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Modular organization of the control of human locomotion

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ABSTRACT OF THE TALK

The question of how the central nervous system coordinates muscle activity is central to an understanding of motor control. The idea that the CNS may control complex interactions by modular decomposition has received considerable attention. We explored this idea for human locomotion by examining both limb kinematics and motor patterns. A modular control of limb kinematics in different gaits results from a superposition of separate length- and orientation-related angular covariances of limb segment motion. A modular control of motor patterns includes both spatial (muscle synergies) and temporal architecture. Indeed, motor programs may be considered as a characteristic timing of muscle activations linked to specific kinematic events. In particular, muscle activity occurring during human locomotion can be accounted for by a few basic temporal components in a variety of locomotion conditions. Spatiotemporal maps of spinal cord motoneuron activation in different gaits also show discrete periods of activity. Furthermore, the coordination of locomotion with voluntary tasks is accomplished through a superposition of motor programs or activation timings that are separately associated with each task. As a consequence, the selection of muscle synergies appears to be downstream from the processes that generate activation timings.