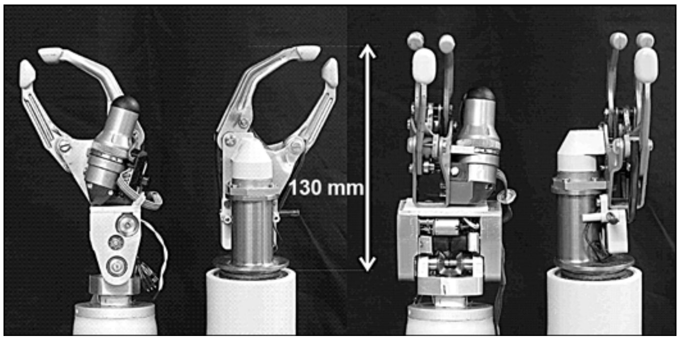
Two-degree-of-freedom powered prosthetic wrist

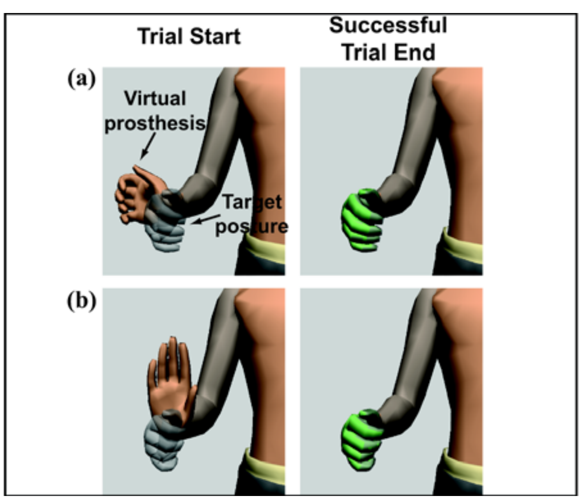
Peter J. Kyberd, PhD, et al.



Two versions of a novel compact wrist design were built and tested. The device design flexes and extends, rotates at the same point on the arm, and fits within the hand, taking up little space in the forearm. It was tested with a single-prosthesis user in the laboratory. A controller that uses the patterns of activity in the forearm muscles was employed to allow the user to control the wrist.

Target Achievement Control Test: Evaluating real-time myoelectric pattern-recognition control of multifunctional upper-limb prostheses

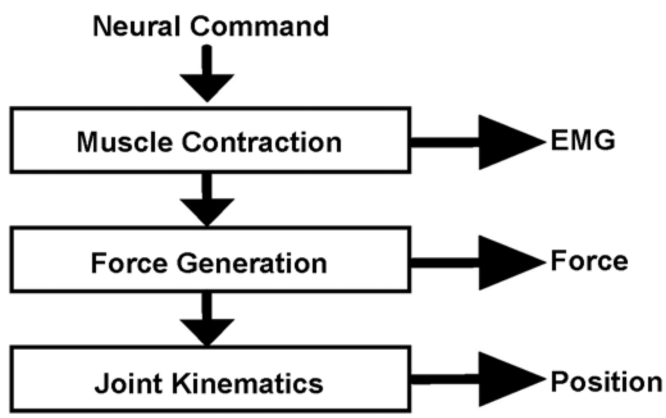
Ann M. Simon, PhD, et al.



Individuals with upper-limb amputations may currently use artificial limbs controlled with signals from their residual muscles. Pattern recognition, one type of advanced control, uses the patterns produced by several muscles to control prosthesis movements. This article describes a new way to test this control by using a virtual environment performance test called the Target Achievement Control Test. During this test, we asked five individuals with a below-elbow amputation to move a virtual arm into a target posture. The results of the study demonstrated that this new test can be useful in measuring individuals' control without the initial need for a physical prosthesis.

