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EECE 3841 Speaker Detection Final Project

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Introduction

- Determine if a voice belongs to a nominal user
- Uses FFT and RMSE for detection
- Lightweight, no ML required

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Method Summary

- FFT transforms voice recordings
- Use files 1–3 to generate average profile
- Compare file 4 using RMSE
- RMSE < 0.005 ⇒ Match

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Methodology: Data Collection

- 14 users: 10 nominal, 4 imposters
- Each provided 5 recordings
- First 3 recordings used for user profile
- Consistent hardware and sentence
  - The arsonist has oddly shaped feet and the human torch was denied a bank loan.

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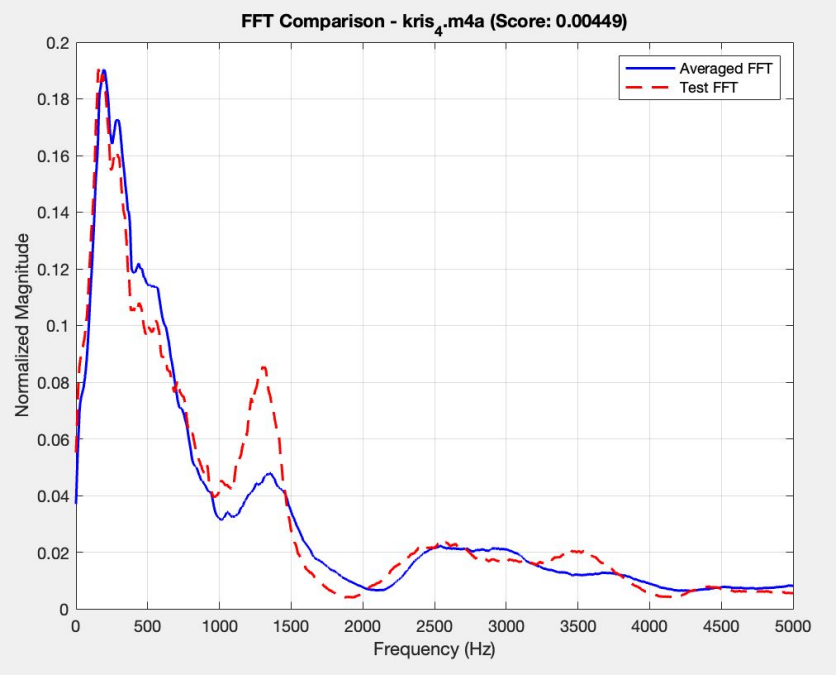
Methodology: Input Processing

- FFT
- Normalize
- Truncate
- Average
- Smooth
- Compare



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Methodology: Algorithm

- Create user profile: avg(FFT of files 1–3)
  - FFT → Normalize → Truncate → Average → Smooth → Compare
- Compare sample to user profile
- Return match if RMSE < threshold

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Training, Validation, and Testing

- Training: files 1–3 per user
- Validation: 4th audio file
- Testing: 5th audio file
- Fully automated in script

Pseudocode

```
For each user:
    avg_profile = average(FFT(file1), FFT(file2), FFT(file3))

    For each test_file in [file4, file5, imposters]:
        processed_test = normalize(smooth(FFT(test_file)))
        score = RMSE(processed_test, avg_profile)

        if score < threshold:
            match = true
        else:
            match = false
```

Pseudocode

```
Set configuation
For each_user [Test Users for self recognition]
For each_user [Test User against each imposter]
Print Results
```

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Threshold Tuning

- Threshold sweep: 0.0015–0.005
- 0.005 chosen for best results
- Lower ⇒ false rejects, higher ⇒ false accepts

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Final Results

- True Positives: 10
- False Negatives: 0
- False Positives: 0
- True Negatives: 40
- Precision: 100%
- Recall: 100%

