

Armed Man

Robo Specs

Name: Motion Control Utah Arm 2 with Motion Control Hand

Purpose: Rehabilitation of arm amputees

Creative inspiration: Human arm and hand

Length: 27.3 cm

Weight: about 1.3 kg, with Hand and cosmetic glove

Actuators: Basket wound motor with permanent magnet, 1 motor for each degree of freedom (i.e. elbow, hand, and wrist movements)

Load limit: 22.7 kg with elbow locked

Feedback sensors: Position, force

Frame composition: Composite of nylon with carbon fiber and fiberglass

Batteries: 12v Nickel Metal Hydride; rechargeable

Cost: \$50,000 to \$75,000

Funding agency: National Institute of Health

Project status: Ongoing

Information from: Harold Sears

Peter's Notes

Spending a few days with Bob Goodman at his home in eastern Oregon was a real treat. He lives in Halfway, named for its location between the towns of Robinette (now under water) and Cornucopia (now deserted). Quiet town, big sky, friendly people. In 1989, Bob was putting up a TV antenna when it came in contact with some high-voltage wires. His right arm was burned off and his leg was also burned where the electricity exited his body. The sparking was so bad that it started a grass fire which burned up a nearby trailer. His heart stopped, but when he fell off the ladder the shock of hitting the ground restarted it. He was taken to Portland by helicopter, where his arm was amputated. After skin grafts and reconstructive surgery on the stump, Bob went to Salt Lake City, where he was fitted with a myoelectric prosthesis at Iomed Inc., which is now Motion Control. With the insurance money from the accident, Bob was able to upgrade his living conditions to an 80-acre ranch outside of town. Today, he continues to run his ranch, do carpentry and odd jobs, and cook and clean for himself. When we met, he told me he had just begun skiing again.

Rancher and carpenter Bob Goodman can't remember the moment he was shocked by the high-tension wire while doing some work atop his neighbor's roof, but the ten years since have been a constant reminder. After his badly burned right arm was amputated above the elbow, he was fitted with a prosthetic limb in Salt Lake City. His new myoelectric prosthetic arm uses an electrical signal from his own muscle to control a motor that operates the realistic-looking hand. The myoelectric arm was harder for Goodman to learn to use than an ordinary prosthesis because he had to learn how to flex his muscles to send the proper signals to the arm and hand. Nonetheless, Goodman says the extra mobility is worth the trouble. He has replaced the first myoelectric arm with a newer, more advanced version.

Faith: Do you think of your prosthetic arm as part of you Bob?

Bob Goodman: I was amazed at how soon it really did start becoming a part of me and I didn't really have to concentrate on flexing my muscles to make my hand open and close. It just became second nature to open and close the hand and release the elbow. That's the hard part; you have to flex both muscle sites at the same time and then relax and then release the elbow. It took me awhile to get the muscles flexed at the right time.

How long were you without an arm before you actually got fitted?

I had a fair amount of surgery on what remained of my arm, so it was pretty sensitive to being fitted with an artificial arm. It was probably three or four months.

You told me that you can't imagine not having your prosthetic arm, but I would imagine there are things you would like to do that you still can't.

Yeah, and a lot of 'em are simple things. I really miss just a two-armed hug, right off the bat, you know, or dancing. I used to dance a lot. It's funny how I can farm and build houses, but then there's these little things that come up that are so simple, you would think, but they are difficult. Sometimes those Ziploc bags—it's hard to get the finger in there. You're using your teeth a lot on stuff like that.

I can't do that very well with my regular hands [laughs].

Well, that makes me feel better. Let's see—other things. Holding nails is no problem, and a lot of times for big jobs I use a nail gun. But little finish nails or little brads—that was really kind of a setback for me to deal with that. So, I did have to tool up quite a bit more. I used to love to hold a chisel—now I have just had to get some different tools to keep on woodworking the way I like to.

You have an updated version now, which has a long-

lasting nickel-metal hydride battery. Did the battery in your last arm ever die?

I sure did. If I happened to have the elbow locked and I didn't know that the battery was getting low, then all of a sudden it would go completely dead, and I couldn't unlock the elbow. There's an override, but I had to take the forearm off, then take one of those little nine-volt batteries and do a jump to get a little spark going—*So you jump-started your elbow?*

Yeah, and that released the elbow—that only happened to me once.

What were you doing when it happened?

I was just around the house, so it was real convenient to break it down, but I didn't have a nine-volt battery handy, so I took one out of the smoke alarm. *The arm must be pretty reliable if it only happened once, but that was quick thinking.*

I'm glad I did think of it. I think there is going to be a manual override on the newer arms. There will be a little switch or button somewhere that you can push and it will release the elbow, so you can put a new battery in.

Is the arm heavy?

It is kind of heavy. I believe it weighs about the same as a live arm, but there is more weight distributed toward the hand, and I hear that's why a lot of people don't opt to wear myoelectric, or if they do it's just to go out to dinner or something, because of the weight of it.

What's the most surprising question you've been asked about your arm?

A couple of years ago I was giving a talk to an elementary school, it was a third or fourth grade class, and one boy asked, "In your dreams, do you have your artificial arm on or not?" It was a wonderful question and something I was paying attention to. *What did you tell them?*

That for the first couple of years I was dreaming with two arms. Once in a while I was dreaming with an artificial arm, or no arm at all.

The way mass media sometimes portray technological breakthroughs, do they do prosthetics a disservice?

I think that's a big hindrance for an amputee—believing that they are going to receive a prosthesis that's a bit like something in a James Bond movie. Well, it isn't. With myoelectric, you've got to mentally flex the muscles you are working with. It would be really frustrating if you're going in there thinking right off that your hand is gonna be opening and closing and the elbow locking and unlocking very effortlessly. It's hard work in the beginning.

What realistic technological advance do you hope for?

I'm pretty excited about the idea that someday a hand could operate more like a robotic hand, with each finger having individual movement. The point of contact on the hand now is still pretty limited. It's just the thumb, and then the middle and pointer finger as a solid unit.