Comparison of electromyography and force as interfaces for prosthetic control

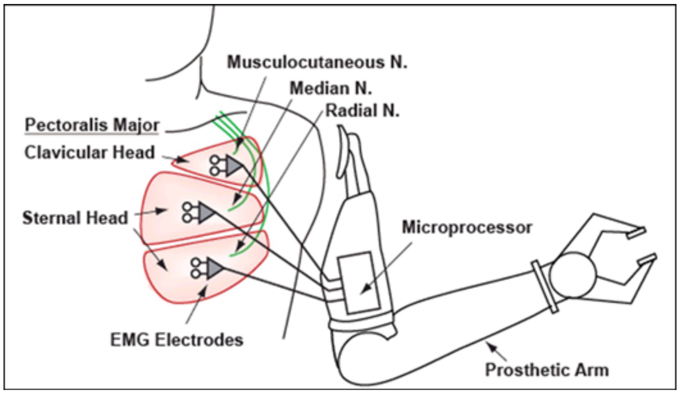
Elaine A. Corbett, MS, et al.



In this study, we tested three control interfaces for upper-limb prostheses. We compared the performance of myoelectric control with force and position, two more direct means for humans to interact with the environment. We used a tracking task to conduct the tests, in which myoelectric control performed as effectively as force control. To explore the limits of the myoelectric control interface, we also evaluated it at different tracking frequencies. The results will be useful in designing prostheses.

Electromyogram pattern recognition for control of powered upper-limb prostheses: State of the art and challenges for clinical use

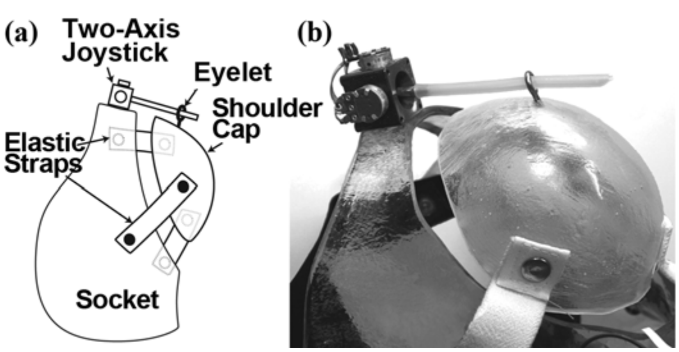
Erik Scheme, MSc, PEng; Kevin Englehart, PhD, PEng



The expectations for artificial upper-limbs have always been high because of their portrayal in popular media and comparisons with nondisabled dexterity. In the United States, approximately 30,000 persons have an above-elbow amputation and 60,000 have a below-elbow amputation. Only a small percentage of patients with an upper-limb amputation regularly use a prosthesis, mainly because of a perceived lack of function. This article describes the use of pattern recognition to enhance the dexterity of upper-limb prostheses and the current challenges in transferring this dexterity to commercial devices.

Use of two-axis joystick for control of externally powered shoulder disarticulation prostheses

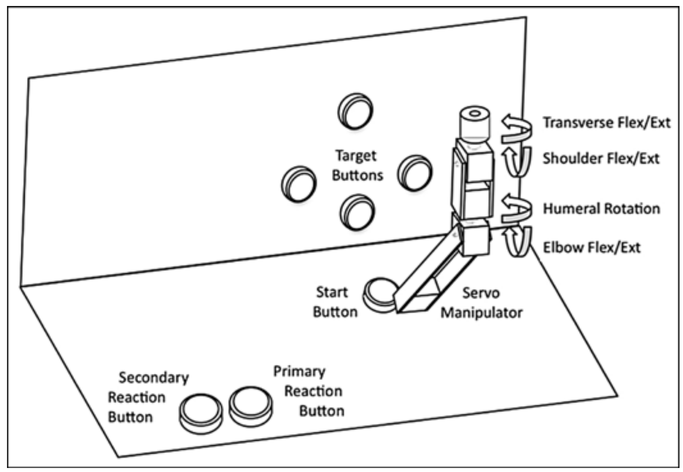
Robert D. Lipschutz BSME, CP, et al.



Throughout history, individuals have sustained amputations from war and internal conflict. Even with modern artificial limbs, restoring function to those who have had high-level, upper-limb amputations is very difficult. One of the challenges for these individuals is finding a method for controlling electrically driven prostheses. By using remaining shoulder movements, these individuals can engage with electromechanical controls that operate the artificial limb. This research explores a new method by which users may more easily use their remaining shoulder movements to operate the prosthesis.

