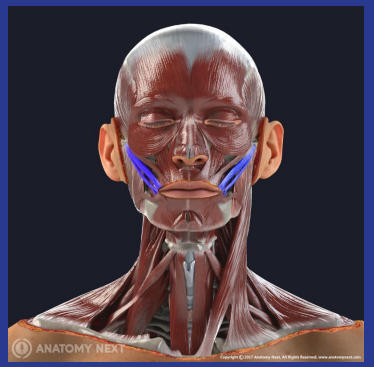
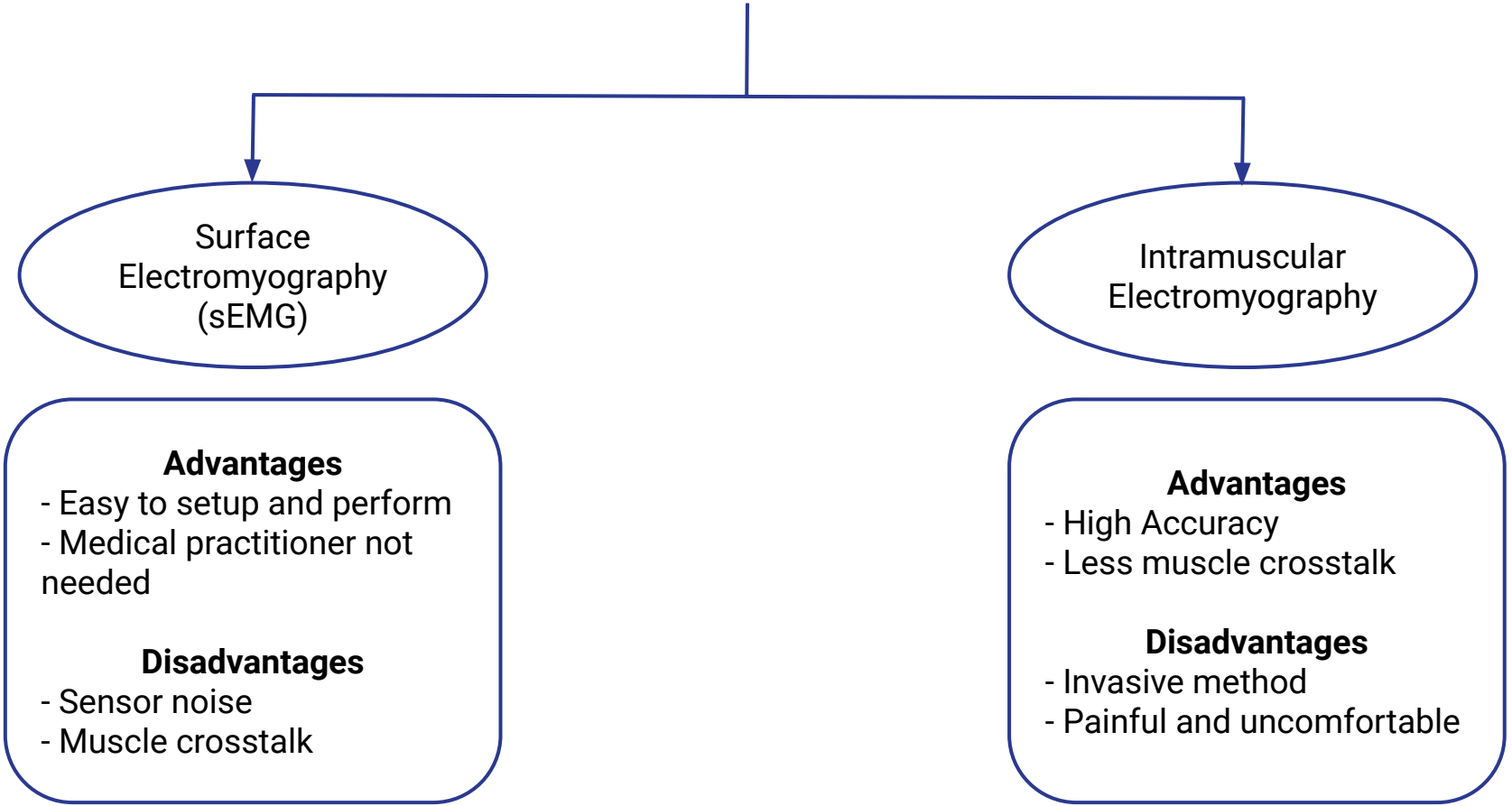
EMG SIGNAL ANALYSIS

ZYGOMATICUS MAJOR



Electromyography (EMG)



sEMG Setup

- sEMG method used for non-invasive assessment of muscles
- Apply spirit to the area before placing electrodes
- Place electrodes inline with each other to minimize artifacts
- Place the ground electrode on a bone segment
- Properly arrange the wires and observe the raw signal acquired on the software

ZYGOMATICUS MUSCLE

ELECTROMYOGRAPHY

- MEASURES ACTION POTENTIAL OF MUSCLES.
- GROUND ELECTRODE ON COLLAR BONE SEGMENT.
- SURFACE EMG FOR **ZYGOMATICUS MUSCLE**.

