

JOINT-BASED VELOCITY FEEDBACK IMPROVES MYOELECTRIC PROSTHESIS PERFORMANCE

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BACKGROUND

Those with upper-limb amputations have reduced sensory feedback, and this likely contributes to difficulties in performing daily activities [1]. Many attempts have been made to improve performance by providing sensory substitution, but few have succeeded with visual feedback present [2]. Research in computational motor control proposes three criteria for augmented feedback to be most useful. First, the feedback should provide information not available to other senses, notably vision [3]. Second, the feedback should have low uncertainty compared to the control of the task [4]. Third, feedback should provide information in the most uncertain reference frame (which, for EMG control, tends to be a local reference frame) [5]. These criteria suggest that a local, joint-based velocity feedback paradigm will improve prosthetic arm control, even for those with unaffected vision.

The aim of this study was to determine if local joint-based velocity feedback improves performance, even with vision present, during control of a 2 degree of freedom (DOF) myoelectric interface.

METHOD

Ten able-bodied subjects participated in the study, which was approved by our local ethics board. After providing informed consent, subjects controlled a myoelectric interface consisting of a virtual shoulder and elbow and were asked to perform time-constrained center-out reaches, arriving at the target within 1.5 seconds. Subjects completed one session with no audio feedback, and one session with audio feedback provided, where amplitude corresponded to joint speed, with a different frequency for each joint. After subjects were familiarized with the task, the simulated dynamics were perturbed by reducing the damping coefficient of the joints. We measured the increase

in reaching error and average movement speed post-perturbation, and during reaches to different targets testing generalizability, and modeled the adaptation to these new system dynamics as an exponential decay function.

RESULTS

Subjects experienced a smaller increase in both reach errors and average speed immediately following the dynamic perturbation with audio feedback present. Though reaching errors were within baseline levels during the first generalization trial, speed increased by a smaller margin with audio feedback present.

DISCUSSION

These results suggest that local joint-based velocity feedback helped users recognize changed system dynamics and allow them to adapt faster to these new dynamics, even with vision feedback present.

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