Actions and activations of hindlimb muscles in the rat

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The control of movement is a distributed process, involving both neural control strategies and musculoskeletal properties. We are currently pursuing investigations into both systems, in order to better understand biological motor control and leverage this understanding towards improving function following injury. We describe a set of related experiments examining these issues. First, we examine the degree of specificity and flexibility in spinal pattern generators, assessing whether the pattern generators at birth are capable of differentially activating intramuscular subdivisions in the complex hindlimb muscle biceps femoris. Second, we describe a novel approach for creating a musculoskeletal model to capture the mechanical actions of individual muscles and evaluate its ability to capture the action of both simple and complex muscles in the rat hindlimb. Finally, we describe our recent efforts at controlling the rat hindlimb through direct muscle stimulation. We have developed an experimental system to perform isometric force control with a large number of muscles and applied probabilistic methods to improve the accuracy of control. With this preparation we can evaluate proposed biological control strategies directly, both as potential strategies for neural control and as strategies for restoring movement following spinal cord injury. Together, these experiments allow us to examine this process of distributed motor control, characterizing the contributions from neural and musculoskeletal systems.