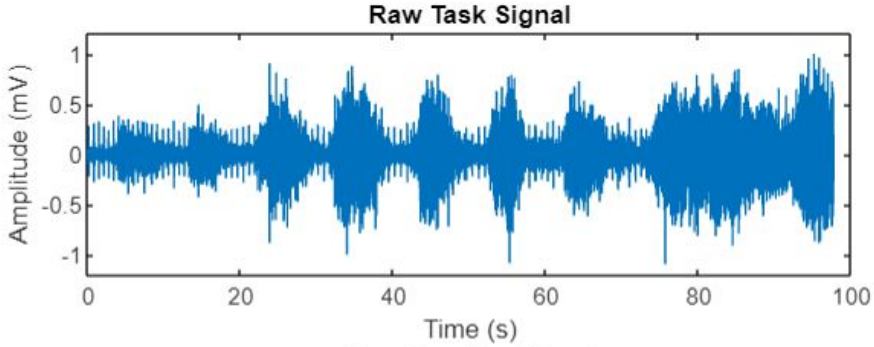
DATA ACQUISITION

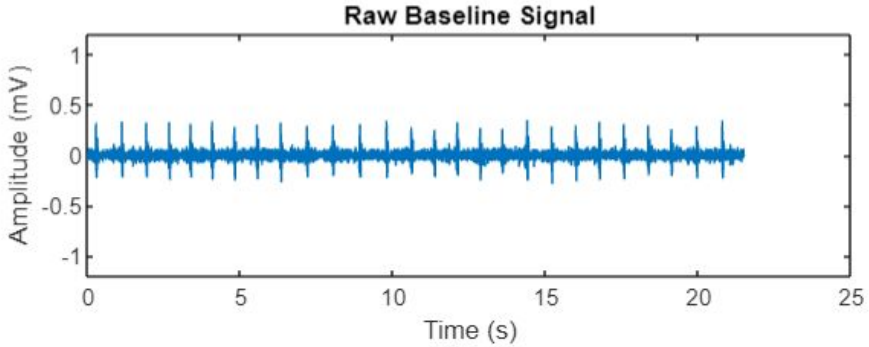
- **BASELINE SIGNAL** SERVES AS A REFERENCE POINT FOR COMPARISON.
- **TASK SIGNAL** CAPTURES VARIATIONS WITH DIFFERENT DEGREES OF ZYGOMATICUS MUSCLE ACTIVATION

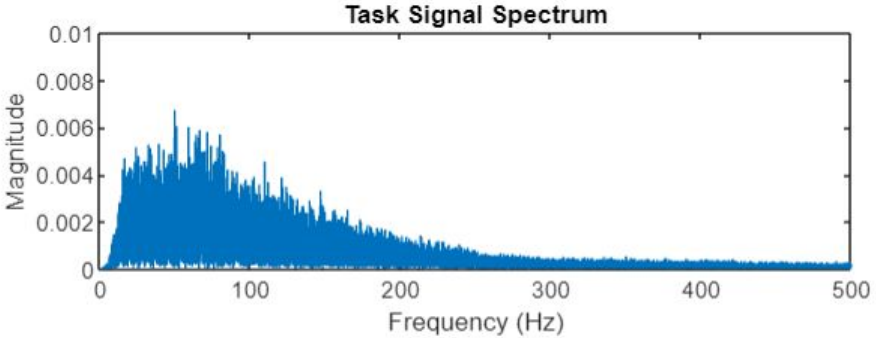
PROBLEM STATEMENT

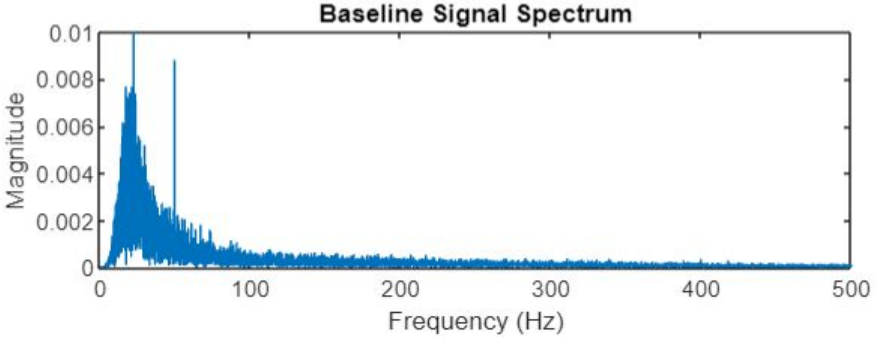
ANALYZING EMG SIGNALS FROM THE ZYGOMATICUS MUSCLE TO DELVE INTO THE NEUROMUSCULAR DYNAMICS OF FACIAL EXPRESSIONS, PARTICULARLY SMILING, AND EXPLORING POTENTIAL APPLICATIONS IN **HEALTHCARE DIAGNOSTICS.**

