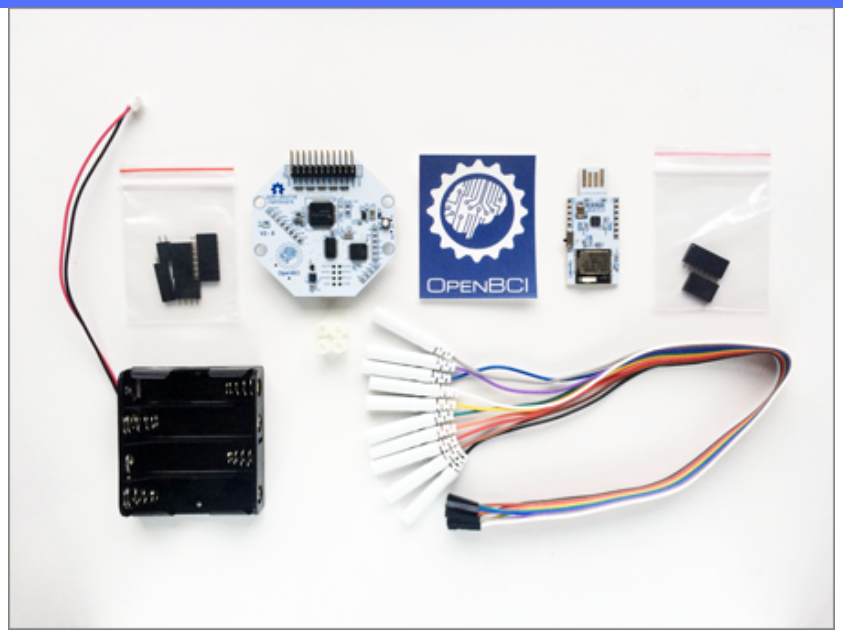
Using Pattern Recognition and Digit Control in Transradi

Low Density EMGs for Refined al Myoelectric Prosthetic

Background:

1. To offset the disability caused by a lack of one or more limbs, many people choose to get prosthetics
   - Body powered prosthetics:
     - Controlled by the movements of other body parts
     - Tend to be cheaper and do not require electricity
     - Have very limited control over DOFs
   - Myoelectric prosthetics
     - Use EMGs to read electrical impulses from muscles
     - Give significantly more control to the amputee
     - Can be difficult to learn to control
2. AI has begun to be used to offset problems with myoelectric prosthetics
   - Allows for control over more DOFs i.e. hand open-close, wrist pronation-supination, wrist extension-flexion, etc
   - Allows for simultaneous control (less DOFs) or adaptive switching (more DOFs)
3. Almost all machine learning-powered myoelectric prosthetics researched only allow control over full-hand
   - They do not allow for individual finger control

Materials:



PyTorch

NumPy

Kendall EMG electrodes

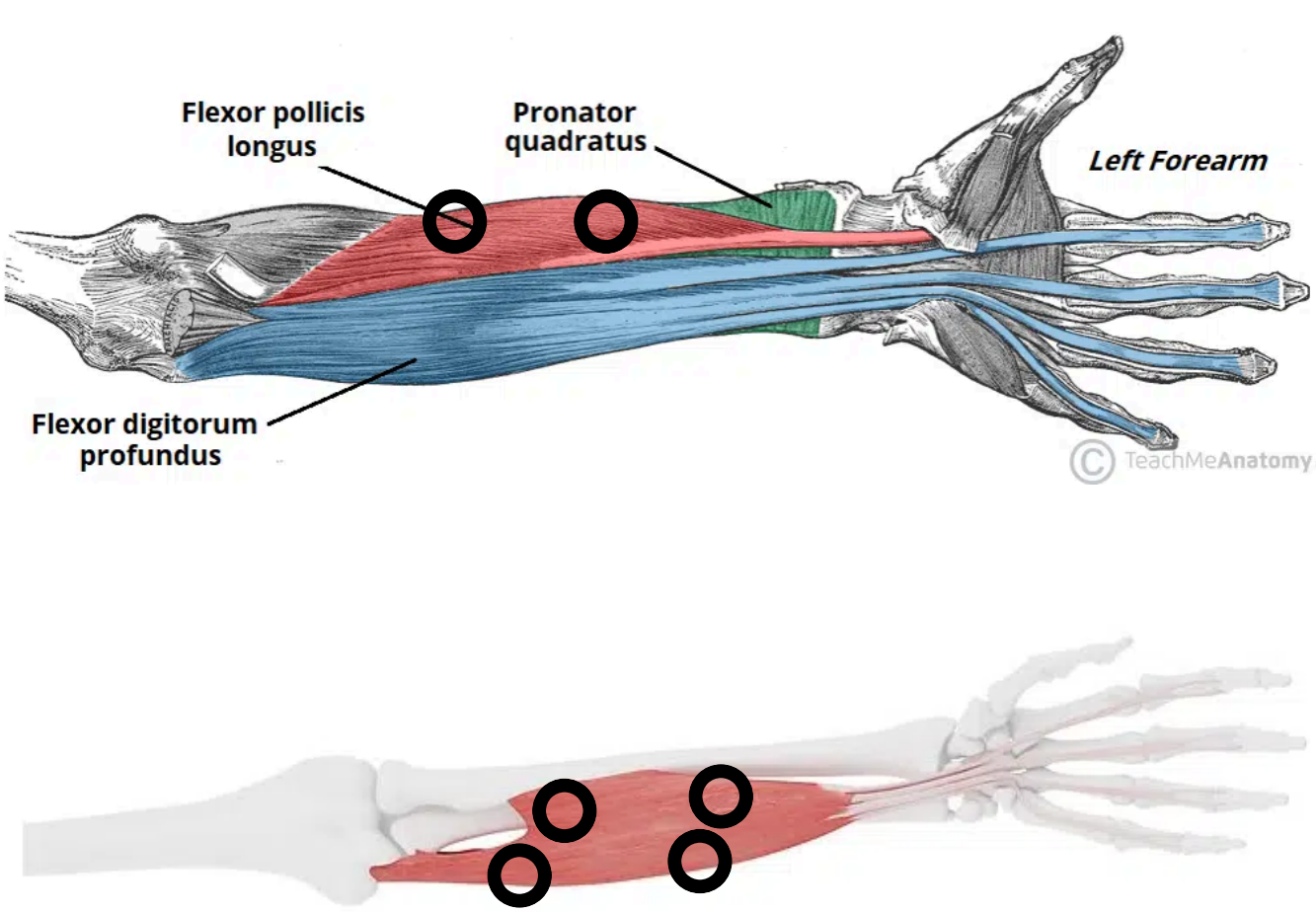
Engineering Problem

Most current myoelectric prosthetics do not allow the user individual finger control, instead only allowing control of the full grasp at once. The few algorithms that do allow for this control require many sEMG electrodes, which can be very expensive.

Engineering Goal

This project aims to engineer a way to detect individual finger movement/contraction using low density EMGs and muscles above the wrist which may be available to transradial amputees.