Evaluation of shoulder complex motion-based input strategies for endpoint prosthetic-limb control using dual-task paradigm

Yves Losier, MScEE, PhD, PEng, et al.



In this study, we designed and evaluated two different approaches to control the endpoint of powered upper-limb prostheses. One method used the position of residual shoulder motion; the other used the myoelectric signal produced by the shoulder muscles. Both approaches were tailored for individual users through a short training protocol. The two control systems were assessed with a functional test experiment. The results showed that the residual motion-based strategy outperformed the myoelectric signal-based strategy and that neither strategy significantly increased the users' mental burden.

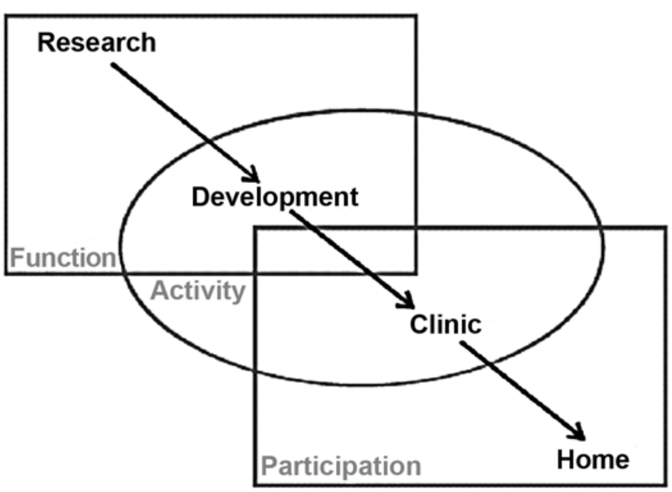
Prosthetic sockets stabilized by alternating areas of tissue compression and release

Randall D. Alley, CP, LP, et al.

Traditional prosthetic sockets are almost circular in cross section. This shape permits the remaining bone to move substantially before it is close enough to the socket wall to cause motion. Compression-stabilized sockets are made with four long depressions that push the tissue close to the bone and prevent motion. Between these depressions are open release areas to accommodate the displaced tissue. The release areas may be left open for cooling. Persons with above-knee amputations have improved gait and stability, while persons with arm amputations have better control of their artificial hands or hooks.

Development and testing of new upper-limb prosthetic devices: Research designs for usability testing

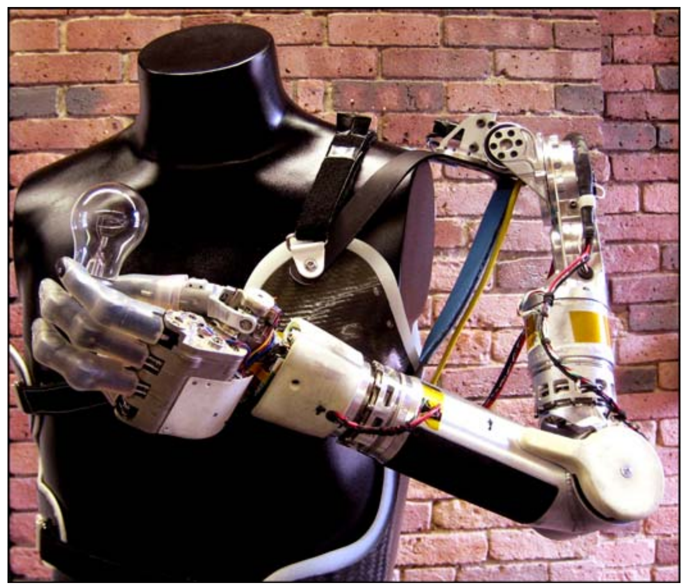
Linda Resnik, PT, PhD, OCS



This article defines and reviews key aspects of usability testing research for new devices, focusing on their relevance to upper-limb prostheses. The article discusses the importance of patient and clinician involvement in device development research and describes approaches and designs for usability testing, the sample size needed, and use of outcome measures. Finally, the article compares usability testing to other types of study designs used in prosthetics research.

Using virtual reality environment to facilitate training with advanced upper-limb prosthesis

Linda Resnik, PT, PhD, OCS, et al.



