

Myoelectric Prosthetics

Introduction to Upper Limb Prosthetics

The primary purpose of an arm prosthetic is to mimic the appearance and replace the function of a missing limb. While a single prosthetic that achieves both a natural appearance and extreme functionality would be ideal, most artificial limbs that exist today sacrifice some degree of one for the other. As such, there is a wide spectrum of specialized prosthetics that range from the purely cosmetic (which are inert) to the primarily functional (whose appearance is obviously mechanical). Myoelectric prosthetics are an attempt to serve both purposes of an artificial limb equally, without sacrificing appearance for functionality.

What are myoelectric prosthetics and how do they work?

Functional arm prosthetics can be broadly categorized into two camps: body-powered and externally-powered prosthetics. Body-powered prosthetics use cables and harnesses strapped to the individual to mechanically maneuver the artificial limb through muscle, shoulder, and arm movement. While they are highly durable, they often sacrifice a natural appearance for moderate functionality. As well, though the user experiences direct control and feedback through its mechanical operation, the process can be fatiguing. Externally-powered artificial limbs are an attempt to solve this physical exertion through using a battery and an electronic system to control movement. At the forefront of this technology is the myoelectric prosthetic.

Myoelectric prosthetics have a number of advantages over body-powered prosthetics. Since it uses a battery and electronic motors to function, the myoelectric artificial limb does not require any unwieldy straps or harnesses to function. Instead, it is custom made to fit and attach to the remaining limb (whether above the elbow or below) with maximum suspension using suction technology. Once it is attached, the prosthetic uses electronic sensors to detect minute muscle, nerve, and EMG activity. It then translates this muscle activity (as triggered by the user) into information that its electric motors use to control the artificial limb's movements. The end result is that the artificial limb moves much like a natural limb, according to the mental stimulus of the user. The user can even control the strength and speed of the limb's movements and grip by varying his or her muscle intensity. As well, the acute sensors and motorized controls enable greater dexterity, even allowing the manipulation and use of small items like keys or credit cards through functioning fingers. In addition to this extreme functionality, the myoelectric artificial limb needs not sacrifice any of its cosmetic appearance. The most advanced versions of these prosthetics are incredibly natural and on par with purely cosmetic limbs.

The primary disadvantages of this kind of prosthetic are currently their weight and cost. Their heavy weight is primarily due to the fact that the myoelectric artificial limb contains a battery and motor inside, and unlike the body-powered prosthetic, it does not use any harnesses to counter-balance the weight across the body. This is an admitted trade-off for a more natural appearance. As well, as the technology develops, the weight of each component will eventually become lighter and less of a problem. The other disadvantage of myoelectrics is the cost. While it is currently more expensive than other kinds of prosthetics, it also offers the best quality in regard to both cosmetics and functionality. Like the problem of weight, it is estimated that the cost will eventually diminish as the technology becomes cheaper to reproduce.

Web Resources

Since myoelectric prosthetics are on the cutting edge of innovative technology, the primary resources and dialogues on the internet about the topic are currently in technical and scientific journals. However, there are a few great resources outside of that community.

- <http://www.myoelectricprosthesis.com/> - A great website dedicated to myoelectric prosthetics for children. If you are considering a myoelectric prosthetic for a child, this is the first place to go. It features a step-by-step process of fitting your

child with a prosthetic.

- <http://www.oandp.org/> - The website for the American Academy of Orthotists and Prosthetists. A primary hub for prosthetics and orthotics, both for the industry and for the community.
- <http://openprosthetics.org/> - A site dedicated to the development and sharing of new prosthetic technology, funded and kept alive by the prosthetic community itself. Very informative and has a great sense of spirit (check out the artificial hand entirely made of LEGOs).
- [Smart Hand Project](#) - A project that is working on a lifelike hand that looks and feels like a real hand.
- [Cyberhand Project](#) - A highly advanced project to bring numerous technologies together to make a very functional and lifelike prosthetic.
- [Deka Arm Project](#) - The inventor of the Segway has been working on a very high tech arm developed for soldiers who were injured in combat. This is one of the most advanced arms to date. Called the Luke Arm as a tribute to the technology of the hand that Luke gets in the Star Wars movies.
- [Military Bionic Arms](#) - A news article on a military site that talks about a new arm that can have up to 24 movements!
- [Vanderbilt](#) - News article about a controller that is being developed that works with light to mimic the way the body naturally works. Supposedly it is dual feedback meaning it can move as well return feeling sensations.
- [The Give A Hand Project](#) - An organization that literally gives people a hand when they need one. They donate prosthetics to those who need them.
- [RoboHand](#) - This is a really neat project that is using 3d printers to bring the cost down to under \$1000, some are saying as low as \$150. They are also building kits for people for a very low cost or free. Totally worth checking out. There is a few places to get information, but it does not seem like a single source or a place to order one just yet. [RoboHand Facebook Page](#). Download the 3d Plans at [Thingaverse](#).
- [InMoov Robot Project](#) - This is also a neat project that is an open source robot. The parts are very functional though, and a hand has already been turned into a [voice activated hand on this page](#).
- [Open Prosthetics](#) - A list/ wiki of various resources related to open source prosthetic projects.