RTM-PDCP LINKAGE PLATFORM MULTI-MODAL SENSOR CONTROL OF A POWERED 2-DOF WRIST AND HAND

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ABSTRACT

Highly functional multi-DOF upper limb prostheses are available to the users, though problems remain on the control strategies' operation load. We proposed Multimodal Sensor Control, MSC, which integrates myoelectric signal and forearm posture signal to operate the prosthetic hand and wrist. Experiments comparing MSC and locked-wrist myoelectric control showed that compensatory shoulder motion can be reduced with MSC, yet only on specific conditions.

To augment the MSC to variety of daily activities with least operating burden, we propose to combine environmental information to the motion signal, e.g. myoelectric and forearm posture, since hand operation is selected by the relativity of the grasping object posture and hand orientation. The key is the network for streaming the environmental information to the prosthesis controller. A robotized room for comprehensive support environment for the physically handicapped is an expedient and RT-Middleware, RTM, has a proven strategy. Prosthetic Device Communication Protocol (PDCP) is the best test bed for the prosthetic control, and therefore, the objective of this project is to develop and verify the availability of MSC using environmental information with RTM-PDCP linkage platform. As a proof-of-concept model, wearable tag reader was implemented to demonstrate the operation based on the relativity of the hand and environment. By mounting RFID on the grasping target's surface, tag reader on the hand and an inclination sensor to the working table, the information of the tag ID, inclination angle of the object, approaching motion signal of inertia measurement unit and trigger of the myoelectric signals are combined to presume the grasping direction of the target object and switch the servo control mode and drives the 2 wrist motors to maintain the wrist angle to while grasping the object.

The operation load applying the MSC was verified by conducting experiment of 48 trials. A powered wrist and hand was assembled and donned on the right forearm of 4 non-amputees subjects. Six tasks were selected from the therapeutic battery, Simple Test for Evaluating hand Function (STEF), for evaluation. The operating forearm posture angles and work times of the trial with MSC and conventional myoelectric control were measured. The average work time of MSC was larger but not statistically significant, while the average forearm posture angle range was significantly smaller ($p<0.05$). These results of downgraded forearm posture angle range without prolonged operation time demonstrates that the MSC using environmental information can be operated on RTM-PDCP linkage platform and suppresses compensatory motion.