

Rehabilitation Engineering & Applied Research

Introduction

In this study, a method for the robust detection of manual wheelchair movement with accelerometer-based data logging is used to obtain metrics of wheelchair mobility that complement mean and total distancebased measurements. These metrics, that include distance, time and number of bouts, are shown to provide a better understanding of everyday use of manual wheelchairs (MWC).

Methodology

Subjects

•12 adults, ages 23 to 68 (median 39.5), with some affiliation to the local spinal cord injury (SCI) rehabilitation center

•Diagnoses:SCI (n=10), ataxia (n=1), transverse myelitis (n=1)

 Manual wheelchair is the primary mobility device •IRB approval

 Data collection period varied between 2 and 12 days per subject (80 days total)

Variables and Data Processing

•Data processing:

Acceleration is used to detect wheel motion

- oThe rate of change of wheel revolutions is
- used to compute speed
- •Variables:
 - Bouts of wheelchair activity
 - oDistance wheeled

oTime wheeling

• Wheelchair speed

oNon-movement durations

•Bout detection accuracy exceeds 90%⁽¹⁾

⁽¹⁾ Sonenblum, S.E., Caspall, J., et al, "An Analysis Method for Detecting Manual Wheelchair Movement." Presented at the BMES Annual Meeting. 2009. Pittsburgh, PA.

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Monitoring Manual Wheelchair Use

Protocol

- •Acceleration logger (solid-state, triaxial, MEMSbased acceleration sensor with a ±2g range) was mounted on one of the wheels (see picture below) •Radial and tangential components of acceleration (along Y" and X" in the figure below, resp.) were used for movement detection
- •Sampling rate: 10 Hz



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Conclusions and Future Work

•A single measure of mobility, such as distance, cannot convey a full description of MWC usage Daily wheelchair usage varies greatly within and between subjects •Idiosyncrasy of usage can be better understood by analyzing bouts in addition to other measures •Future research should look into studying larger population samples and methods of combining the additional metrics presented here in a way that facilitates manufacturing, prescription and dosage

