Prosody Features for Medical Speech

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Parkinson's Disorder

- Why it occurs ?
  - Many of the neurons break down and die. Especially, the ones responsible for the neurotransmitter - dopamine.
  - Due to dopamine, it causes abnormal brain activity leading to various symptoms.
  - This mainly affects movement.
    - Any kind.
- Some Symptoms:
  - Tremor: Usually starts in one hand.
  - Slowed movement: Even for simple tasks
  - Posture: stooped
  - Loss of automatic movements: like blinking
  - Speech changes.

How is this reflected in speech ?

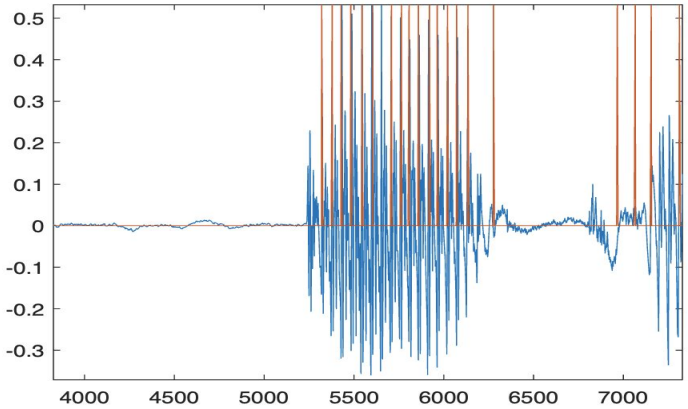
- Drooling: They have trouble controlling their saliva.
- Accelerated Speech
- Breathiness in their voice
- Tremor in voice
- Syllable repetitions
- Nasal sounding voice
- Softer voice
- Emotionless Speech.

How can we capture these symptoms ?

- Accelerated Speech
  - Count the number of syllables spoken in a given time frame. Can use VOP-VOP
- Breathiness in their voice
  - Harmonic : Noise
- Pauses in Speech
  - Time the silence region and have a threshold.
- Softer voice
  - Have an energy threshold
- Emotionless Speech.
  - How the fundamental frequency of the person changes over time.

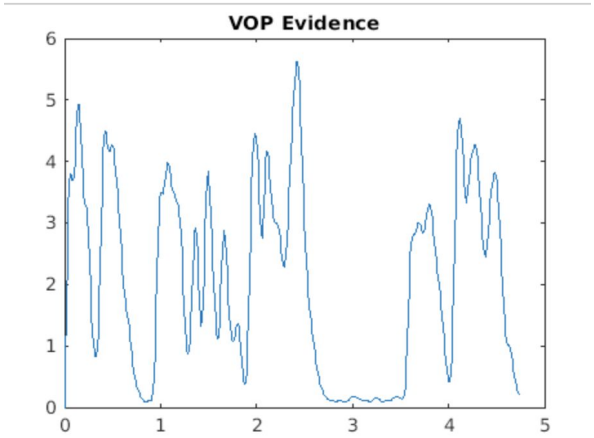
Epoch Extraction

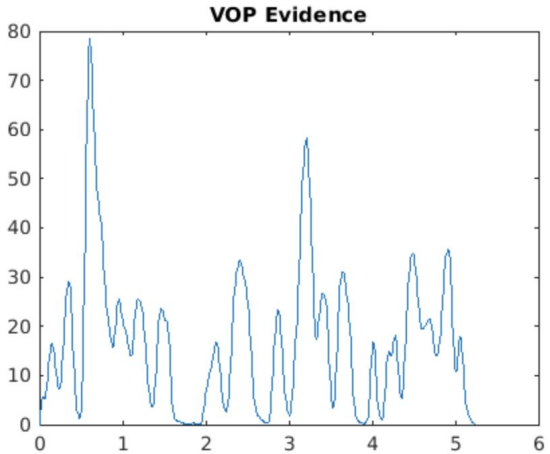
- Used Zero Frequency Filtering.
  - Applied the filter twice. ($1/(1-z^{-1})^2$)
  - Then subtracted the resultant signal four times with the moving average.
- Results:



Accelerated Speech

- Correlated speech rate with the number of VOPs in the speech. I have compared speeches where the normal person and the patient speak the same thing.
- Sum of 10 largest peaks in DFT Spectrum



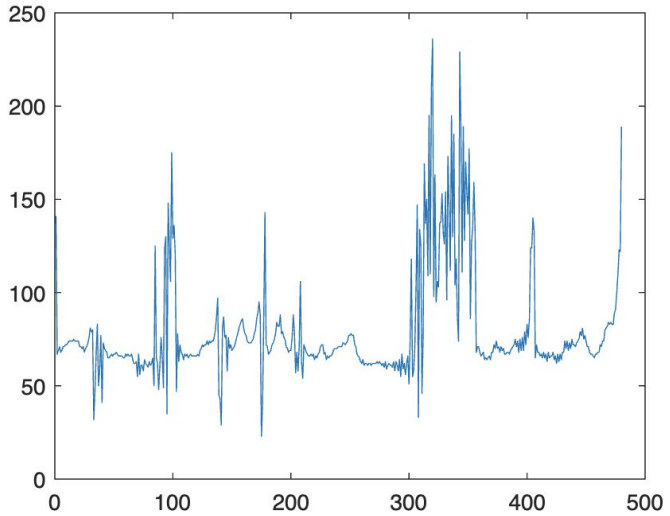


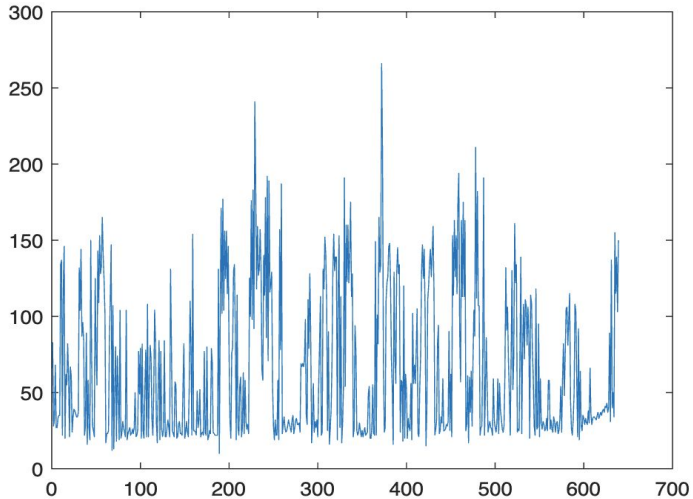
Softer Voice

- Looked at the Epochs.
  - Found the Epochs using ZFF.
  - Wherever zero crossing occurs I found the slope.
  - After that, I removed false epochs in the unvoiced regions to get the accurate strength.
- Observations:
  - Parkinson's:
    - On an average, Strength of Excitation (SOE) is less.
  - Control:
    - On an average, Strength of Excitation (SOE) is high.
- Clear indicator of whether a person has Parkinson's Disorder or not.

Monotone Speech

- Found Epochs in the speech using ZFF.
- Differentiated the Epoch locations to find out the pitch contour.





Pauses in Speech

- Wherever energy was zero (other than the start and the end of the sentence) was marked. I checked the time for this.
- This was not a clear indicator of pauses.