

**Oral Presentation #3**  
**Clinical Analysis of Speech Rhythms in**  
**Language Development using MATLAB**  
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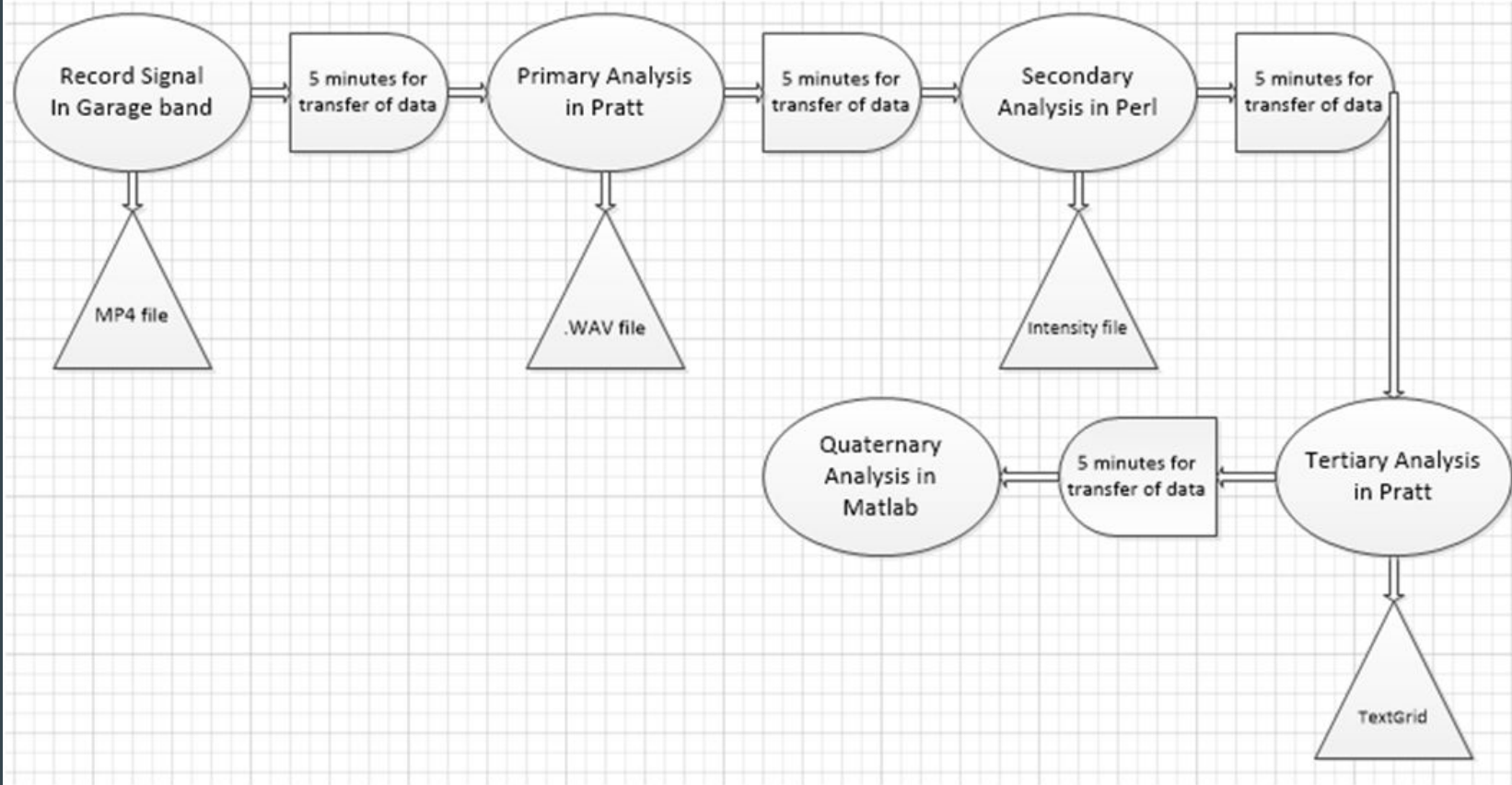
# Problem Statement

Preliminary research has been conducted that indicates a correlation exists between an **individual's rhythmic capabilities and language development**.

Currently, the data analysis process used to determine an individual's rhythmic abilities is **inefficient and impractical** in a clinical setting.

No data analysis process or system exists to assess an individual's speech rhythm. There is a need in the industry for **a diagnostic technique** that efficiently analyzes the individual's recorded speech to determine whether their rhythm is considered good or bad.

