Using Machine Learning to Recognize Chronic Rhinosinusitis

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Background

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Chronic Rhinosinusitis (CRS)

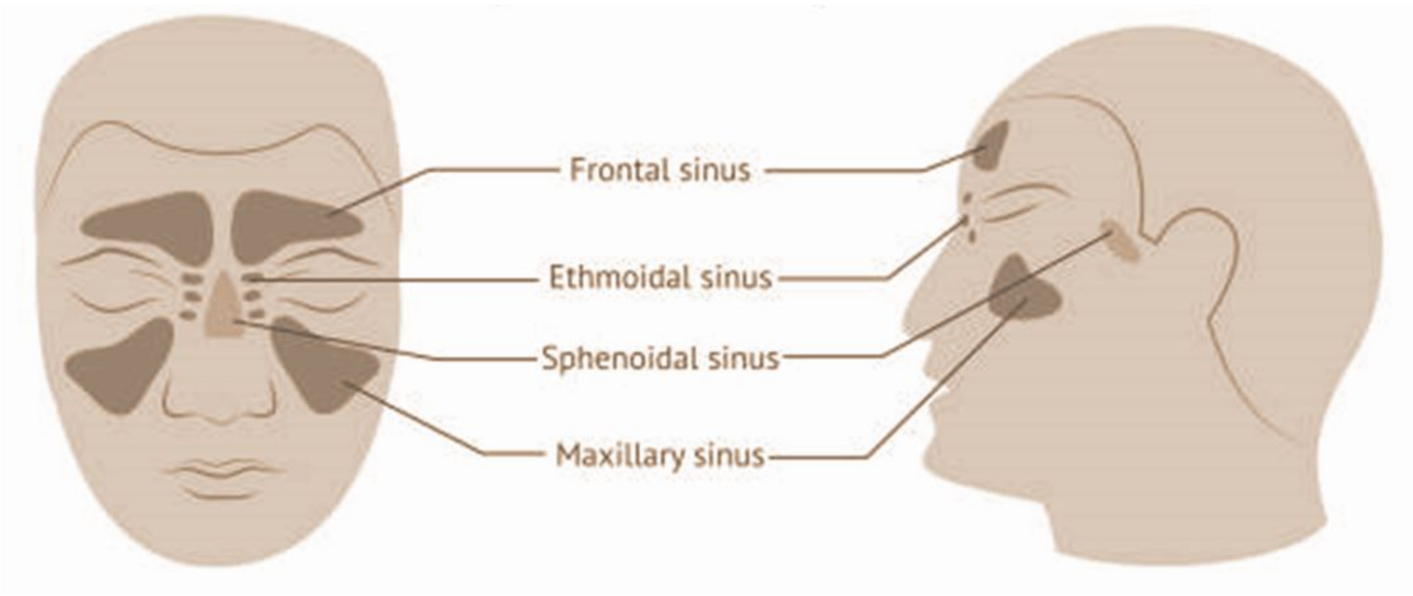
12+ consecutive weeks

Mucosa + paranasal sinuses

Inflammation

- 11.8% to 17.4% of Americans have CRS
- Costs medical system $22 billion per year

Paranasal Sinuses + Mucosa



Diagnosis

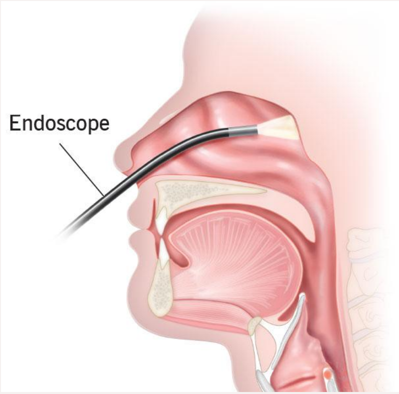
Symptom Tracking	Nasal Endoscopy	Computed Tomography

Symptom Tracking

- Facial and ear pain or pressure
- **Nasal obstruction, congestion, and discharge**
- Decreased sense of smell
- Headaches
- Fevers
- Bad breath
- Fatigue

