Characterization of elderly, stroke and chorea populations using gait variability and stability indexes economy after stroke, but not through enhanced somatosensory input alone.

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http://dx.doi.org/10.1016/j.gaitpost.2015.06.018

Session OS02 Rehab Adults

Characterization of elderly, stroke and chorea populations using gait variability and stability indexes

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Research question: Are gait variability and stability indexes representative of specific diseases? And can they explain the physiological deficit of motor control in these pathologies?

Introduction: The importance of stability and variability indexes in the assessment of motor functionality is known [1–4]; however much effort is still required to identify which indexes are representative of specific diseases and consequently which physiological aspects each index analyzes. To improve these aspects the ability of the indexes to discriminate (a) young healthy subjects from pathological ones and (b) different pathologies was assessed.

Materials and methods: The study was conducted on 10 healthy young people (Y), 10 elderly subjects (E), 10 stroke patients (S) and 10 subjects with choreic movement disorder (C). The participants performed an instrumented over ground gait task wearing three inertial measurement units (IMUs): one located on the trunk at the height of the fifth lumbar vertebra to acquire trunk acceleration, and two attached above the ankles, allowing the strides detection according to [5]. 5 stability and 7 variability indexes were calculated on stride time and trunk acceleration data during gait, for antero-posterior, medio-lateral and vertical directions.

Statistical analyses were performed (a) to verify if the indexes were able to discriminate young healthy subjects from pathological ones and (b) to evaluate the ability of the indexes to describe different pathologies.

Results: Two variability indexes (Standard Deviation and Coefficient of Variation) and one stability index (Multiscale Sample Entropy) were able to discriminate pathological people from healthy young ones. None of the evaluated indexes was able to discriminate all the different pathologies (S C E); conversely, clusters of indexes representative of elderly and stroke subjects were found.

Discussion: The obtained results shown that the variability of the stride time and the complexity of acceleration signals are able to discriminate healthy young people from pathological ones; this not surprising since gait pattern of healthy and pathological subjects are very different. Indeed these features are the first to be influenced by the ability of the subject to implement a right motor-control.

The indexes that are able to discriminate S from C and E are about the smoothness of the signal. This could be explained with the nature of the pathologies; indeed stroke subjects have important impairments only in one side of the body, instead old age and chorea are degenerative diseases that affect the whole body.

The indexes that are able to discriminate E from C and S are about the recurrences of the signal. This could suggest that the variability of gait pattern is lower in elderly than in chorea and stroke subjects.

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http://dx.doi.org/10.1016/j.gaitpost.2015.06.019

Session OS02 Rehab Adults

Contribution of personalized avatar for post stroke gait rehabilitation: A preliminary study

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Research question: Can the mimetic abilities of human, be involved in functional rehabilitation using virtual reality?

Introduction: Mimetic learning by empathy is possible trough the mirror neurons network [1,2]. Moreover, bio-feedback is benefit for subject's rehabilitation [3]. As Human is able to feel own existence into other realities trough his specific ability which is presence [4], using immersive virtual reality during rehabilitation allows combining both paradigms. This preliminary study aimed to check if displaying a parametric AVATAR with improved parameters lead to positive changes for the subject's gait pattern during rehabilitation.

Materials and methods: 9 hemiplegic subjects with a "stiff knee gait" performed gait rehabilitation in a laboratory consisting of a motion capture system, a treadmill, a panoramic screen, and a software allowing interactivity. Subjects were equipped with retro-reflecting markers following the Plug-In-Gait model. 3 groups were formed. Group 1 was the control group without AVATAR. Group 2 performed the program including a real time AVATAR. Group 3 performed the program with a parameterizable AVATAR for which, the knee flexion was slightly improved (15°). Motion analysis was performed before and after the program and during the 10 last minutes of each session. Knee flexion was measured and knee's Motion analysis profile (MAP) was calculated [5]. In order to have a global sight on walking in virtual reality, the gait deviation index (GDI) was calculated for all subjects.

Results: MAP improved after the rehabilitation program for all groups. Knee flexion's maximum and MAP improved more for the last group with enhanced AVATAR. GDI improved significantly after rehabilitation sessions.

Discussion: This work is a preliminary study on the use of AVATARs during rehabilitation with virtual reality.

Results shown that virtual realities during rehabilitation are positive for the subjects. Moreover knees MAP values for subjects with the enhanced AVATAR show that they tend to mimicry the displayed model. A study relating the optimization of the improvement range for the AVATAR's knee flexion is considered.

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