Control of Paraplegic Standing Using Adaptive Neuro-Fuzzy Sliding Mode Control: A Simulation Study

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In this paper, an adaptive neuro-fuzzy sliding mode control (ANFSMC) is employed for control of quiet standing posture in paraplegia using functional electrical stimulation. For this purpose, a dynamic model of paraplegic standing is proposed as a virtual patient. The skeletal model comprises the feet, shanks, thighs, trunk, arms, forearms and a walker. Each joint was modeled as a hinge joint. The head, trunk and pelvis are lumped into a single rigid body. Each joint in the lower extremities is driven by a pair of muscles. The muscle model used for simulation of equivalent flexor and extensor muscles includes an input delay, nonlinear recruitment, linear dynamics, and multiplicative nonlinear torque-angle and torque-velocity scaling factors. The results show that the controller could successfully maintain the upright posture in a stable way and stabilize the quiet standing posture during fatigue and applying external disturbances.