Nasal Endoscopy

- Thin, flexible tube with a tiny camera and a light inserted into nose



Computed Tomography

- Type of x-ray

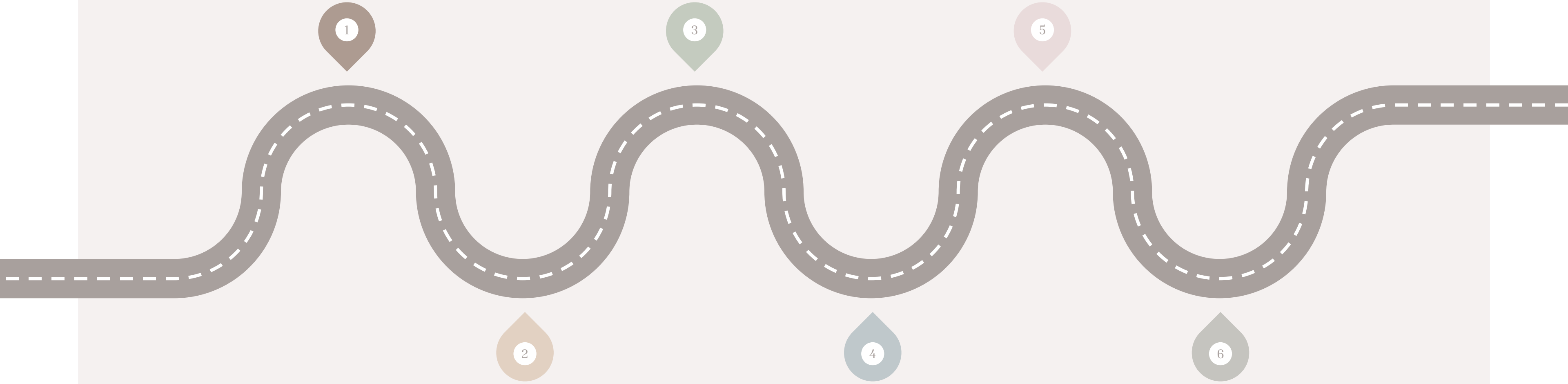
Question / Purpose

Do CRS patients speak differently enough that a machine learning algorithm can classify someone as having CRS or not having CRS, based on how they talk?

Methods

2

Roadmap of Methods

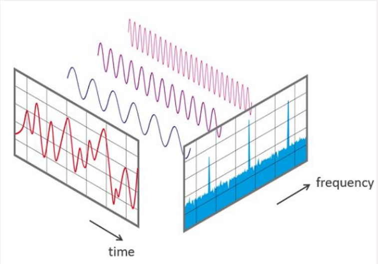


1. Record test subjects at 44100 kHz
2. Snip recorded files
3. Signal process with FFT, CWT, and Spectrogram
4. Take spectrogram data and make it into a feature vector
5. Train SVM on feature vector
6. Classification report gauges accuracy of the SVM

Signal Processing

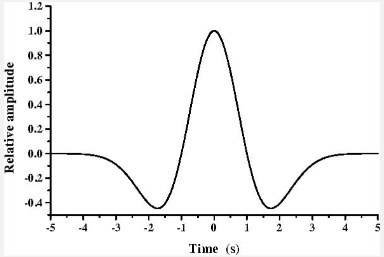
FFT

- Sampling rate of 44100
- Log scale, cut off at 3000



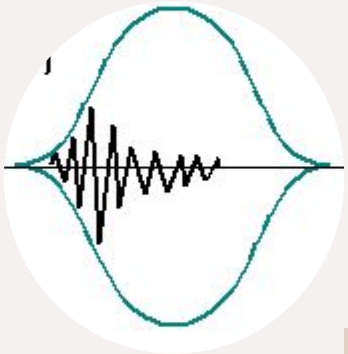
CWT

- Mexican hat wavelet
- Wavelet scales from 2 to 50 (step size 5)
- Graphed on a power spectral density



