its relatively likely to develop PD in a later phase. As a control group, 50 healthy subjects (HD) were included.

**Data description:**

For each population (n=180) in this data set, we have the following information:

* Demographic information:
  + Age (years)
  + Gender (M for male, F for female)
* Clinical information:
  + Family\_History
* Overview of motor examination: total score of rating scale to assess Parkinson`s disease
  + UPDRS\_III\_Total: UPDRS III total score; examination only on subjects with PD
* UPDRS III motor scale: speech specific item (18) of UPDRS III, examination only on subjects with PD and RBD
  + UPDRS\_18\_Speech

0 = Normal  
1 = Slight loss of expression, diction and/or volume  
2 = Monotone, slurred but understandable; moderately impaired  
3 = Marked impairment, difficult to understand  
4 = Unintelligible

* Speech examination - speaking task of reading passage: speakers read a standardized, phonetically-balanced text of 80 words twice
  + Rate of speech timing (-/min)
* Speech examination - speaking task of monologue: participants were instructed to provide monologue about their interests, job, family or current activities for approximately 90 seconds.
  + Rate of speech respiration (-/min)
* Group:
  + PD: subjects with Parkinson`s disease
  + RBD: subjects with REM sleep behaviour disorder
  + HC: healthy controls