EE / CprE / SE 492 - sddec22-13

Simultaneous Call Transmission

Bi-Weekly Report 3

9/28/2022 - 10/11/2022
Client: Collins Aerospace
Faculty Advisor: Dr. Andrew Bolstad

Team Members:

Sullivan Jahnke - Project Manager and Machine Learning Co-Lead
Json Rangel - Reports, Webmaster, and Communication Systems Co-Lead
Tyler Mork - Reports and Communication Systems Co-Lead
Austin Rognes - Research and Machine Learning Co-Lead
Hani El-Zein - Digital Signal Processing Lead and Research

Past Week Accomplishments:

- Sully: Neural Network Additions, New WindowLabeler approach
    - Added the keras test and evaluate functions to the sctneuralnetwork class
    - Added two new neural network layouts into our sctneuralnetwork class that is configurable in the constructor.
        - One is the same as our first one except the output layer uses the ReLU function to go along with the new WindowLabeler approach.
        - One adds additional hidden layers, while also increasing the input size to 512.
    - The new WindowLabeler approach takes a window of labels, adds up all the 1s within that window, then divides it by the window size.
- Json: Simulated Data Generation and Labeling
    - Continued to run simulations to generate data.
        - Generated two more data sets containing no interfering signal and another set containing an interfering signal present the entire simulation.
        - Exported complex data to .csv file and pushed to the personal branch of the Git Repository.
    - Created MATLAB script to optimize data labeling.
    - Informed Software team of new data and MATLAB script.

- Tyler:
    - Began archiving ATC live scripts for inputs to data simulation
        - Scripts are downloaded as MP3 files from liveATC.net
        - Scripts are being stored and archived with flow of conversation in mind
    - Adjusted Gain ratios of input audio sources relative to the AWGN channel implemented in the simulation
        - Mathematical implementation with a goal of SNR = 10.
    - Created Simulink data simulation copy but with audio inputs greater than two.
    - Still attempting proper implementation of Doppler Effect and Shift.
        - Attempted frequency shift variable that varied with time of simulation.
            - Results varied with shifts in hundreds of HZ. Negligible?
            - Considered variables include:
                - aircraft moving towards and away from ATC
                - Presumed velocities of modern commercial aircraft
        - Will be attempting to research other methods for comparison in results
- Austin: Continuous Integration Pipeline
    - Created DataImportor to incrementally import csv/binary files to use. This can use multiple methods of data import depending on the files we want to use.
    - Worked on pipeline for automated data generation.
    - Found Microsoft audio dataset for static noiseless voice audio (5GB worth).
- Hani:
    - Research and attempt to implement doppler effects

Pending Issues:

- The program should not continue if the ReLU output network is specified and the correlating WindowLabeler is not.
- Need to do some additional testing to ensure the new changes work, then merge those changes into the master branch.
- Realized that we were implementing the "training in batches" approach incorrectly
    - Were doing 20 epochs per batch
    - Should be doing n batches per Epoch, where n is the number of batches total in the training dataset
- Need to start training multiple times a week and evaluating parameters that change the performance (evaluated using the new evaluate and predict functions).
- Noise implementation un-optimized due to improper signal-to-noise ratio during testing. Fixes are coming soon.
- Uncertainty with methods of transmitting the carrier alone.
- Documentation could always be worked on.

Individual Contributions:

Team Member	Contribution	Hours Spent	Total Hours

Sullivan Jahnke	Neural Network Additions & New WindowLabeler approach	10	58.5
Json Rangel	Data extraction, generation, and labeling	12	60
Tyler Mork	Doppler Effect, Archiving Live ATC Segments	10	51.5
Austin Rognes		10	42
Hani El-Zein	Tinkered with simulink model	4	38

Plans for Coming Week:

- Sully
  - Training
    - And lots of it
    - Make sure to save configurations in order to better analyze what parameters are affecting the model positively or negatively.
  - Find the best way to save and use a model after training/testing on it is done.
  - Fix the batch training mistake, and look into the keras feature that will help us with this
- Tyler
  - Further research on Doppler Effect implementation into Simulink. Compare and Contrast results
    - Determine if the Doppler Effect frequency shift is negligible at DC baseband for ATC radio transmissions
  - Continue archiving piece segments of Live ATC audio transmissions
- Json
  - Continue to extract and analyze simulated data.
    - Vary the audio being tested.
    - Label data once extracted.
    - Export to suitable file format for Software team (.csv).
    - Verify signal data sent is complex.
  - Push labeled data to Git for Software to test.
  - Generate a test data set for the software team.
- Austin

- ○ Start training models off configs
- ○ Setup ISU's Singularity GPU for better performance
- ● Hani
  - ○ Incorporate doppler effects to the team's simulation data