There is an immediate need in the Gordon lab for **a data analysis** process that quickly and efficiently judges rhythm in speech. Beyond the Gordon lab, there is a **clinical need for a device** with an intuitive interface that is capable of immediate analysis and display of feedback



# Needs Assessment

- Must:
  - **Detect the rhythm of the English language.**
  - Detect the rhythm of musical metronomes.
  - Compare rhythms of English language and music.
- **Data** collected from instrument **should be stored** for analysis and future retrieval.
- Design must **not exceed NIH grant budget**.
- Instrument **must be safe, physically compatible** with children, and **comfortable**.
- Design must allow for **variability between patient speech** and disorders.
- Lab setting must induce positive reinforcement for child compliance.
- Must be **compatible** with data files of past research.

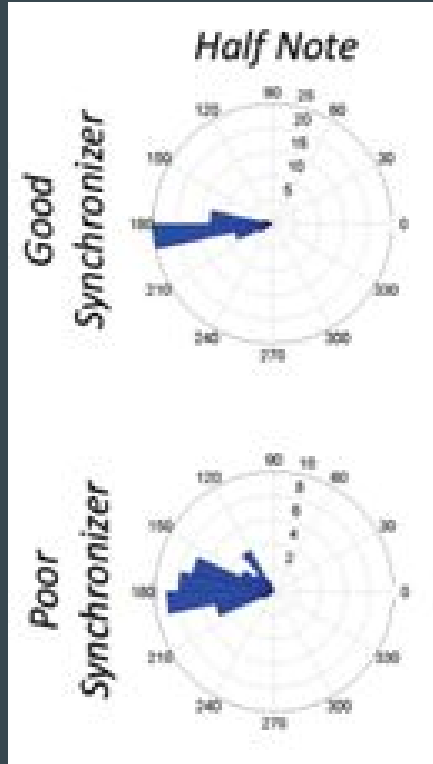
# Updated Needs Assessment

- Must streamline data in one software program
- Must reduce time needed to analyze data
- Must use consistent analytics
- Must provide feedback to user and lab staff
- Must have intuitive interface

# Specific Language Impairment and Lab Data

- ~75% of SLI goes undiagnosed
- SLI prevalence: about 7% of kindergartners
- Potential subjects are found from pediatric speech clinics, flyers, and word of mouth
- How are subjects chosen for the study?
  - Potential subjects have screening visits to quantify language skills
  - Occurs by administering the SPELT-3 exam
  - This data excludes late talkers and untrue SLI
- Often is comorbid with dyslexia

# Manifestation of SLI



Here we see the differences in self synchrony between a good and a poor synchronizer. While these graphs are not from and SLI patient and a healthy patient. We expect that SLI patients will have data that more closely represents the bottom graph.

# Design Components

- *MATLAB program:*
  - *Collect and analyze speech and metronome tracks*
  - *Utilization of toolbox functions and circular statistics*
  - *Feedback and user interface to assess patient rhythm consistency and accuracy*
- Data analysis program must be compatible with:
  - Various computer operating systems
  - A microphone (SM 58)
  - Headphones (any brand)
  - External Soundcard (Scarlett 2i2 system)
- The design of the study will:
  - Determine the rhythm baseline by sampling a population of individuals with normal speech development
  - Longitudinally assess impact of musical training on speech rhythm therapy