Spectrogram

- Hanning window
- 256 sampling points
- Overlap of 128



Results

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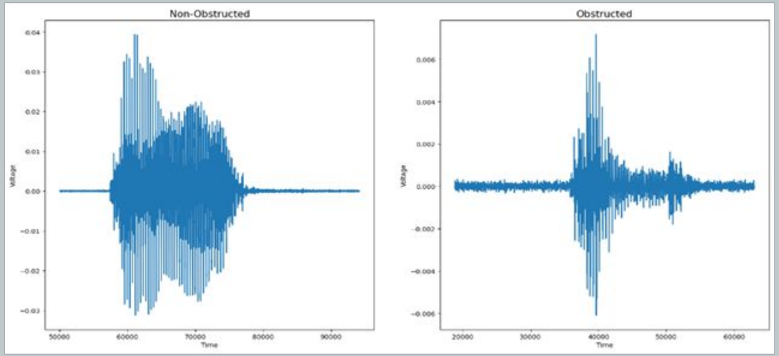
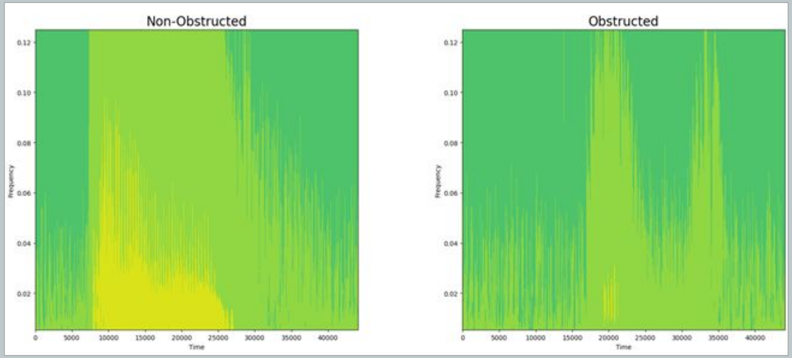
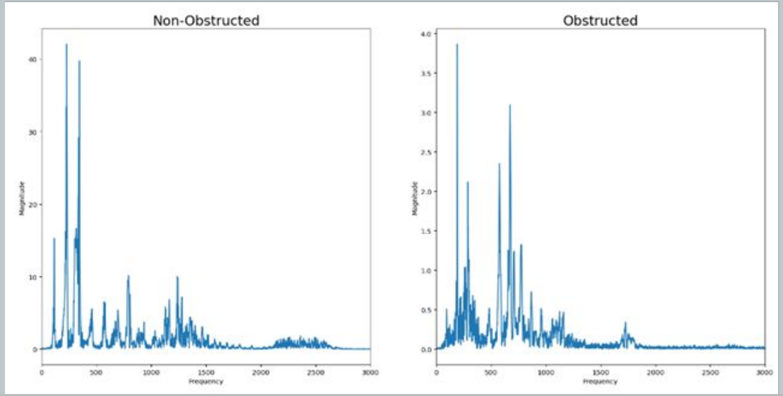
“ang” Signal



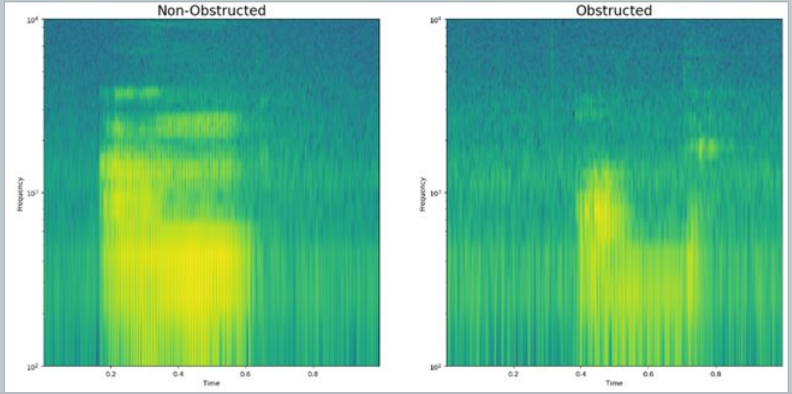
“ang” Continuous Wavelet Transform



“ang” FFT



“ang” Spectrogram



Parts of a Classification Report

Precision

Fraction of positives that were true positives

- If the alg. said 5 people had CRS but only 3 of them did, the precision would be 0.6

Recall

Fraction of true positive values that were found.

- If there were 10 CRS patients and the algorithm found 8 of them, the recall would be 0.8

	precision	recall	f1-score	support
NO	0.64	0.46	0.53	35
O	0.58	0.74	0.65	35
accuracy			0.60	70

Classification Report

$$\frac{TP}{TP + FP}$$

$$\frac{TP}{TP + FN}$$

(more important in this case!)

Harmonic mean of precision + recall

Conclusion

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Main Idea

SVMs effectively identified speech from obstructed noses, a symptom of Chronic Rhinosinusitis.

Future Work

- Better Precision + Recall
  - Machine Learning
    - Other algorithms
      - CNN
      - KNN
      - Decision Tree
    - Different parameters
  - Data
    - Real CRS Patients
    - Larger train set

Thanks!

Any questions?

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