

Assessment and visualisation of daily-life arm movements after stroke

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Introduction

For an optimal guidance of the rehabilitation therapy of stroke patients in an in-home setting, objective and patient specific assessment of upper extremity task performance is needed.

The objective of this study was to assess and to visualize capacity and performance of arm function in stroke patients during daily-life.

Method

Metrics of hand movement relative to the pelvis were estimated in 13 stroke subjects using a full body ambulatory movement analysis system, including 17 inertial sensors (MVN Biomech, Xsens Technologies) [1], while performing a simulated in home task (figure 1).

Results were compared with the level of arm impairment evaluated with the upper extremity part of the Fugl-Meyer Assessment scale (uFMA) [2].

Results

Figure 2 shows typical hand position data with respect to the pelvis of a single subject performing the simulated in-home task.

Differences in arm usage can be quickly evaluated by comparing the distributions of the hand positions of a measurement (figure 2 - lower graphs).

Metrics of arm movement performance of the affected side, including size of work area and maximum reaching distance appeared to strongly correlate with uFMA scores (figure 3) [3].

Conclusion

Proposed metrics and visualisation can be used to objectively assess the performance of the arm movements over a longer period of time in a daily-life setting.

An adequate activity monitor and classifier could give context to performed arm movements, which will allow the evaluation of arm movements using the suggested metrics on a functional level.

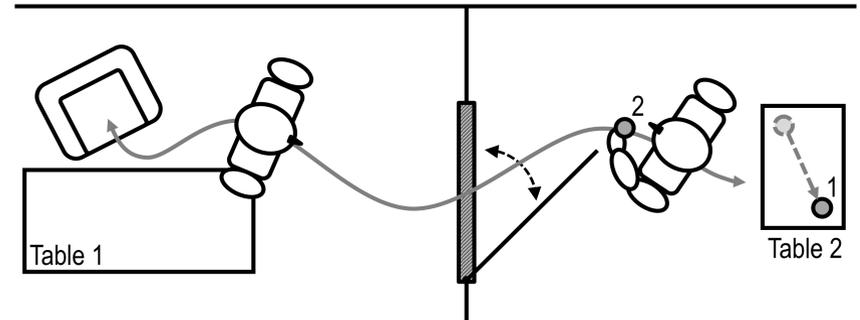


Figure 1 Schematic top-down overview of the simulated in-home task. Subjects start at the first table (Table 1), walk through a hinged door, move the first tube (1) along the second table (Table 2) and take another tube (2) back to the first table.

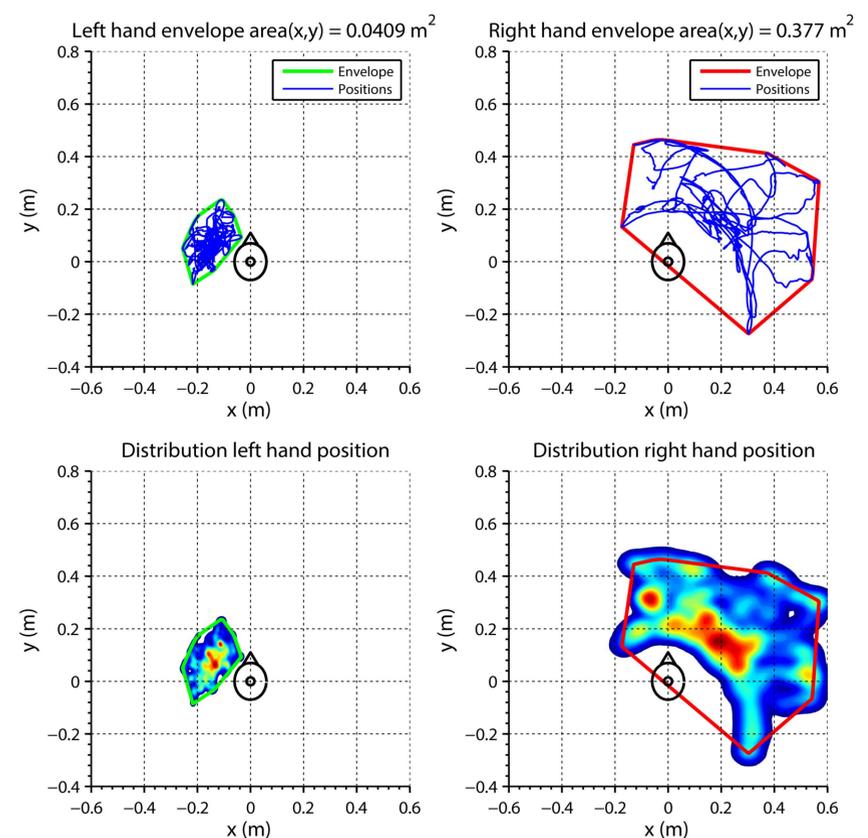


Figure 2 Hand movements in the transversal plane during the simulated in-home task, positions are relative to the pelvis (origin of graphs). Subject with a left affected side, uFMA score = 20 out of 66. Upper graphs, hand movement and maximum reached area. Lower graphs, distribution of hand positions.

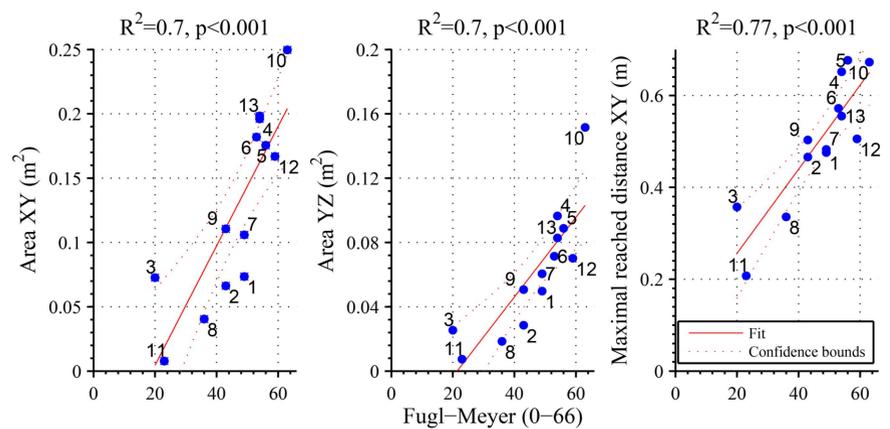


Figure 3 The relation between metrics and uFMA scores with: (left) mean area of the envelopes around movements of the affected arm in the transversal plane, (middle) area around movements of the affected arm in the sagittal plane and (right) the maximal reached distance between pelvis and hand in the transversal plane.

References:

- [1] Roetenberg et al. *Xsens Motion Technologies BV, Tech. Rep.* 2009
- [2] Fugl-Meyer et al. *Scand. J. Rehabil. Med.* 1975
- [3] Van Meulen et al. *Ann Biomed Eng.* 2014

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