CSE 514 Data Mining

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Project 2 Letter of Intent

Our group consists of three team members: Steven Hartman, Hao (Eric) Tang, and Benjamin Bush. We have decided to pursue project option 2 and intend to tackle a challenge presented in the NIPS 2018 conference: AI for Prosthetics. Recent advancements in biomedical technology have led to increased interest in using prosthetics to improve human movement. However, training these prosthetic devices is difficult as it is hard to pre-program how the devices should interact with the body in every possible scenario and it is difficult to synthesize physically and physiologically accurate motion.

In this challenge, we seek to develop a controller to enable a human based model with a prosthetic leg to walk or run at varying speeds. We are provided with a musculoskeletal model and a physics-based simulation environment similar to OpenAI Gym. The controller will map input from a state space of the biomechanical model to an output in the action space such that the action results in the model running. This challenge naturally motivates a reinforcement learning approach, as the goal of reinforcement learning is for an agent to learn how to evolve in an environment. More formally, we seek an optimal policy π^* that maps a given state of the musculoskeletal model to a set of muscle excitation actions that will result in the human model running.

The challenge provides experimental data to bootstrap the development of the controller. The data gives a set of joint angles and resulting electromyography (EMG) signals. The data were collected from 83 typically developing children ages 4-17 walking at varying speeds. We can consider the problem of predicting the EMG signal from a given set of joint angles to be a regression problem. In this supervised learning setting, we can use a multivariate linear regression (softmax regression), or more complicated model such as a neural network to predict the muscular excitation from a given joint angle. Once we have trained such a model, we can use this supervised model as a starting point for training in a reinforcement learning simulation environment. This process of reusing a model developed for a given task as the starting point for a new model is called transfer learning.

The links to the challenge homepage and datasets may be found below. First, we intend to train a supervised model the basic kinematics of muscular excitation using the provided datasets. We will use this pre-trained supervised model as a starting point for developing our controller. Second, we will train the controller using the provided simulation environment to find the optimal policy.

Link to challenge: https://www.crowdai.org/challenges/nips-2018-ai-for-prosthetics-challenge

Link to datasets: http://osim-rl.stanford.edu/docs/nips2018/experimental/