RAW SIGNAL & SPECTRUM







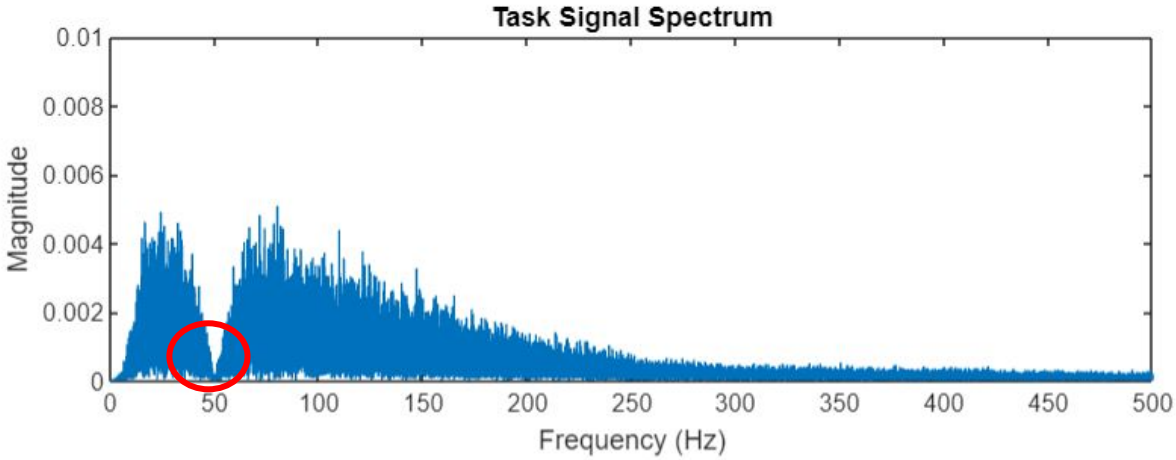


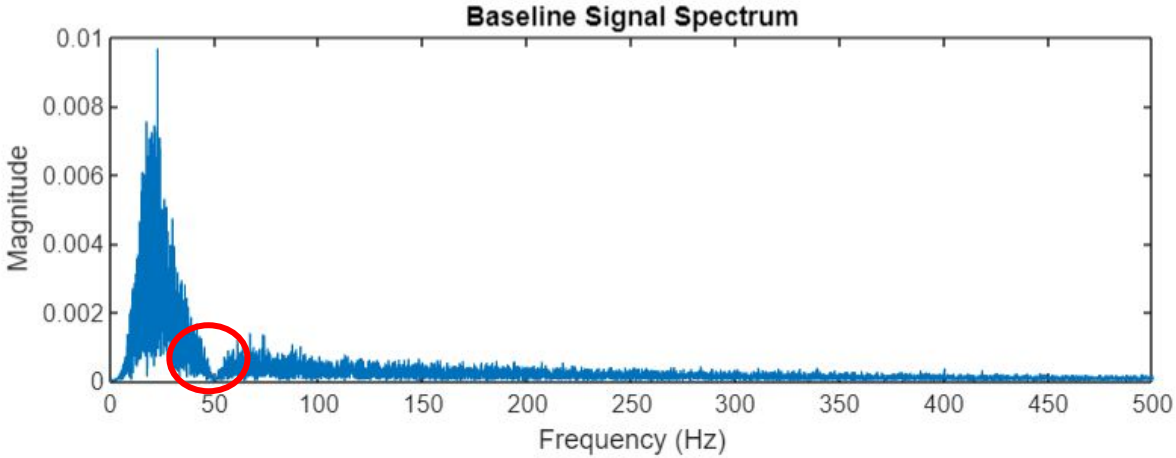
RAW SIGNAL

Challenge 1

POWER LINE INTERFERENCE

Notch Filter: When electrical equipment is used there is a possibility of unwanted power line interference (50 Hz) contaminating the signals of interest.



