**Motivation**

1. Animals are good robots are bad. Make robots like animals

**Modeling Considerations**

1. Quality biomechanical models can provide insight into how animals “work” but the most effective models must consider both systems to understand emergent behavior
   1. Biomechanical models have been developed for insects, rats, cats, etc.
   2. Biomechanical models are becoming more prevalent, meaning the scientific community is finding them useful
   3. Emergent behavior is the result of a complex interplay of the nervous and body systems which develop in tandem with each other
   4. Locomotion is a specific type of emergent behavior that is commonly analyzed because its output metrics are easily quantified and most environments traversed by humans are best approached using legged locomotion
2. Living nervous systems are incredibly complex which necessitate novel approaches to modeling and simulation
   1. Nervous systems have layers, understanding this is hard
   2. Feedback from low neural levels are critical for quick responses
   3. Introducing the FSN approach

**Zooming into a biomechanical model: Previous Project Developments**

1. Introducing Animatlab
   1. Animatlab is a simulation suite designed to incorporate both the physics engine and the neural modeling methods
   2. Animatlab is great for rapid experimentation and testing a lot of neuron/actuator configurations
   3. Animatlab has a number of faults, though, and will become less and less reliable
   4. Animatlab bad
   5. Animatlab bad
2. Animatlab has been used to develop a model of a rat
   1. High level discussion of Alex rat
   2. “functional model with morphological influences where available”
   3. List of reasons why rats are nice to work with
   4. The fact that the model is simplified and lacking many muscles, mainly biarticular ones
3. Describing CPGs and how they work
   1. How CPGs fit into Hunt’s model
   2. How CPGs interface with a redundant muscle model

**Methods for Neural Modeling: Synergies**

1. What is a synergy/history
2. Numerical methods for decomposing synergies
   1. Current methods use averaged EMGs which is bad
3. Arguments against synergies

**Methods for Neural Modeling: Perturbations**

1. Perturbations are key for understanding feedback pathways