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Prediction of Muscle Torque Production for the Control of a Paralyzed Arm

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Abstract

Functional electrical stimulation (FES) is a method of restoring function to muscles using electrical pulses delivered through an implanted controller. FES has shown potential for enabling people with high spinal cord injuries to perform basic reaching motions essential to everyday tasks. In order to determine the necessary muscle activations an FES neuroprosthesis must produce to cause a desired arm motion, we must first be able to predict the amount of torque that muscles can produce at each joint. The torque production varies depending on the state of the system. Gaussian Process Regression models were trained with data gathered using a dynamic arm simulator in MATLAB that includes models of joint and muscle groups within the shoulder and arm. The Gaussian Process Regression models are able to predict, with acceptable accuracy, the torque at a given joint due to the activation of a certain muscle group. These predictions can be used to develop a method to calculate the muscle activations that will produce the torques necessary to move the arm along a specified trajectory.