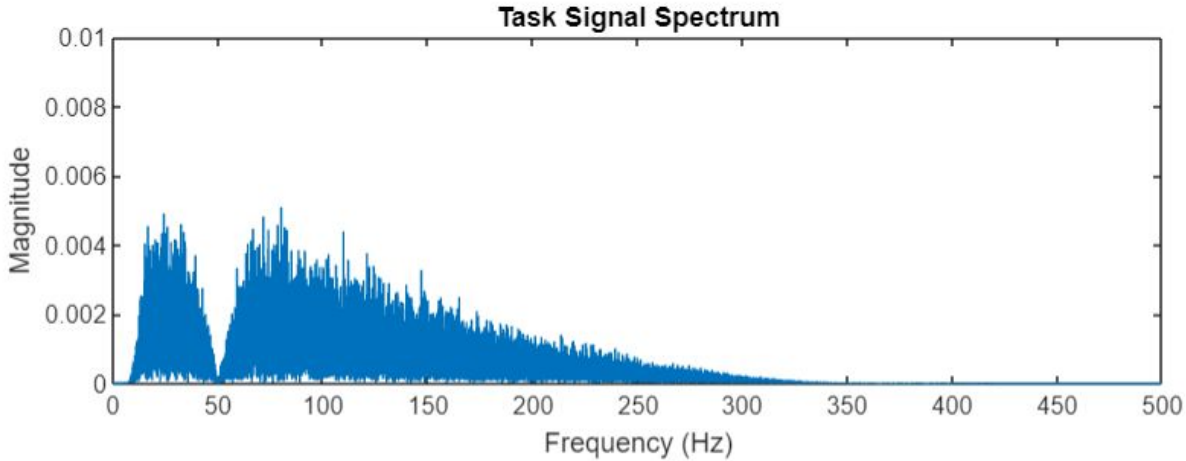


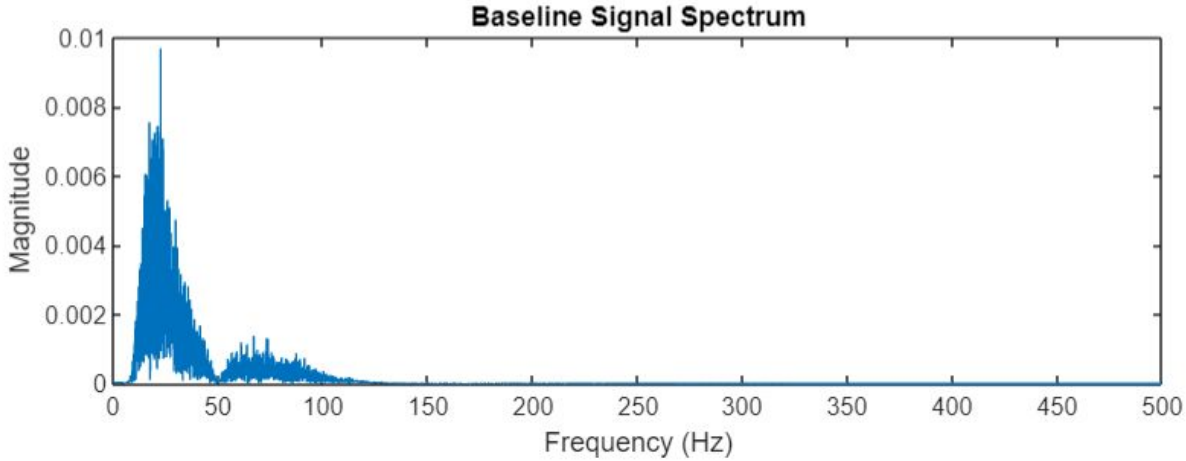
RAW SIGNAL

Challenge 2

NOISE

4th order Butterworth Bandpass Filter: Low & High Frequency Artifacts are noise caused due to unwanted movement of electrodes when placed on the surface of the skin.



