Abstract:
Functional electrical stimulation leg cycle ergometry (FES-LCE) is an effective treatment in the maintenance of bone and muscle health in spinal cord injured (SCI) people. However, the “one-size-fits-all” stimulation paradigm currently used may actually promote the onset of premature fatigue. Refining the presently used paradigm, or developing a new one, could prevent premature fatigue and possibly extending a rider’s cycling time. **Purpose:** to investigate leg joint biomechanics during progressive resistance and submaximal FES-LCE cycling protocols in order to identify parameters indicative of muscle fatigue. Specific aims were (a) develop an index which quantifies and predicts fatigue as a function of knee power output during progressive resistance cycling, and (b) identify mechanical and physiological parameters for determining the comparative effectiveness of progressive resistance and submaximal cycling protocols. **Methodology:** Six spinal cord injured subjects participated in the study. Motion capture software was used to measure the displacement of the crank tip, hip, knee, and ankle joints during cycling. A force transducer, mounted underneath the right ergometer pedal, recorded pedal forces. Free body diagrams were constructed to calculate the forces and torques produced at the ankle, knee, and hip joints, respectively. Pedal force, crank angle, segment mass, joint kinematics and anthropometric data were used to calculate resultant joint forces and joint moments. **Results:** An index of fatigue was successfully developed, comparing knee power capacity during cycling with a predetermined value of fatigue during progressive resistance cycling. Also, subjects displayed a more favorable cycling performance during submaximal cycling than during progressive resistance cycling. **Conclusions:** A rapid increase in stimulation intensity and subsequent decrease in cadence and power output observed during progressive cycling suggest that the one-size-fits-all stimulation protocol may be one root cause of premature fatigue. Likewise, the use of a progressive resistance cycling therapy further contributes to fatigue onset. While submaximal cycling was more effective for SCI riders, a hybrid protocol incorporating both strength and endurance training may be the most successful.