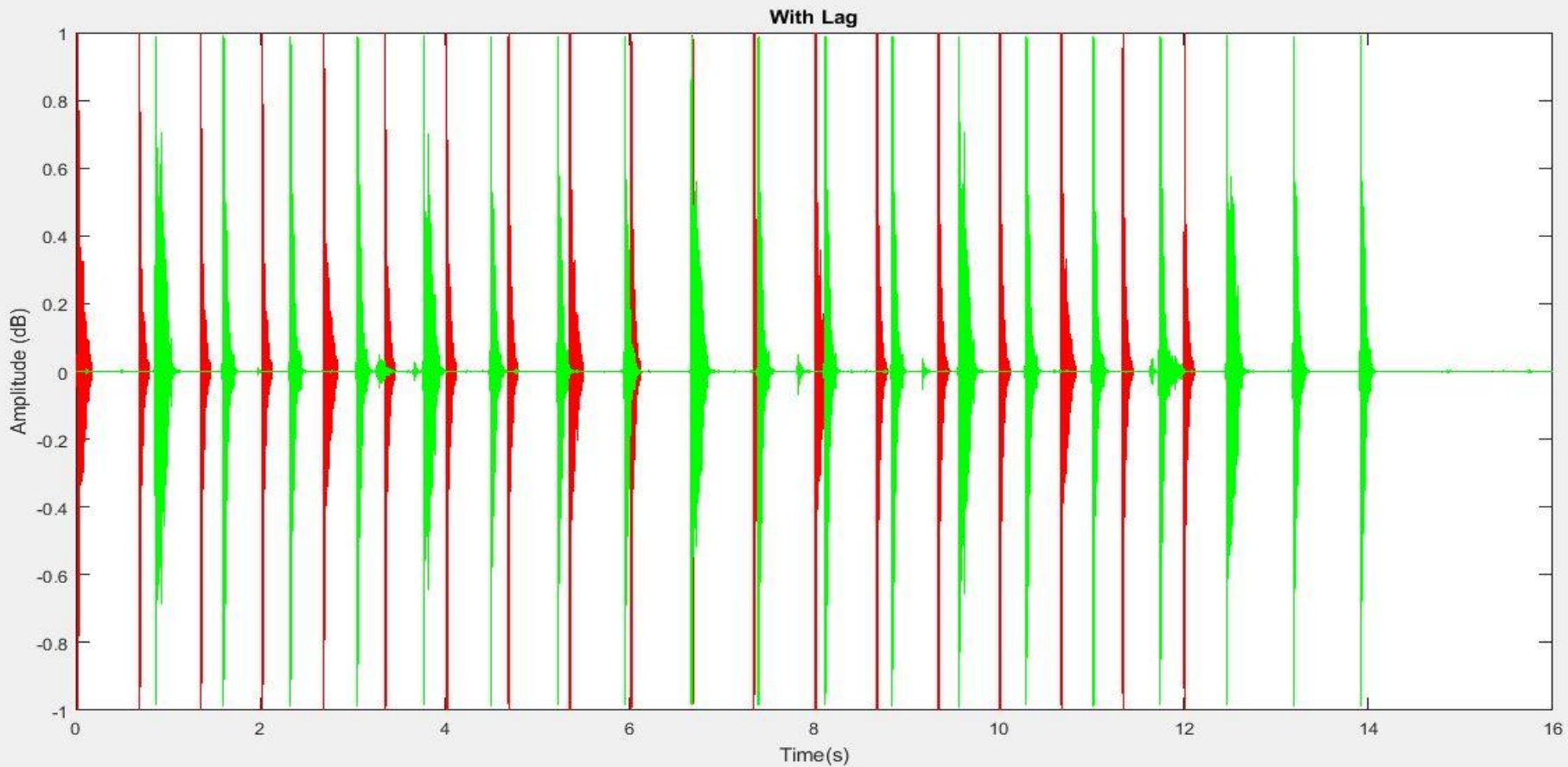


# Meeting with Dr. Nori Jacoby

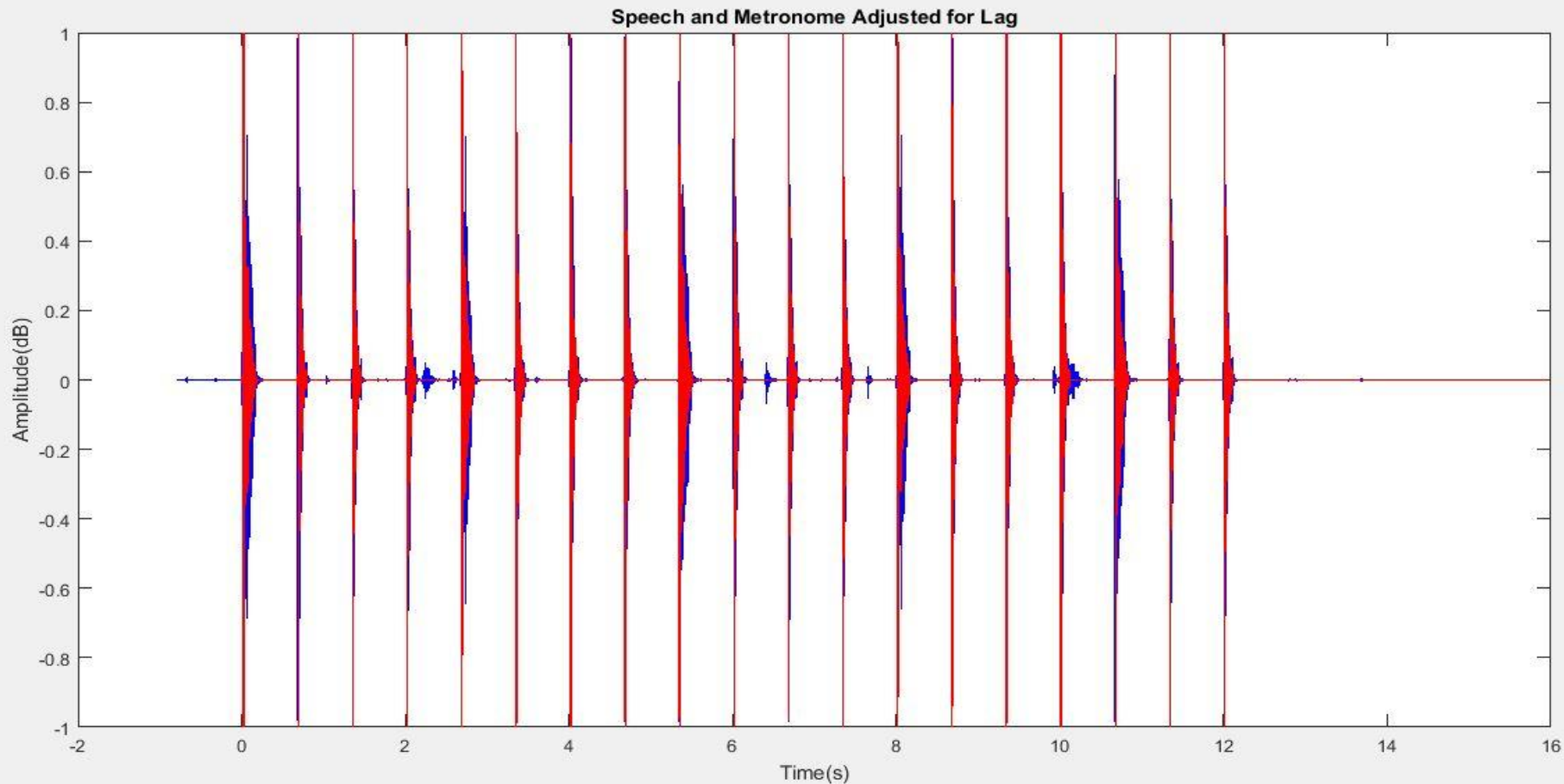


- Tuesday January 26<sup>th</sup> 2016- Research Fellow at MIT
- We discussed:
  - The difference between using the onset of the syllable versus using 60% of the speech beat amplitude
  - The root cause of lag and latency using a PC's sound card
  - Resampling data in order to change sampling frequency to 44,100Hz
  - Equipment: sound cards, cables and microphones