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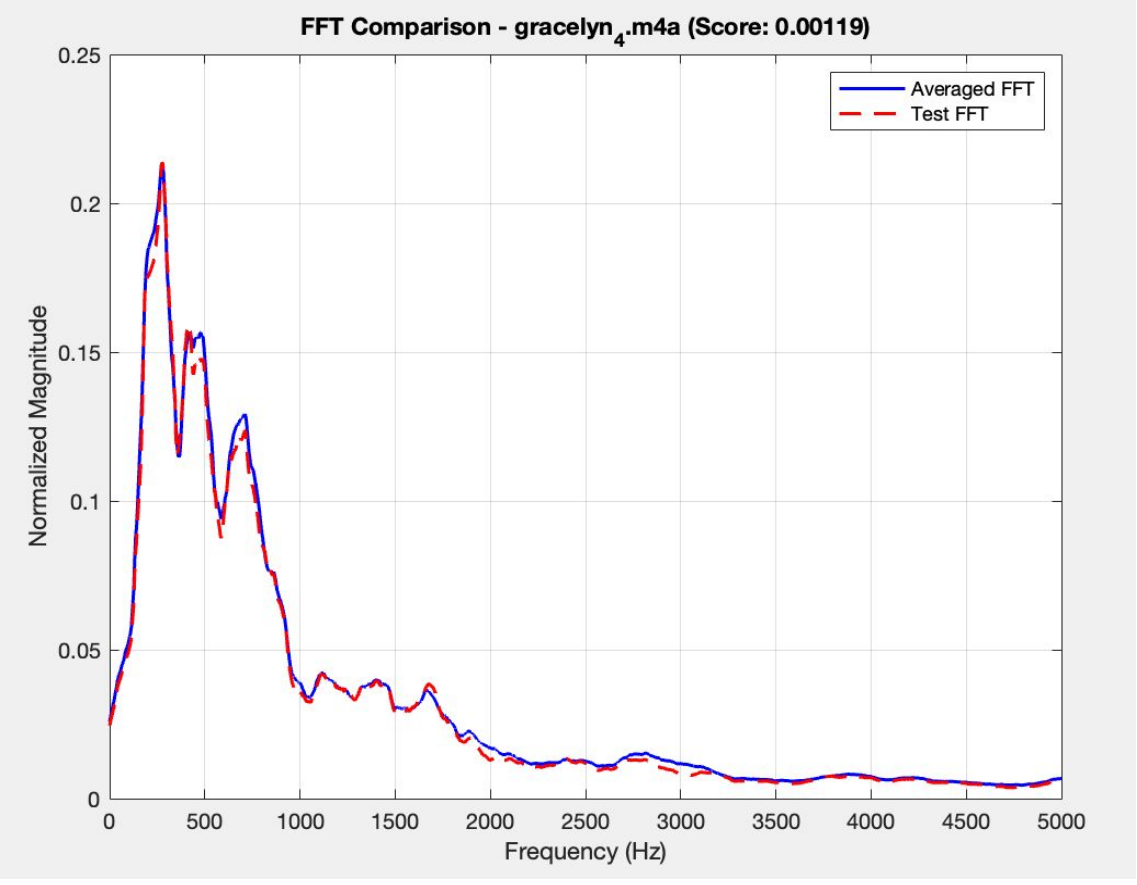
Match Case



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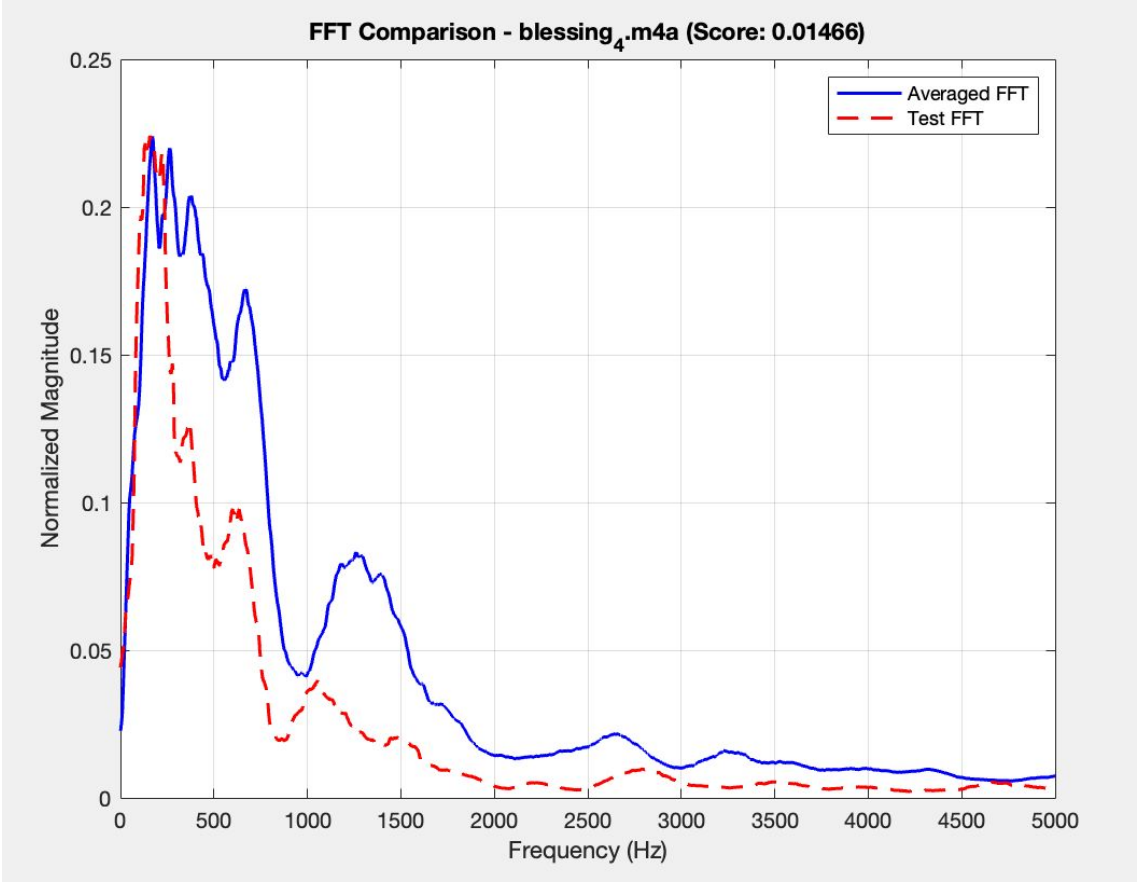
Rejected Case



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Runtime Analysis

- Total runtime: 10.27s
- test user.m: 0.21s per call
- Profile generation: 0.18s
- FFT comparison: 0.05s

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Discussion and Lessons Learned

- Strengths: efficient, accurate, simple
- Weaknesses: sensitive to noise and users with similar FFT’s
- Lessons: preprocessing and tuning are critical