The gait measuring system GAIMS

In general, all gait impairments have an impact on the movement of the lower limbs extremities. Neurologists qualitatively look at the feet movements. GAIMS also observe their movements, but measure them quantitatively thanks to a set of range laser sensors scanning a common plane a few centimeters above the floor. It is reliable (e.g. the measures are not affected by the colors of clothes or the lighting conditions) and does not require to equip the patients with any marker or sensor.

The use of GAIMS with MS patients in clinical routine

- We can draw a 25 ft straight path on the floor and ask the patients to follow it, to perform the standardized test.
- We can draw a ∞-shaped path on the floor and ask the patients to follow it several laps to observe the motor fatigue [2] on long distances, or to perform the 6 minutes test.
- We can draw the 6 spots of the SSST to analyze the feet movements during it.
- We can ask the patients to walk in different modes (at preferred pace, as fast as possible, or in tandem gait).
- GAIMS provides quantitative and objective measures such as the deviation from the followed path, the speed, the inter-feet distance, the cadence, the stride length, the gait asymmetry, the temporal variability, the proportion of double support time, etc.

Comparison of GAIMS with other systems

<table>
<thead>
<tr>
<th>Test</th>
<th>25 Fst</th>
<th>20 m</th>
<th>100 m</th>
<th>500 m</th>
<th>Comfortable</th>
<th>As fast as possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>CMR</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>ACE</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>CMR</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

The reference database

- This is an ongoing project, so its size is still increasing.
- 71 patients with MS (27 with an EDSS ∈ [1.5, 3], and 44 with an EDSS ∈ [3.5, 5.5]).
- 129 healthy volunteers.

Figure: Example of setup. The 25 ft straight path is shown in green, a 2D ∞-shaped path is shown in orange, and the SSST spots are shown in blue. A few laser rays (invisible in reality) are shown in red. The range laser devices (BEA LZR-i100) are in small enclosures in the corners of the room.

References