Defining a score based on gait analysis for the longitudinal follow-up of MS patients

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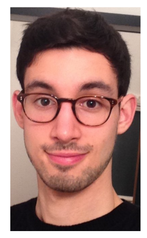

Background

The project GAIMS [1, 2, 3] aims at developing a gait measuring system particularly suited for the clinical routine, and providing a reference database with the gait characteristics of many MS patients and healthy people.

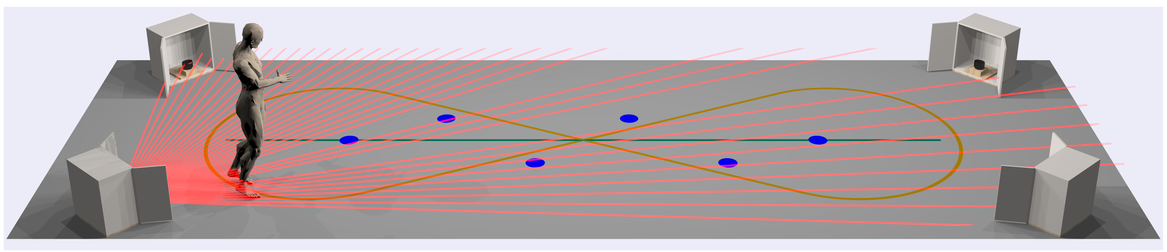

Figure 1 : The gait measuring system GAIMS [1, 2, 3] measures feet trajectories with range laser scanners and derives many gait characteristics.

As the gait impairments are related to the disease progression, defining an objective and quantitative score based on the gait characteristics would be useful for the longitudinal follow-up. Based on the dataset of GAIMS and machine learning techniques, a score, well correlated with the EDSS, can be defined [4].

Objective

Burggraaff *et al.* [5] showed that paired comparisons can help human raters to better judge the state of the patients. In the same spirit, we aim at predicting the difference of EDSS between two persons or between two visits of a same person, based on clinical gait measures. We show that the pairwise comparison strategy leads to a score (Gait-Score) well correlated with the EDSS and sensitive to small modifications of the gait.

Methods

The gait of 162 HP and 72 MSP (44 with EDSS>3) has been recorded and analyzed with GAIMS. The Gait-Score is defined using the machine learning techniques of Geurts *et al.* called *ExtraTrees* [6]. We can compute the Gait-Score of a person by comparing him to others with known EDSS, and compute the difference of Gait-Score of a same person at two different moments. We measure the merits of the Gait-Score by the correlation between the predicted Gait-Score and the EDSS, as well as the ability to detect subtle gait deteriorations among people with ataxia induced by a low dose of alcohol (data of Piérard *et al.* [7]).

