**Project Proposal**

**Detection of Parkinson’s Disease using speech**

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Speech Processing Area: Biomedical voice processing.

Research Question:

Is it possible to diagnose Parkinson’s Disease using speech processing with machine learning?

Hypothesis:

We believe it’s possible to create a model with a high probability of detecting Parkinson’s Disease using certain acoustic features extracted from test subjects.

We estimate that a deep learning-based model will better perform thanks to its feature engineering capabilities.   
we have found research supporting this hypothesis although it depends on the features that are used in the model.

Methods: Speech Processing, Machine Learning.

Introduction:

Parkinson’s Disease (PD) is a chronic and progressive condition caused by the gradual neuronal death in the substantia nigra, implicated in the production of dopamine neurotransmitters, which play a crucial role in motor control. Although PD is the second most common neurodegenerative disease, the average diagnosis time is above two years.  
Therefore, new tools are needed to assist in diagnosis and personalized treatment.

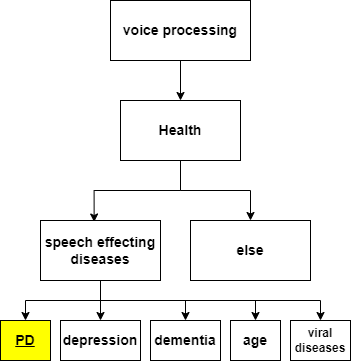
Speech involves complex and precise coordination of the respiratory system, larynx, and supraglottal articulators, being an excellent candidate to provide such diagnostic information1

The main deficits of PD speech are loss of intensity, monotony of pitch and loudness, reduced stress, inappropriate silences, short rushes of speech, variable rate, imprecise consonant articulation, harsh and breathy voice (dysphonia). Regarding the range of possible acoustic measurements to characterize PD’s influence on patients’ phonation, jitter, shimmer, and noise.2

Studies employing a sustained phonation of vowels (the most common is /**a**/) from patients and controls, obtain significant differences between groups for the three measurements: jitter and shimmer higher and HNR (Harmonic to Noise Ratio) lower.1

The recording and diagnosis can be done easily with mobile devices.2

Challenges:

To develop a voice-based model for detecting PD, there is a need to distinguish the test sample from other diseases such as Dementia and Depression, that might have similar characteristics, such diseases might cause the model to produce a false positive diagnosis1.

Age can also be a factor that can influence speech and consequently disrupt diagnosis attempts1.

Any existing disease (viral or otherwise) in the patient’s system may influence features used by the model to determine the diagnosis1.

finding a certain correlation between the variability of a particular acoustic feature and the disease’s severity or diagnosis labels might be taken with caution since correlation does not imply causation1.

Data collected must include and take into account the patient’s demographic information, sex, the stage of PD and pharmaceutical drugs taken by subjects1.

Work-plan:

we will study the influence of PD on the phonatory system. The type of acoustic material analyzed in these cases is usually the voice signal from one or several sustained vowels.1

we will compare different methods:

one method will be – analyzing the acoustic features extracted from recordings, alongside other data collected from PD patients and a control group.

We will use feature selection, specifically the mRMR Algorithm, to extract the most relevant features of a given dataset with respect to an output class, while minimizing the redundancy.2

The second method we will implement is a deep learning CNN (convolutional neural network) Algorithm that will self-extract features from the sound waves of the recordings and detects which patients suffer from PD.

Furthermore, find datasets on the topic that we will use for the ML models, research existing architectures for deep learning models and use statistical models.

Resources:

1. [Advances in Parkinson’s Disease detection and assessment using voice and speech: A review of the articulatory and phonatory aspects Laureano Moro-Velazquez, Najim Dehak (Center for Language and Speech Processing, Johns Hopkins University, Baltimore, USA) , Jorge A. Gomez-Garcia, Juan I. Godino-Llorente (Escuela T´ecnica Superior de Ingeniería y Sistemas de Telecomunicaci´ on, Universidad Polit´ecnica de Madrid, Madrid, Spain) , Julian D. Arias-Londono˜ (Department of Systems Engineering, Universidad de Antioquia, Medellín, Colombia).](https://www.sciencedirect.com/science/article/pii/S174680942100015X?casa_token=k1_xgjS3DzsAAAAA:AZOG57ScUMGTmdcOkUegXFYosaO11K9ZxEHJpSjF3nIxr47C9dtPO5SzbevoSgMPI7-U-F-GPc1F)
2. [Parkinson’s Disease Diagnosis Using Machine Learning and Voice Timothy J. Wroge (Department of Bioengineering, University of Pittsburgh, Pittsburgh, Pennsylvania, USA) , Yasin Ozkanca, Cenk Demiroglu (Department of Engineering, Ozye ¨ gin University, Istanbul, Turkey) , Dong Si (Division of Computing and Software Systems, University of Washington, Seattle, Washington, USA) , David C. Atkins and Reza Hosseini Ghomi (Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, Washington, USA).](https://ieeexplore.ieee.org/abstract/document/8615607?casa_token=EXNoZsTdUZMAAAAA:mI1DoqDvHnhQO52YmMRSIMLsfBt1JkZgiTLjLOTtzZs8Upi0i6zrllqATtLKGEerkRaY2CMD8w)