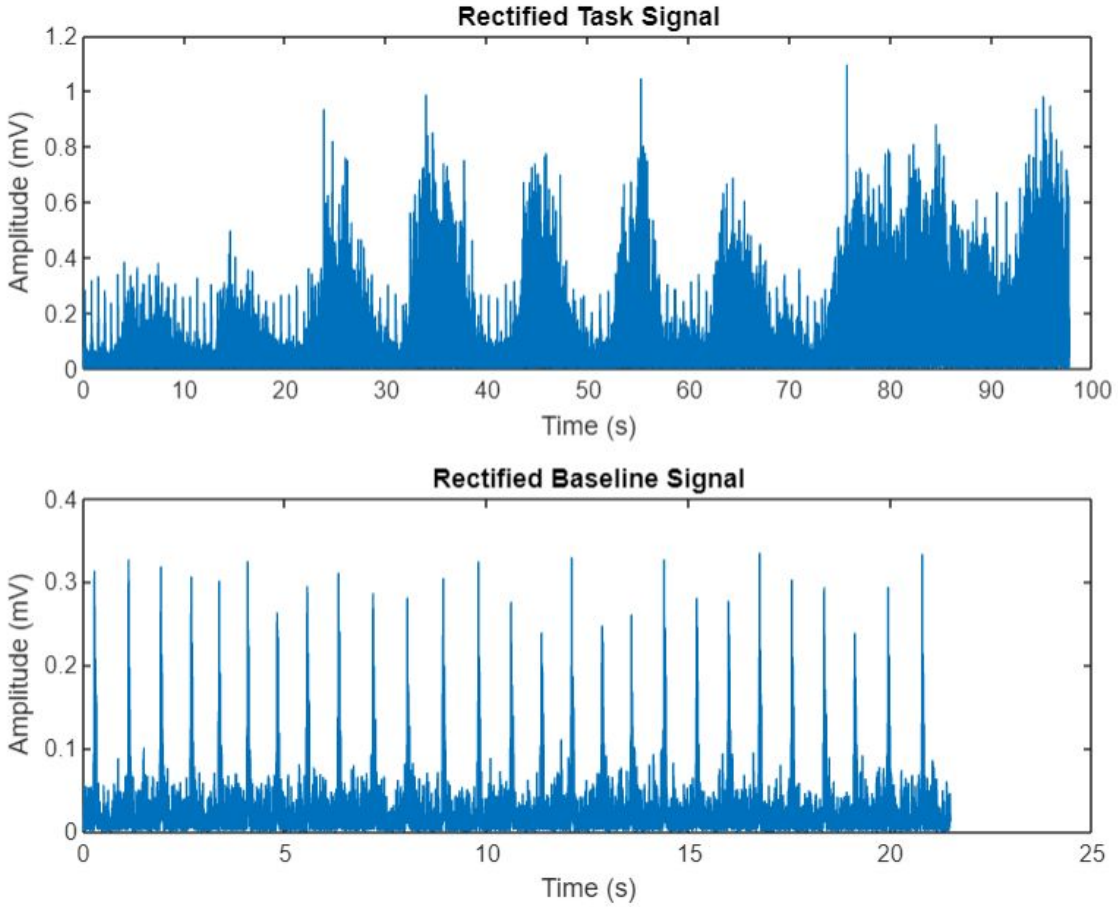


RAW SIGNAL

Challenge 3

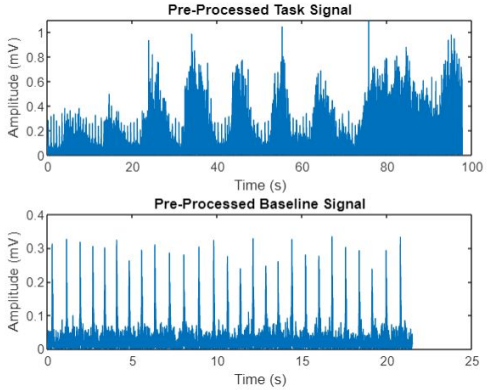
ZERO MEAN POWER

Full Wave Rectification: Raw SEMG contains both positive and negative components which cancel each other out when calculating an average.



