PERFORMANCE AND SATISFACTION WITH INTUITIVE MULTIFUNCTIONAL HAND PROSTHESIS CONTROL

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Summary

In the present study, 6 transradial amputees were wearing pattern recognition controlled prostheses at home for 4 weeks. Before and after the home trial phase, clinical standard tests were administered. We have evaluated these test results and the qualitative user feedback from their home trials. Additionally the feedback on the fitting experience by the CPOs and therapists administering the treatment was collected. Pattern recognition outperformed classic control in the clinical tests but was limited in home trials.

Background

Pattern recognition-based control functions in a fundamentally different way than conventional, myoelectric control. Instead of relying on two manually chosen electrode sites to control a single degree of freedom, pattern recognition uses many electrodes and intuitive movement mapping to control several movements seamlessly[1].

The majority of previous pattern recognition studies have been performed on non-amputee subjects and only virtual arms had been controlled with pattern recognition systems instead of real prostheses[2]. Prolonged home-use of such devices is still little documented.

Aim

The aim of this study was to collect data on the usability of pattern recognition controlled prostheses in daily living, from an amputees and clinical staff perspective, based on objective (clinical tests) and subjective (feedback, questionnaires) measures.

Method

6 amputees (72% male, 44±13.4 years) were fitted with pattern recognition (Hudgins feature set, LDA) controlled transradial prostheses. Users wore the prostheses for 4 weeks at home for at least 6 hours a day. Before and after the 4 week home trial, subjects completed the modified box and blocks test, the clothespin relocation test and a proportional test (open/close various clothespins without dropping them). Additionally , the DASH questionnaire and some project specific questions were evaluated for assessing the qualitative user feedback.

Results

All subjects were able to complete the 4 weeks home trial phase. Fitting of the prostheses and the therapy training were scored with 1.7± 0.53 and 1.2±0.13 respectively on a 5 point scale (1: best, 5: worst) on average by the clinicians.

Results (continues)

Qualitatively, subjects performed better with pattern recognition control in the clinical tests than in home use (*Figure 1*).

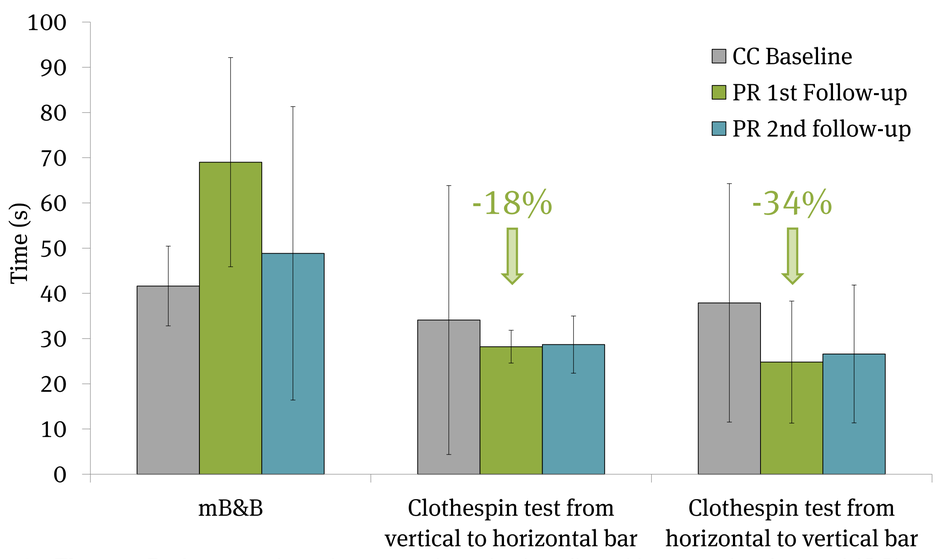

Figure 1: Performance-based tests conducted at baseline with conventional control (CC), and at 1st and 2nd follow- up with pattern recognition control (PR).

Although in the clinical tests pattern recognition outperformed the conventional prostheses, in daily life 4 out of 6 subjects reported at least mild problems with their prosthesis (user´s project specific questionnaire mean score 1.7 ± 0.59). The control was often reported not to be robust enough in daily routine use, e.g. carrying heavy objects (*Figure 2*). No difference was observed in DASH and level of proportional control.

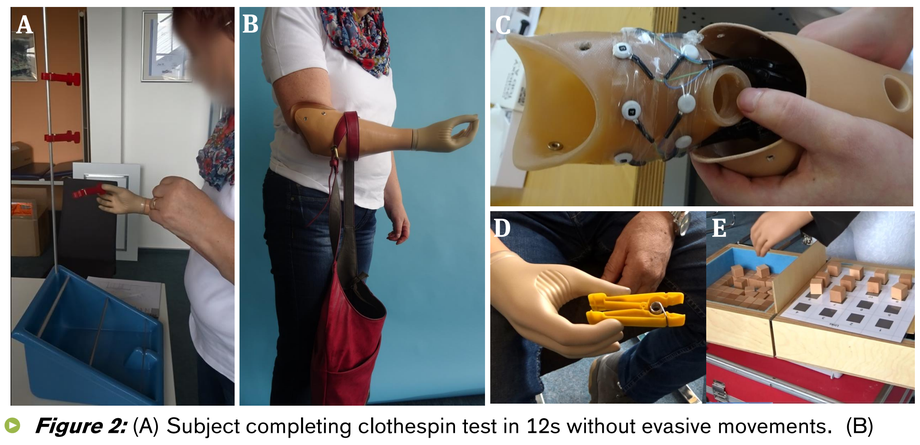

Figure 2: (A) Subject completing clothespin test in 12s without evasive movements. (B) The same subject demonstrating a situation of daily living where the control failed, causing dissatisfaction. (C) Components fitted easily in sockets, also for small residual limbs. (D) and (E): Proportional and modified box and blocks tests performed by participants.

Discussion & conclusion

Improvements in unilateral gross manual dexterity and ability to control two degrees of freedom were observed with pattern recognition during the 1st and 2nd follow-up. Longer patient accommodation time and optimized product development in the future will need to reduce challenges for pattern recognition users at home in daily use, where robustness to non-stationarities is essential.

References

1. Young, Aaron et al. 2014 Journal of NeuroEngineering and Rehabilitation
2. Peerdeman, Bart et al. 2011 The Journal of Rehabilitation Research and Development

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