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BIOMEDICAL TECHNOLOGY AND TECHNICAL MEDICINE

Myopro

GRASPING FORCE AND SLIP FEEDBACK THROUGH VIBROTACTILE STIMULATION TO BE USED IN MYOELECTRIC FOREARM PROSTHESES

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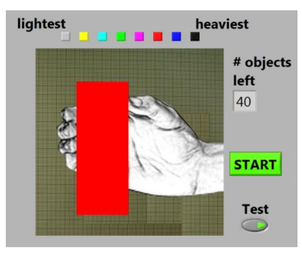
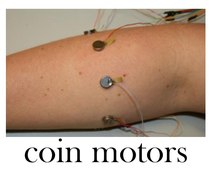
Introduction

- Lack of sensory feedback in myoelectric forearm prostheses results in:
  - difficulties in object handling
  - high mental burden on visual system
  - no subconscious control of the prosthesis
- Vibrotactile stimulation can be a non-invasive, simple and relatively low-cost solution
- How do different stimulation methods, providing grasping force and slip feedback, affect grasping performance?

Methods

Table 1: Overview of the variables used in the experiments

Force control	Virtual Setup	Force Feedback	Slip Feedback
 variable gain	 visual weight info can be blocked	 C2 tactor	Amplitude
			Pulse frequency
		 coin motors	Position
		No	

The experimental task, for 15 healthy subjects, was to hold

- 40 virtual objects of 8 different weights,
- by controlling grasping force through mouse scrolling,
- with feedback about grasping force or slip movement,
- through a single C2 tactor or an array of 8 coin motors,
- varying the amplitude, pulse frequency or position

Outcome parameters :
- time needed to perform the task
- performance = percentage correct (if applied force = required force) force levels

Results

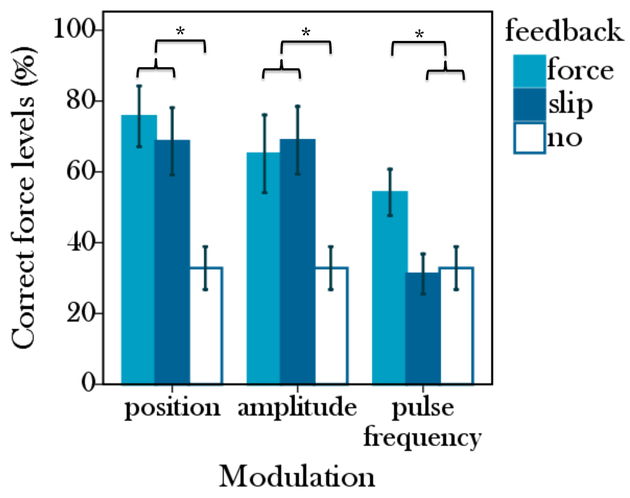


Figure 1: mean percentages & 95% c.i.'s of percentages correct applied grasping forces

- Grasping force and slip feedback both significantly increase the performance of the grasping tasks (see fig. 1)
- Duration of tasks significantly longer compared to non-feedback, but no differences between methods (see fig. 2)
- No differences in performance and duration between modulation techniques for grasping force feedback
- Blocking visual feedback about object weights did not decrease performance when slip feedback was provided
- Frequency modulation was not successful to provide slip feedback

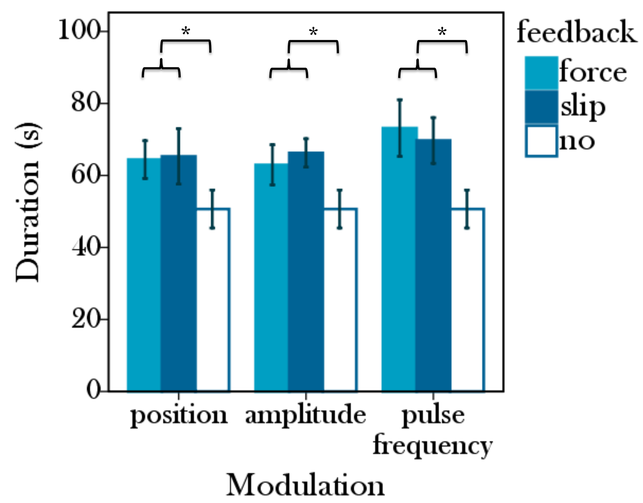


Figure 2: mean percentages & 95% c.i.'s of task durations

Discussion

- Slip feedback does not require preliminary object information (weight or roughness)
  - further investigation on slip detection and the time needed to react is required
- Both coin motors and C2 tactor can be used to succesfully provide grasping force or slip feedback
  - applicability in prosthesis socket becomes important
- Further evaluation with amputee patients and combination with EMG control is necessary

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