Time Domain Analysis

MUSCLE ACTIVATION STRENGTH



MAV Task: 0.101970

RMS Task: 0.149485

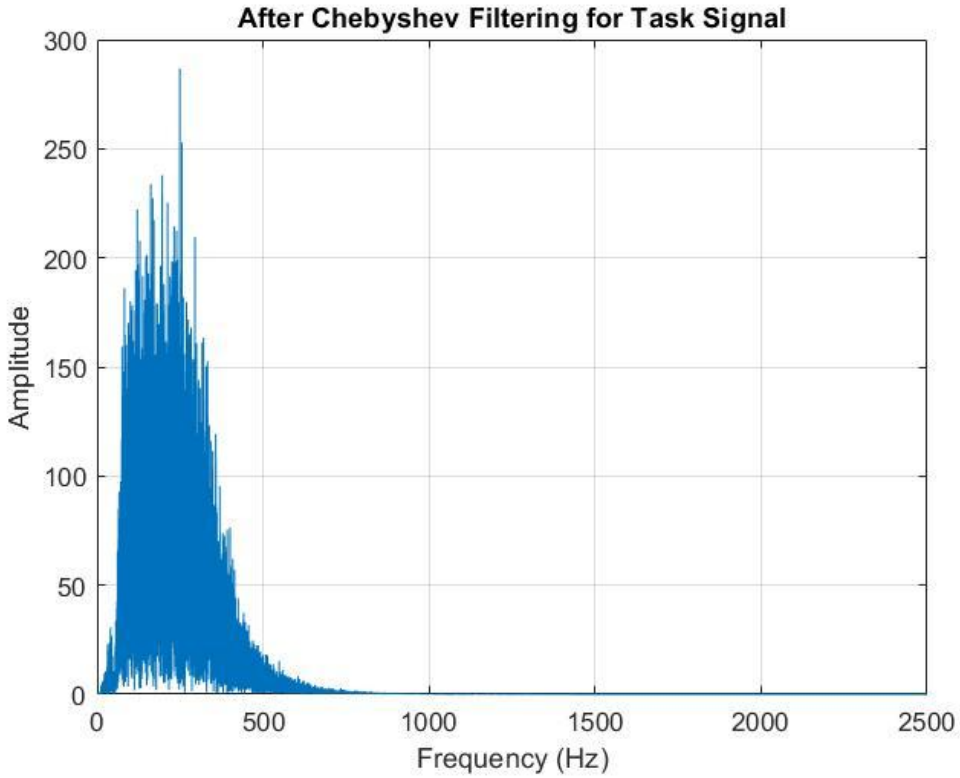
MAV Baseline: 0.031694

RMS Baseline: 0.052183

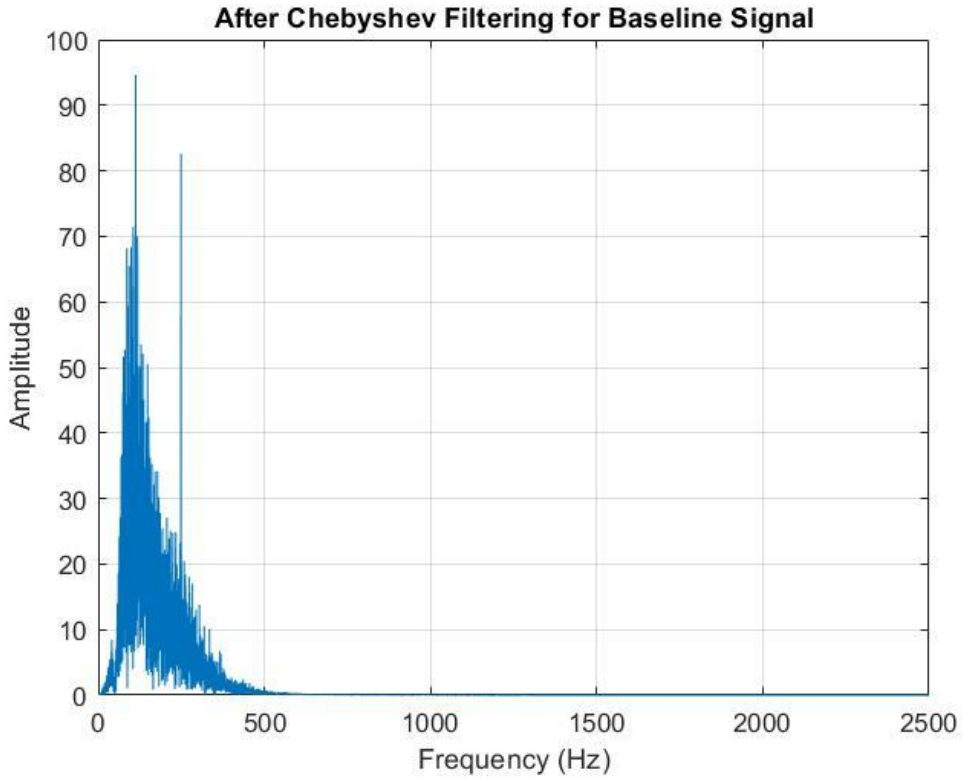
Statistics for Task Signal	0-21 sec	22-43 sec	44-65 sec	Sustained Smiling
MAV	0.053	0.098	0.103	0.137
RMS	0.075	0.145	0.146	0.186

