PATIENT-SPECIFIC OPTIMUM MOTIONS: A NEED FOR MINDSHIFT IN MYOELECTRIC ONTROL OF PROSTHESES?

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INTRODUCTION:

Despite the tremendous attempts in the optimization of feature sets and classifiers, the clinical usability of pattern recognition based myoelectric control has considerable room for improvement. In this study, we propose the degree of motion preference (DMP) as a step toward a patient specific optimization of motions.

METHODS

Six transradial amputees (all males, mean age 31.2 yrs.) took part in this experiment, and participated on seven consecutive days. Five to six surface bipolar electrodes were placed equidistantly about the forearm of the residual limb. Classification of the 11 motions (hand open (HO), hand close (HC), wrist flexion (WF), wrist extension (WE), pronation (PR), supination (SU), side grip (SG) fine grip (FG), agree (AG), pointer (PO); and resting state (NM)) were performed based on seven features using a linear discriminant analysis classifier. Confusion matrices for each amputee were computed. Furthermore, we investigated the best combination of six active motions plus NM per day. The optimum set was selected as the set with the highest average accuracy. Because each day may result in a different optimum set, the DMP across days was quantified as the average accuracy of each motion weighted by its occurrence frequency in the seven optimum sets.

RESULTS

Average classification error was 21.5 ± 4.3 % for all 11 motions but 25.2 ± 4.8 % for the worst combination of 6 active motions (plus rest, thus 7 motions). However, ensemble average error dropped to 5.5 ± 2.5 % using the daily optimum set of motions. Figure 1 depicts that the performance of each specific motions seems to vary across days and subjects. Results showed that DMP depends on the patient and that some motions are not preferred (Figure 2).

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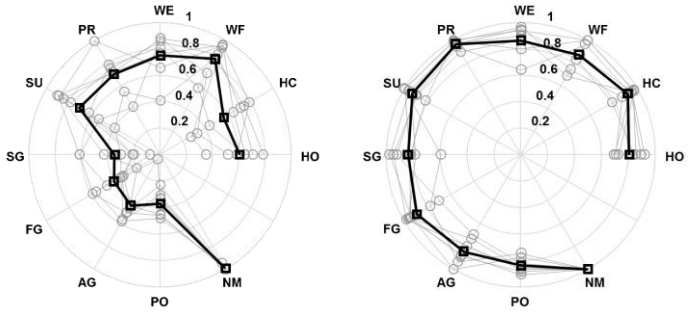

Figure 1: Diagonals of Confusion matrices of accuracies in polar form for a good (right) and a poor user (left) for each day (○) and on average (□).

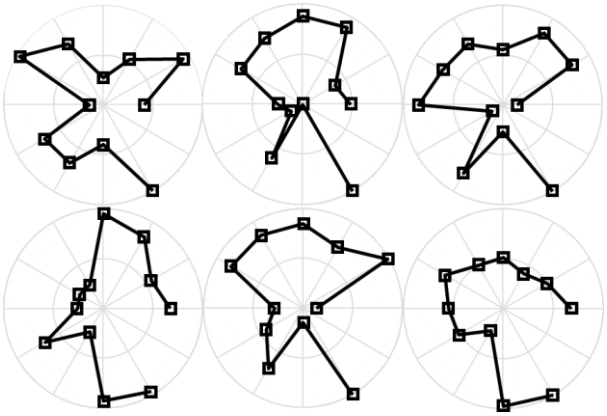

Figure 2: DMP for each amputee showing the difference in the preferred motions. Motion distribution is the same as in Figure 1, but labels are removed for visibility.

DISCUSSIONS

We have shown that selecting an optimum set of motions may improve performance; and that class performance may vary with time allowing quantification of the degree of motion preference (DMP) that is patient specific. This is clinically relevant towards patient's specific adaptive systems.