This article explores the use of virtual reality for upper-limb amputee rehabilitation and describes the system used with the DEKA Arm. This virtual reality program allows users to practice controlling an avatar using the controls designed to operate the DEKA Arm in the real world. We provide highlights from our experiences training amputees to use the full DEKA Arm with a virtual reality system. A case example of a subject using the full DEKA Arm with powered shoulder is presented. Finally, the article recommends future research and suggests use of virtual reality systems in amputee rehabilitation.

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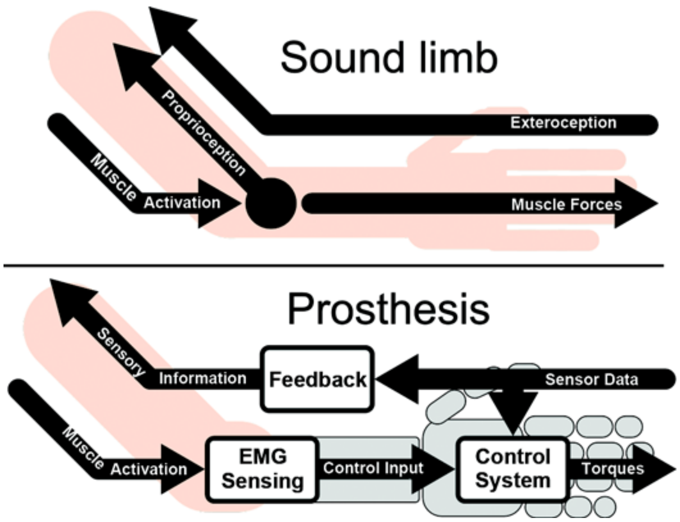
Myoelectric forearm prostheses: State of the art from a user-centered perspective

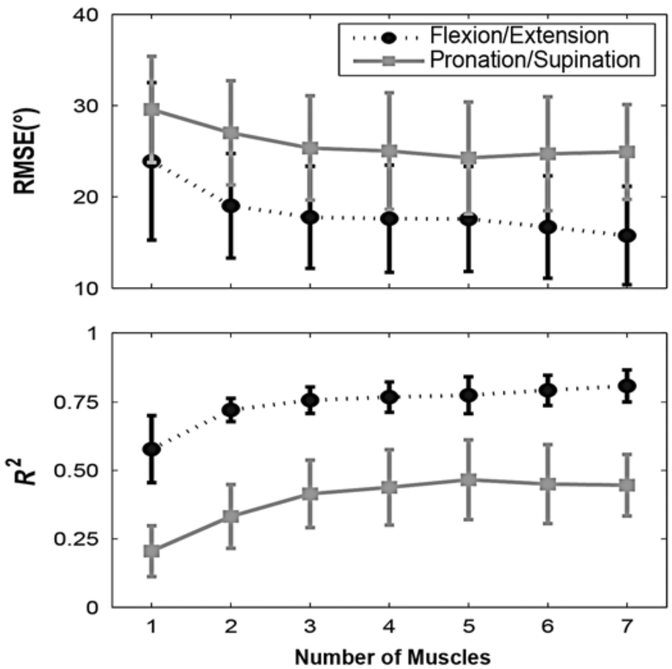
Bart Peerdeman, MSc, et al.



Users often abandon myoelectric forearm prostheses because of control issues and lack of feedback. Modern research is often focused on increasing the functionality of new prostheses. Our research focuses on user acceptance. First, we assessed the needs of the user through a workshop and determined a set of functional requirements. We then evaluated current research in myoelectric forearm prosthesis technology using these requirements. Next, we discussed the current state of the art and recommendations for future research directions that would improve both functionality and user acceptance.

Electromyographic-based neural network control of transhumeral prostheses

Christopher L. Pulliam, MS, et al.



Upper-limb amputation can greatly impairs function of patients, particularly those with above-elbow amputations. Electromyographic (EMG) signals have proven to be effective command sources for controlling externally powered upper-limb prostheses. The work presented here specifically investigates a method for predicting arm movements based on EMG signals from muscles in the upper arm and shoulder. With this approach, a patient may be able to control his or her transhumeral prosthesis more naturally and effortlessly than with current commercially available options.