Data Collection



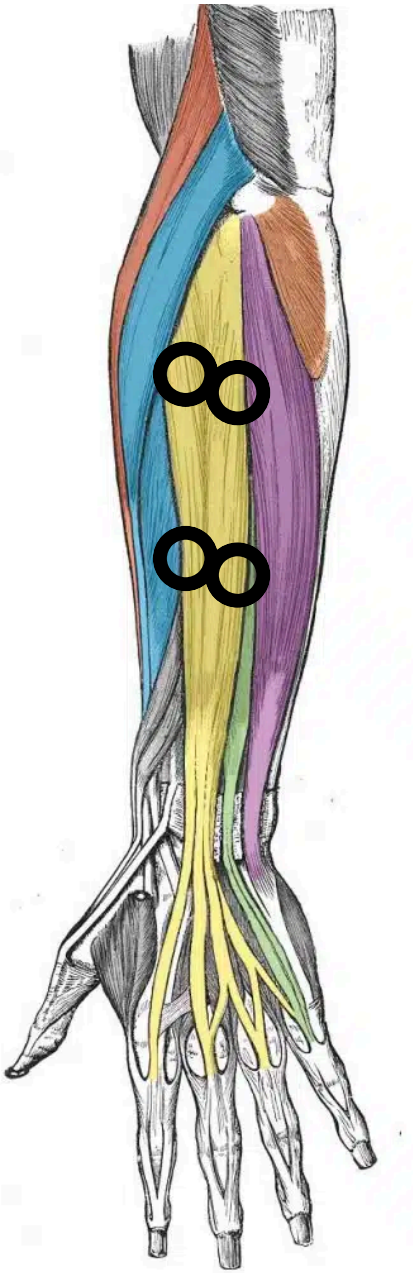


Figure 1: Placements of the five electrode pairs on images of the left arm

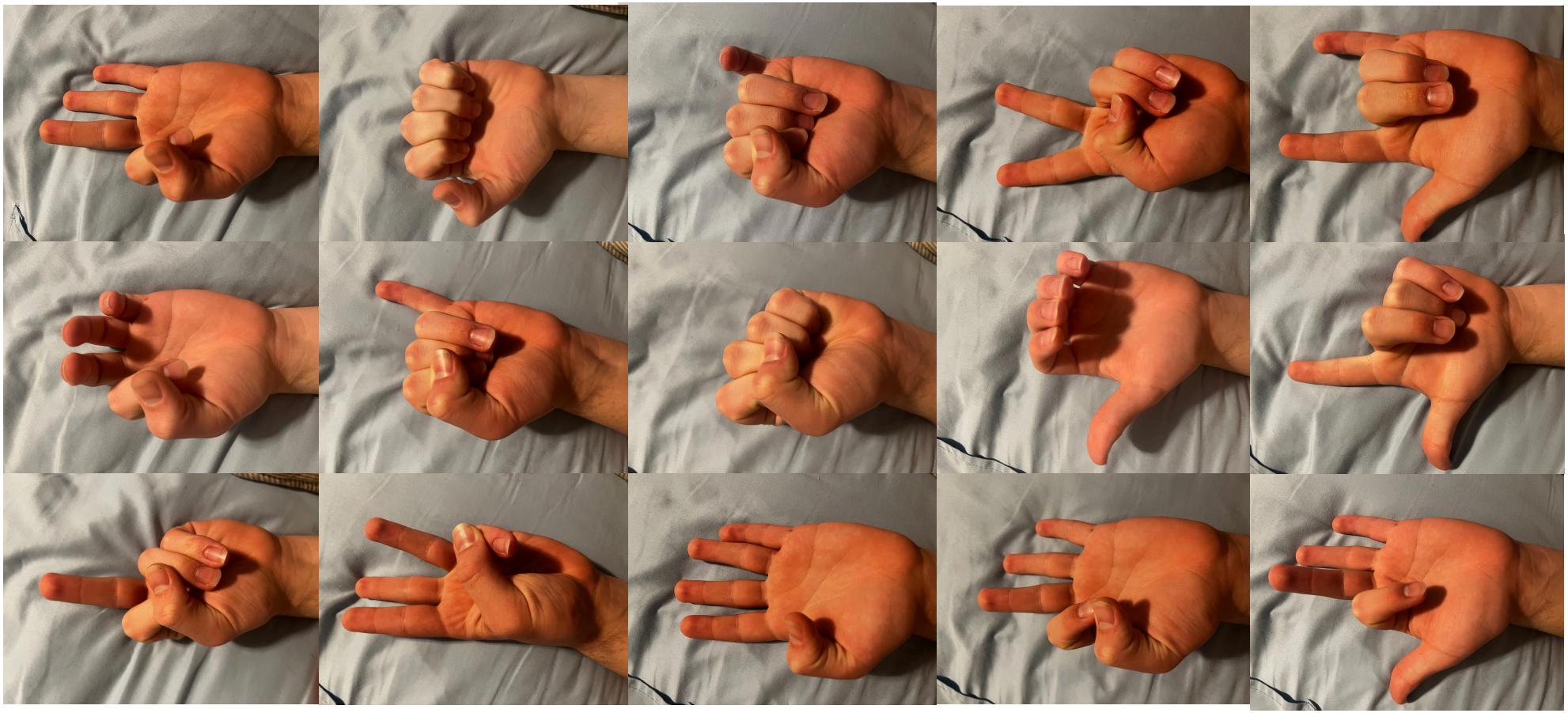
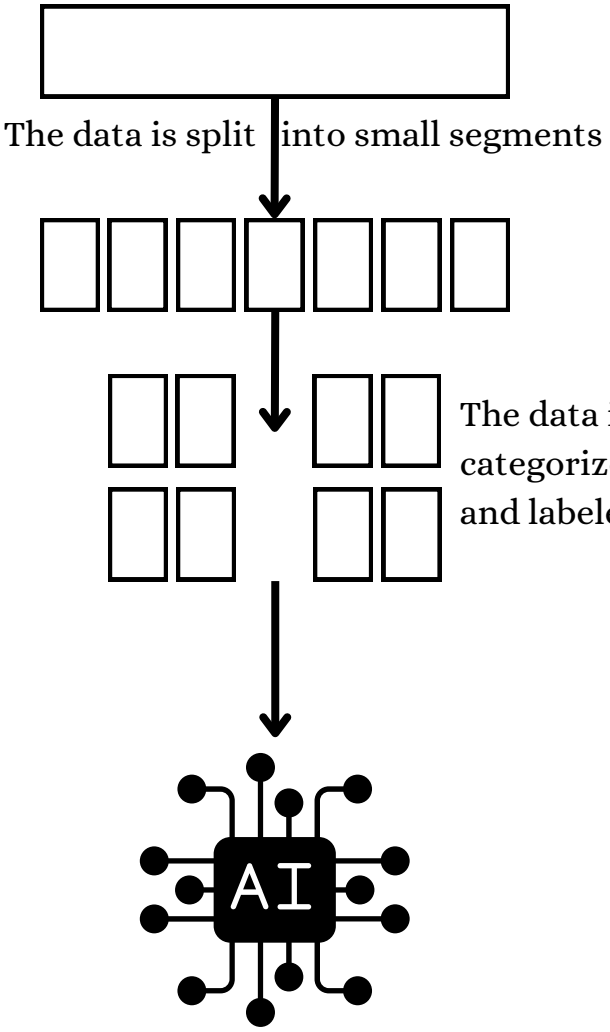
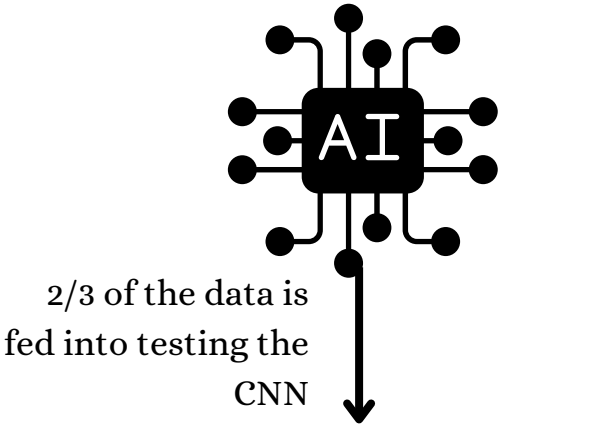


Figure 2: Hand positions recorded with the EMG, each for 10 seconds

Data Processing





The CNN returns values to state how accurate it was to the labels

Furture Work

1. Repeat this experiment with medical-grade technology including
   - Smaller electrodes to allow more to be placed on the subject's arm
   - Electrodes with a higher refresh rate to allow more data to be collected
   - More accurate and focused electrodes to collect better data
2. Conduct this experiment with more subjects and average their data.
   - This would allow for a more generalized model which could be used by all people
3. Connect a prosthetic arm to the subject to allow for visual and experience base testing