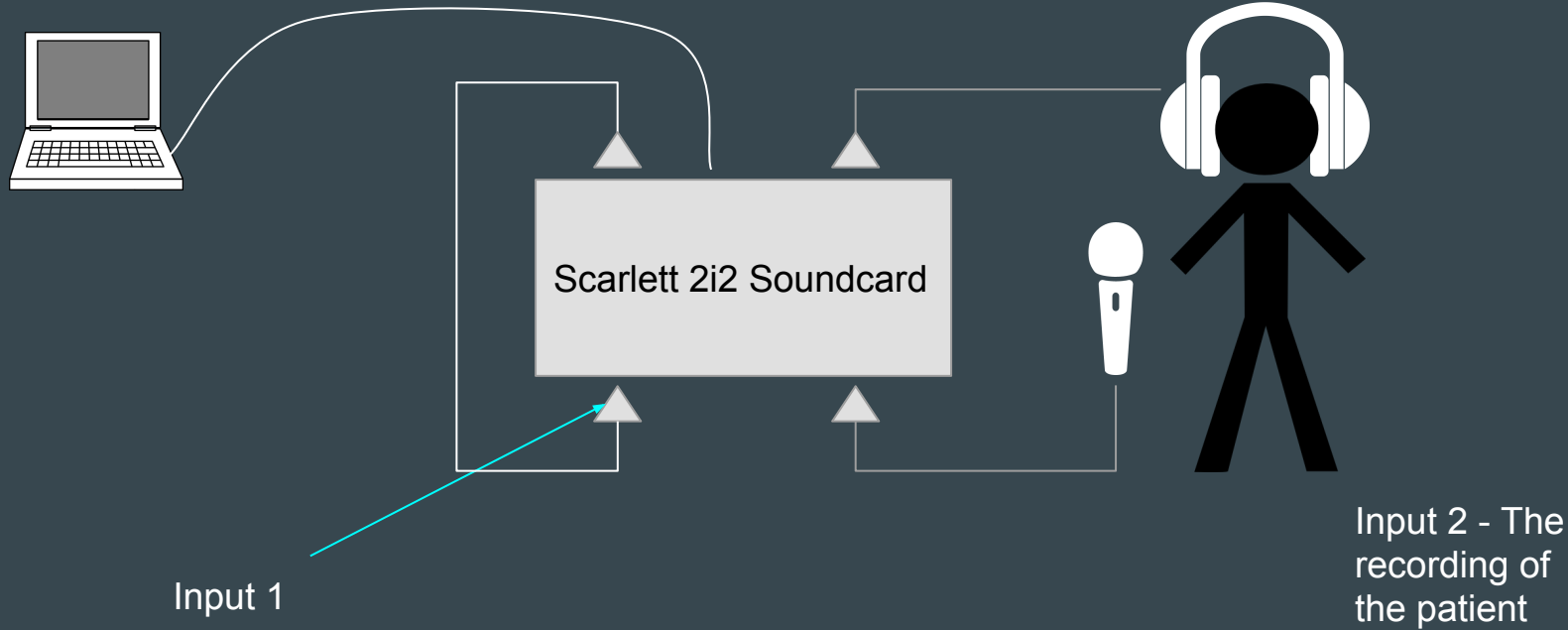
# Latency and Lag



# Pre Soundcard Latency Lag correction



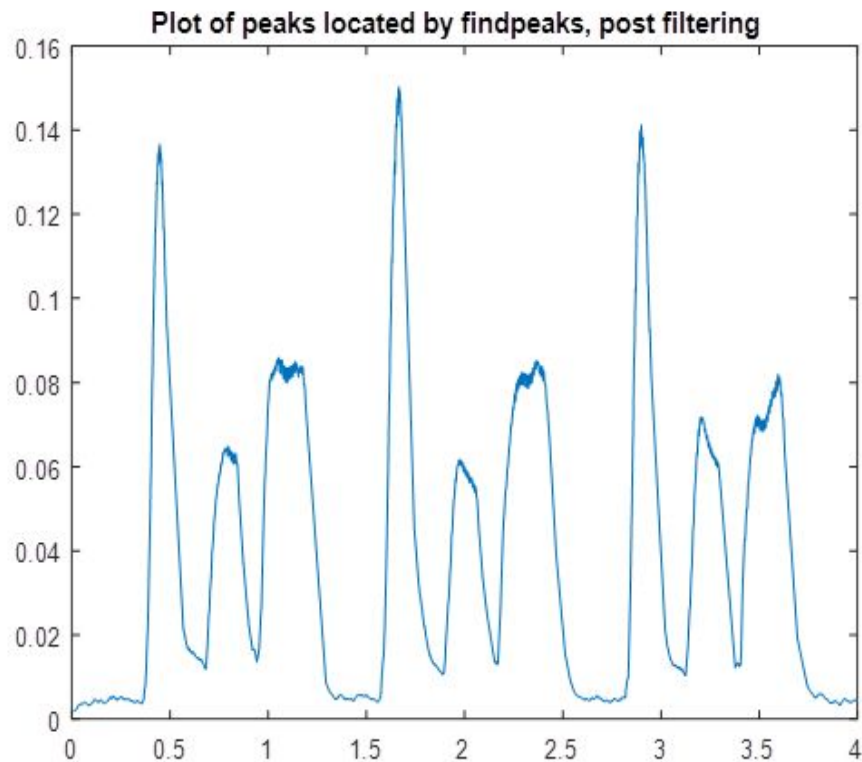
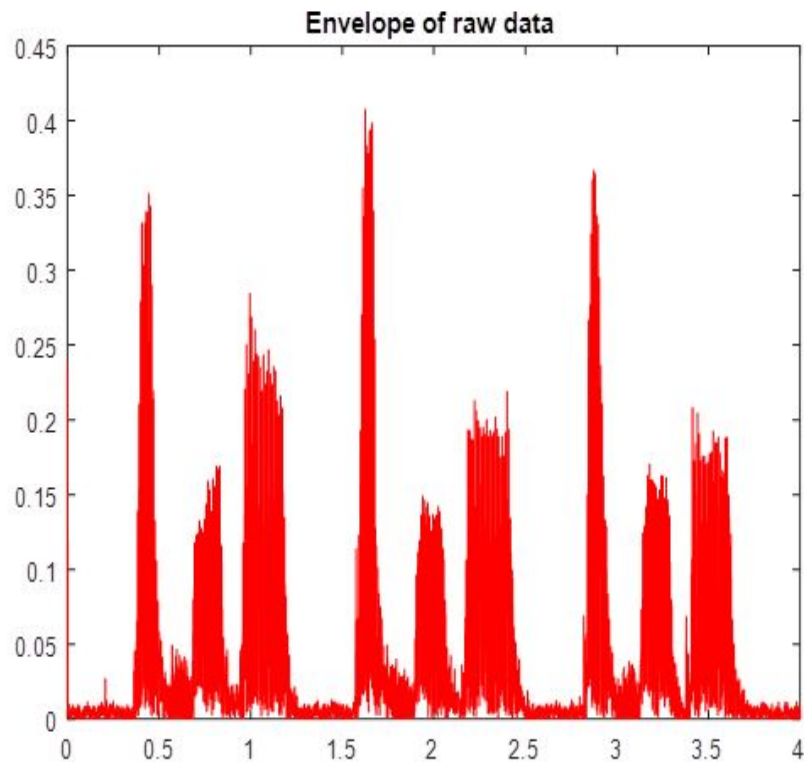
# Soundcard Application working diagram