Frequency Domain Analysis

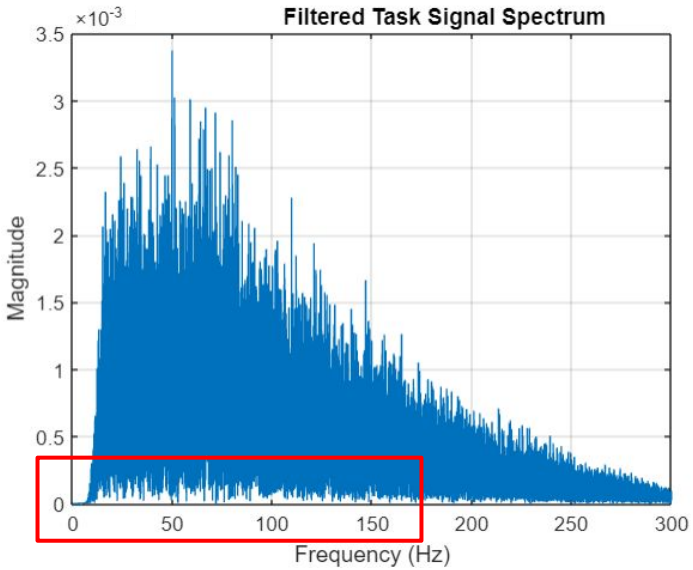
FILTERING

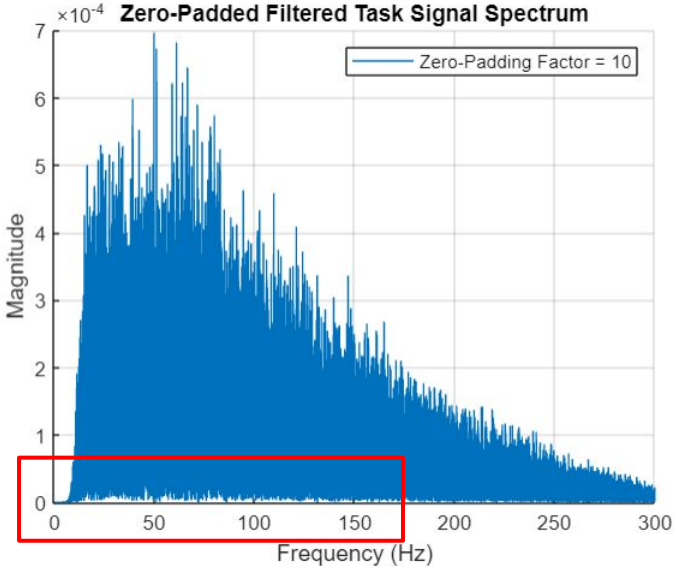

After Chebyshev Filtering for Task Signal
Amplitude
Frequency (Hz)
0
50
100
150
200
250
300
0
500
1000
1500
2000
2500

FILTERING

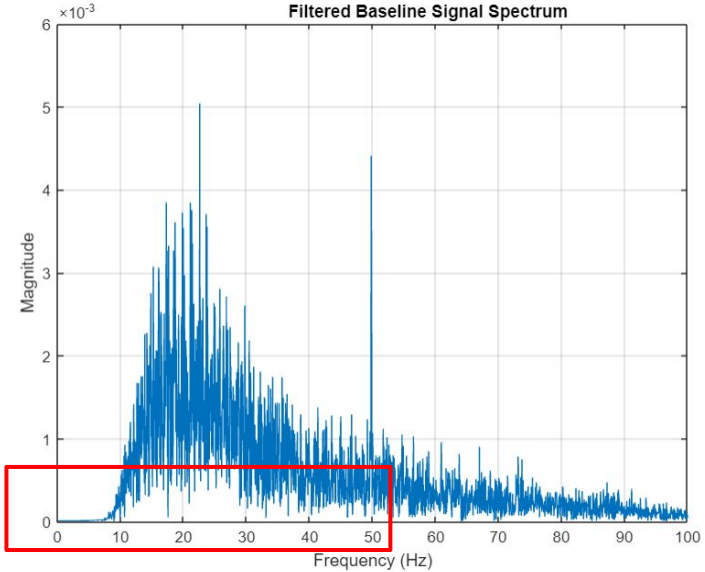

After Chebyshev Filtering for Baseline Signal
Amplitude
Frequency (Hz)
0
10
20
30
40
50
60
70
80
90
100
0
500
1000
1500
2000
2500