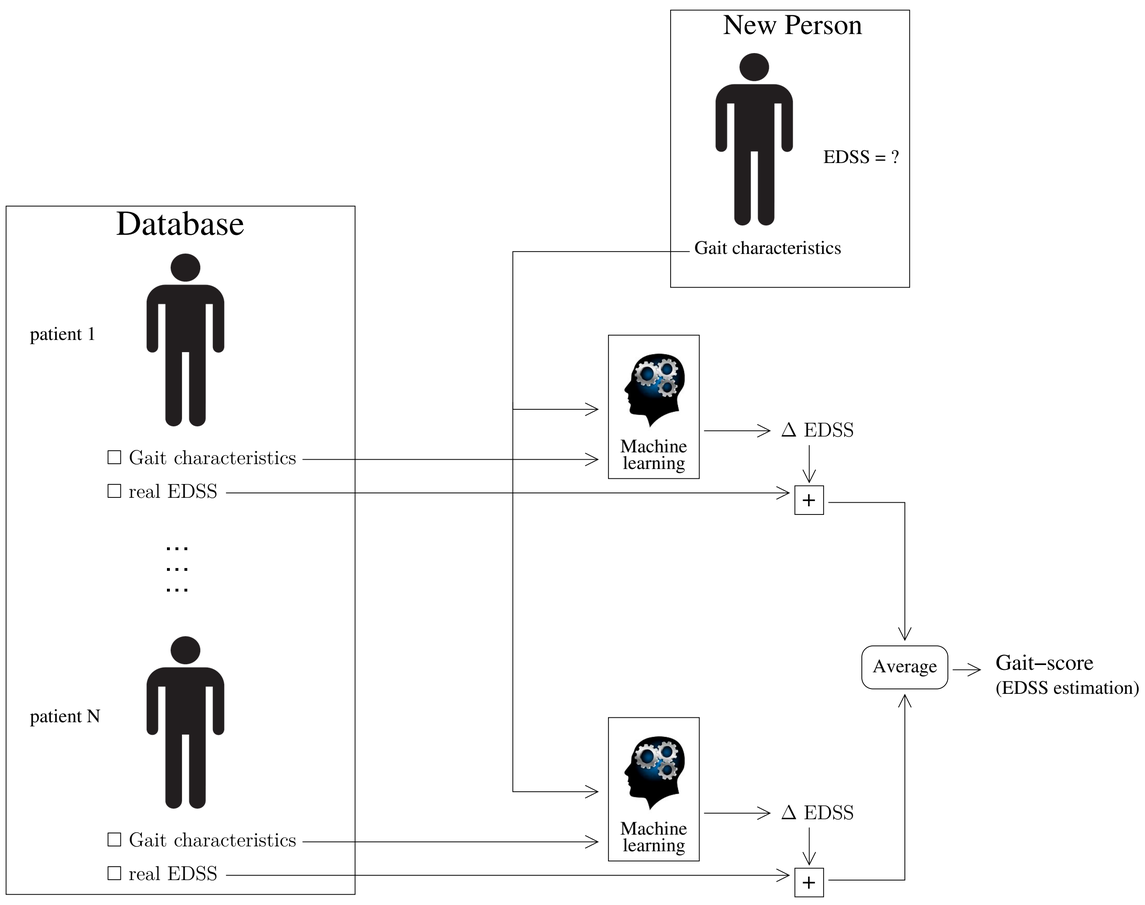

Figure 2 : Method used to determine the Gait-Score of a patient.

Results

The Gait-Score is well correlated with the EDSS (Pearson's correlation=0.8743) as can be seen on Figure 3. Moreover, Figure 4 shows that the Gait-Score manages to detect a gait deterioration after a small alcohol intake for 19 healthy persons out of 24 (79% correct) which is much better than what was obtained by visual inspection of neurologists (62% according to Piérard *et al.* [7]).

