GAIMS: a tool specifically developed for the clinical gait analysis of patients with multiple sclerosis

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Background

People with Multiple Sclerosis (pwMS) often have walking difficulties and perceive it as a major source of disability. Impairments appear early, and are a good indicator of the disease activity. Their clinical evaluation is valuable for the followup. We develop a gait measuring system (*GAIMS*) better suited for the clinical routine than the existing ones, and tools to interpret our measures.

Aims

To provide quantitative and objective measures without equipping the subjects with any sensor or marker (tiring pwMS and time consuming for clinicians). *GAIMS* is precise, robust, and can measure gait characteristics for long tests while avoiding treadmills. It is compatible with the existing standardised tests in MS (a 25ft or 6' walking test, a 6 spot step test, *etc*). Since the inability to follow a path precisely is a common difficulty for pwMS, it measures the deviation from the target path.

Methods

Laser scanners (in the room corners) observed the feet during walking tests of 71 pwMS (27 with EDSS 1.5-3, 44 with EDSS 3.5-5.5) and 129 healthy volunteers (HV) following a trajectory drawn on the floor. The acquisition protocol includes 3 types of walk (comfortable, as fast as possible, tandem), and several distances ranging from 25ft to 500m (when possible for pwMS). At the end of the visit, the feet trajectories are computed, 26 gait descriptors (deviation from the path, speed, double support time, clearance between the feet, *etc*) are derived, and an informative report is produced with machine learning, in a few seconds. The report estimates both the probability that the subject has MS and the EDSS (based on the gait data). It gives a qualitative description of pwMS's evolution since the last visit (improvement, stability, or deterioration).

Results

GAIMS captures relevant information about the pwMS' state: (i) the area under the ROC curve to predict stability or modification between successive visits is 0.89; (ii) and to predict if the modification is a deterioration or an improvement is 0.97; (iii) the correlation of the predicted EDSS with an expert is 0.86 (root mean squared error of 1.11); (iv) the maximum mean of sensitivity and specificity to predict pwMS or HV is 0.92; (v) we observe statistically significant differences between groups of pwMS.

Conclusions

GAIMS is well suited for the clinical gait analysis of pwMS. The provided information is useful for the followup of patients, both for physical therapists and neurologists.