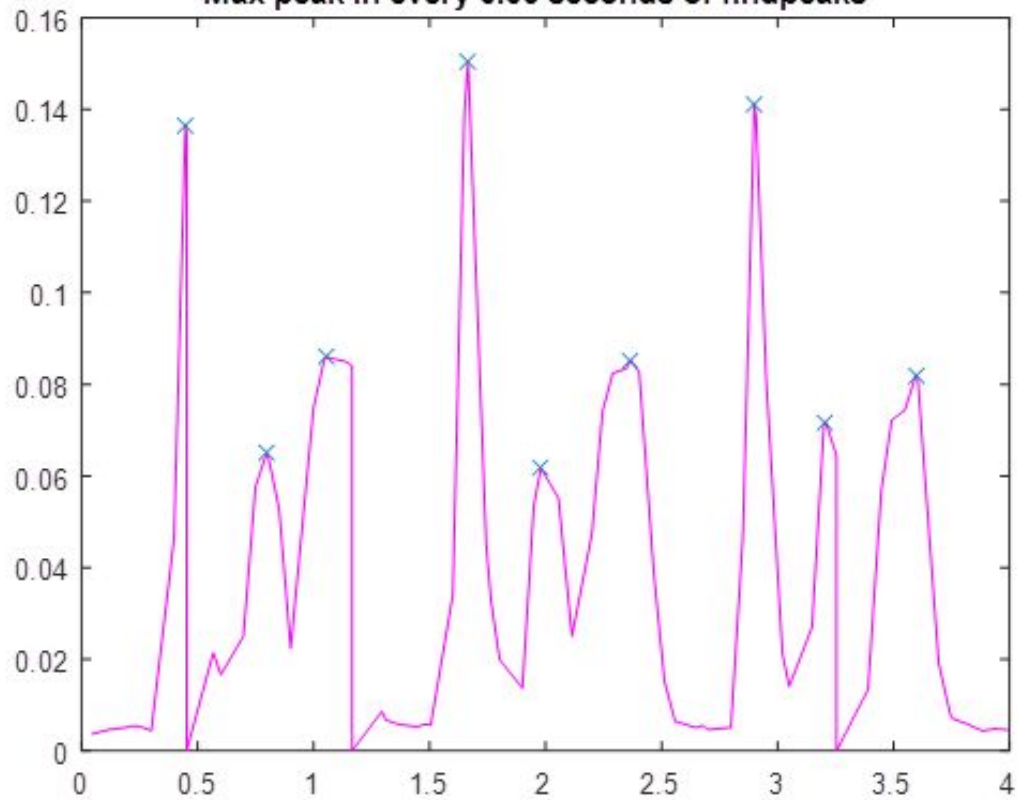
# MATLAB code outline

- Import data into MATLAB-✓
- Create visual display of data-✓
- Filter data-✓
- Locate speech beat peaks-✓
- Locate speech beat 60% onsets
- Import data into past circular statistics code
- Edit circular statistics code
- Output of diagnostic metrics

# New Filtering



Max peak in every 0.05 seconds of findpeaks



# Immediate/Near Future Work

- Identify 60% up the waveform
- Export 60% waveform data into circular statistics code
- Test and report on the effects of the new sound capture system
- Continue work on the grant proposal



# Questions & Comments