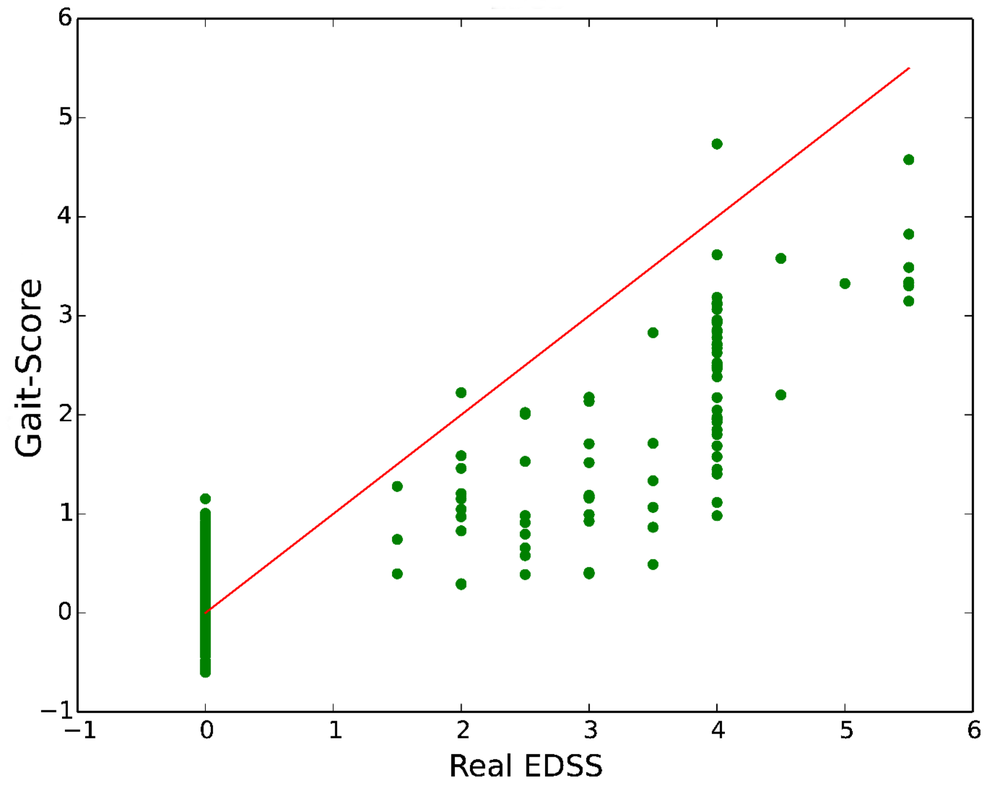

Figure 3 : Correlation between the Gait-Score and the EDSS.

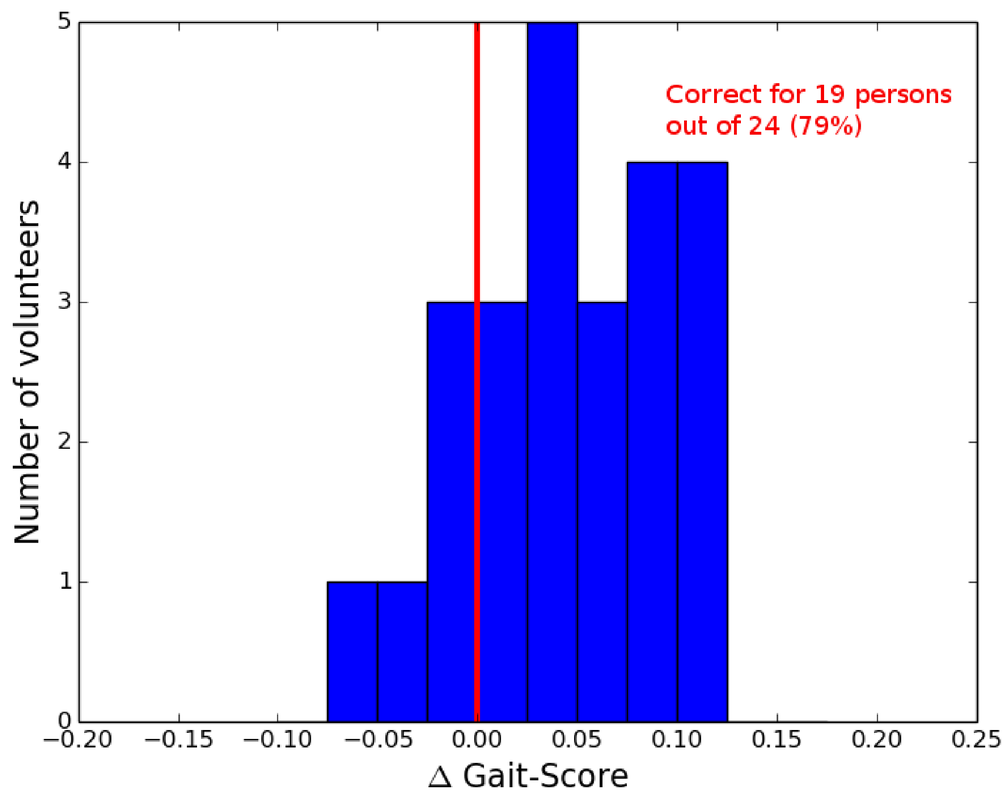

Figure 4 : Variation of the Gait-Score observed for 24 healthy volunteers after a small alcohol intake.

Conclusions

Based on the accurate gait measures provided by GAIMS, we are able to derive a Gait-Score, automatically, that is well correlated with the EDSS. Moreover, this score is able to detect subtle deteriorations of the gait caused by a low dose of alcohol. These results reinforce our conviction that the use of an automatic method based on gait analysis is very promising for the longitudinal follow-up of MS patients and the assessment of the impact of new drugs and rehabilitation programs.

References

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