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Mechanomyography-based muscle fatigue detection during electrically elicited cycling in patients with spinal cord injury (Article)

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Abstract

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Patients with spinal cord injury (SCI) benefit from muscle training with functional electrical stimulation (FES). For safety reasons and to optimize training outcome, the fatigue state of the target muscle must be monitored. Detection of muscle fatigue from mel frequency cepstral coefficient (MFCC) feature of mechanomyographic (MMG) signal using support vector machine (SVM) classifier is a promising new approach. Five individuals with SCI performed FES cycling exercises for 30 min. MMG signals were recorded on the quadriceps muscle group (rectus femoris (RF), vastus lateralis (VL), vastus medialis (VM)) and categorized into non-fatigued and fatigued muscle contractions for the first and last 10 min of the cycling session. For each subject, a total of 1800 contraction-related MMG signals were used to train the SVM classifier and another 300 signals were used for testing. The average classification accuracy (4-fold) of non-fatigued and fatigued state was 90.7% using MFCC feature, 74.5% using root mean square (RMS), and 88.8% with combined MFCC and RMS features. Inter-subject prediction accuracy suggested training and testing data to be based on a particular subject or large collection of subjects to improve fatigue prediction capacity. [Figure not available: see fulltext.]. © 2019, International Federation for Medical and Biological Engineering.

SciVal Topic Prominence

Topic: Muscle | Muscles | EMG amplitude

Prominence percentile: 76.138

Author keywords

Functional electrical stimulation | Mechanomyography | Mel frequency cepstral coefficients (MFCC) | Muscle fatigue | Spinal cord injury

Indexed keywords

Engineering controlled terms: Functional electric stimulation | Muscle | Support vector machines

Engineering uncontrolled terms: Functional electri-cal stimulations; Mechanomyography; Mel-frequency cepstral coefficients; Muscle fatigues; Spinal cord injuries (SCI)

Engineering main heading: Biomedical signal processing

EMTREE medical terms: adult; Article; clinical article; concentric muscle contraction; cycling; data analysis software; diagnostic accuracy; eccentric muscle contraction; feature extraction; female; human; male; mechanomyography; middle aged; muscle contraction; muscle fatigue; muscle strength; myography; priority journal; quadriceps femoris muscle; signal processing; spinal cord injury; support vector machine

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Funding details

Funding text #1

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