

FES-cycling Strategies for the Child with a Spinal Cord Injury using Muscle Force-Stimulation Relationships – A Case Study

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Abstract

While little studied in the pediatric population, FES-cycling has potential as an effective form of exercise for the child with a spinal cord injury. One limitation of FES-cycling is the relatively early onset of muscle fatigue. In this study we approached this problem through the integration of physiological-based stimulation profiles. Force-intensity and force-frequency relationships were identified for a 14 year old male with tetraplegia and subsequently used to predefine fatigue-attenuating cycling stimulation profiles that would utilize both intensity and frequency modulation. A series of step exercise tests were performed with the same subject to investigate performance of the new stimulation profiles and compare them against traditional intensity modulation strategies. The objective during each test was to maintain a target torque at the pedals. Comparison between tests showed a 49.6% and 31% decrease in pulsewidth and oxygen uptake respectively for the same average power output while using the physiological-based intensity profile. Moreover, frequency modulation increased cycling time by 20% beyond intensity saturation. These results are encouraging for the use of physiological-based stimulation profiles and frequency modulation as methods for improving performance during FES-cycling.

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