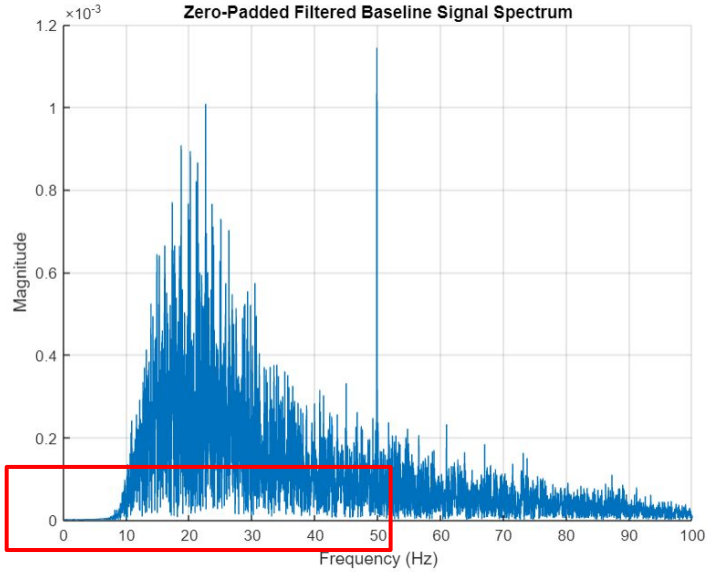
ZERO PADDING



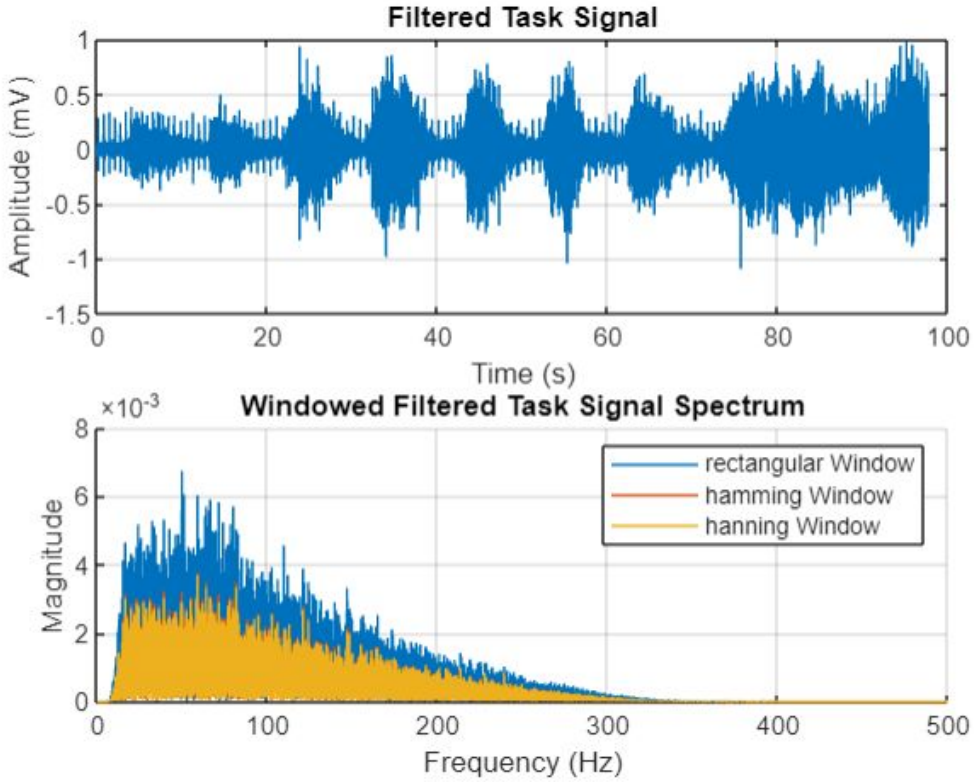


ZERO PADDING

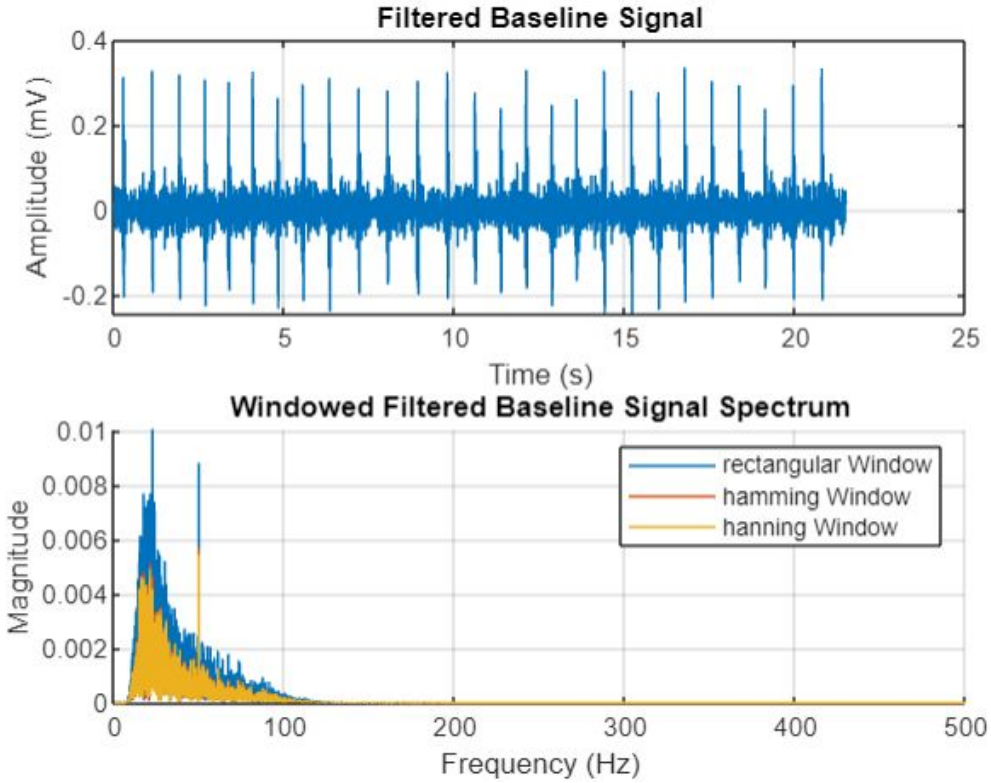




WINDOWING


Filtered Task Signal
Amplitude (mV)
1
0.5
0
-0.5
-1
-1.5
0
20
40
60
80
100
Time (s)
×10-3
Windowed Filtered Task Signal Spectrum
Magnitude
8
6
4
2
0
rectangular Window
hamming Window
hanning Window
0
100
200
300
400
500
Frequency (Hz)

WINDOWING


Filtered Baseline Signal
Amplitude (mV)
0.4
0.2
0
-0.2
0
5
10
15
20
25
Time (s)
Windowed Filtered Baseline Signal Spectrum
Magnitude
0.01
0.008
0.006
0.004
0.002
0
0
100
200
300
400
500
Frequency (Hz)
rectangular Window
hamming Window
hanning Window

Conclusion

1. Signal Enhancement and Clarity
2. Frequency Domain Insights - Components Associated With Muscle Activity
3. Capturing Dynamic Nature of Muscle Contractions and Expression
4. Pattern Recognition and Anomaly Detection - Aiding in Early Diagnosis

The Team

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