Current Findings

Model

Pipeline Components:

- **Data Preprocessing**
  - Bandpass filtering (20-450 Hz) to remove noise
  - Notch filter at 60 Hz to eliminate power line interference
  - Signal normalization and baseline correction
- **Signal Segmentation**
  - Sliding window approach with 250ms windows
  - 50% overlap between consecutive windows
  - Captures temporal patterns in muscle activity
- **Feature Extraction**
  - Time-domain features (mean, variance, RMS, zero crossings)
  - Frequency-domain features (spectral analysis)
  - Multi-channel feature extraction from all EMG sensors
- **Classification**
  - Support Vector Machine (SVM) with RBF kernel
  - Trained to distinguish between 13 different gesture classes (0-12)
  - 5-fold cross-validation for robust model evaluation

Dataset:

- NinaPro database (Subject 1, Activity 1, Exercise 1)
- Sampling rate: 2000 Hz
- Multiple channels capturing different muscle groups

Findings

- **Performance Metrics:**
- **Cross-Validation Results:**
- Mean Accuracy: 81.4%
- Standard Deviation: ±3.6%
- Consistent performance across all 5 folds (ranging from 75% to 85%)
- **Test Set Performance:**
- Test Accuracy: 81.5%
- Shows good generalization (test accuracy matches CV accuracy)
- Model is not overfitting

Positives and Negatives

- **1. Strong Performance**
- 81.5% accuracy is solid for 13-class EMG gesture recognition
- Matches published research benchmarks
- **2. No Overfitting**
- Test accuracy (81.5%) matches cross-validation mean (81.4%)
- Model generalizes well to unseen data
- **3. Consistent & Stable**
- Low standard deviation (±3.6%) across CV folds
- Reliable performance across different data splits
- **4. Excellent Rest Detection**
- Gesture 0 recognized with high accuracy (53/57 correct)
- Critical for practical applications - system knows when user isn't gesturing

1. Severe Class Imbalance

- Gesture 0: 53 test samples vs. most gestures: 1-2 samples only
- Results appear misleadingly good due to rest class dominance
- Cannot reliably evaluate individual gesture performance

2. Limited Scope

- No evidence model works across different users
- Requires cross-subject validation for real-world deployment

5. Incomplete Evaluation

- Per-gesture metrics unreliable with 1-2 samples
- Cannot determine which gestures need improvement
- Missing insights into failure patterns