

# Assessing of Motor Performance in Stroke Using Body Worn Sensing

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**Abstract.** As a part of the EU project INTERACTION, a modular and unobtrusive body worn sensing system has been developed for the objective assessment of capacity and performance of body balance and arm movements. Performance and capacity measures were proposed and clinically tested in stroke subjects and results were compared with results of frequently used clinical tests. First results show a discrepancy between subjects' ability to use their affected side as evaluated with clinical tests and their actual performance during daily life tasks.

## 1 Introduction

Stroke often results in impaired body balance and/or arm function. Ambulatory qualitative assessment of body balance and arm function while performing activities of daily living is essential for optimal guidance of rehabilitation therapy. The objective of this study is to evaluate in stroke patients, body balance and arm capacity and performance while performing activities of daily living in a simulated ambulatory setting using the INTERACTION body worn sensing system. Parameters will be related to results of clinical assessments of balance control: Berg balance scale [1] and arm function: upper limb part of the Fugl-Meyer test [2].

## 2 Materials and Methods

Seventeen stroke subjects were included in a clinical study, which has been approved by the local medical ethical committee [3]. Subjects were asked to perform different activities of daily living in a simulated ambulatory setting. Using previously developed instrumented shoes (ForceShoes<sup>TM</sup> - Xsens, Enschede, The Netherlands) and an ambulatory 3D human kinematic

measurement system (MVN Biomech, Xsens, Enschede, The Netherlands), capacity and performance measures of body balance control and arm function, were estimated.

Parameters to qualitatively evaluate ambulation, which are based on Schepers et al. [4], are: step width, step length, swing/step phase ratio, motion of the center of pressure (CoP) and the center of mass (CoM). Qualitative parameters of arm function are: relative distance between hand, sternum and pelvis; differences in reaching using the affected arm and the non-affected arm and synergies of shoulder abduction/activation and elbow flexion.

### 3 Results

Preliminary results of two subjects show differences between the capacity of reaching movements (maximum reached area of the hand) and the actual performance of a subject's affected side. Although a subject had the capacity to use its affected arm, the arm was hardly used - in quality and quantity - during the activities of daily living.

Furthermore, differences are found in asymmetry of CoP and estimated CoM while subjects are standing, performing a 10 meter walk test and walking while performing other arm tasks. CoP and CoM shifted more towards the non-affected side while performing more difficult combinations of activities.

### 4 Discussion

The use of the INTERACTION system enables the measurement of balance and arm performance parameters during activities of daily living without being restricted to a laboratory environment. Measured performance parameters vary per individual and per task, but results did not appear to correspond with the results of the frequently used tests and clinically assessed functional motor capacity. This supports the need for assessment of the quality and quantity of motor performance during daily-life activities in stroke survivors. However, in-home tests need to be performed to evaluate the possibility to assess motor performance in a real daily life setting.

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