Photography: Courtesy of Georgia Tech

Children have enough neuroplasticity that the hope is with the right corrective training, they might relearn to walk with a more normal gait. In this context the exoskeleton becomes a tool for physical therapy rather than a mobility device intended for prolonged use.

There are also potential applications for the technology for able-bodied users. "Companies are interested," Dr Young says, "in using exoskeleton-type technology, or powered exosuits, to enable people who have extremely physically demanding jobs who have high risk of injury, high rates of fatigue, to be able to improve their efficiency and safety in the workplace."

GOING MAINSTREAM

At this point, wearable robots and powered prosthetics are still very much a nascent field. "The technology is a long way from being ubiquitous," says Dr Young, but it's definitely on an upward curve. "We do see a lot of start-up companies and excitement," he says. "In the last few years there have been three FDA-approved exoskeletons."

As more and more companies have moved into the space, looking for practical applications for the technology that EPIC Lab is working on, wearable robots are moving out of academia and into the wider world.

Or, as Dr Young puts it, "They're starting to become reality."

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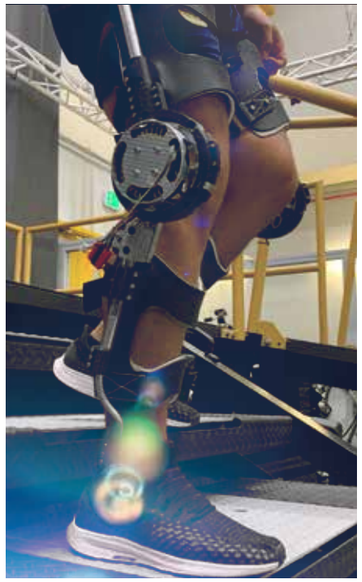
SCIENCE FICTION TO SCIENCE FACT

EPIC LAB IS CREATING THE FUTURE OF WEARABLE ROBOTS

Robotic limbs and exoskeletons are enhancing mobility options

I think that a lot of the students are initially inspired by some of the comics like Iron Man," says Aaron Young, PhD, Assistant Professor at Georgia Tech's School of Mechanical Engineering. While science fiction may be one of the gateways into robotic research, Dr Young's work with the EPIC Lab is very much in the realm of science fact.

EPIC ('Exoskeleton and Prosthetic Intelligent Controls') Lab was established three and a half years ago to perform bleeding-edge movement analysis for prosthetics and wearable robots. The application for the research is, as Dr Young, puts it, "wearable robotic devices for enhancing human mobility."



AARON YOUNG PHD,
Assistant Professor
Georgia Tech

IT'S LOOKING AT HOW ROBOTS CAN HELP PEOPLE MOVE OUT INTO THE COMMUNITY," HE SAYS. "WE FOCUS A LOT ON COMMUNITY AMBULATION AND HELPING PEOPLE TO BE ABLE TO DO DAILY TASKS."

"It's looking at how robots can help people move out into the community," he says. "We focus a lot on community ambulation and helping people to be able to do daily tasks."

That means primarily (though not exclusively) working with subjects who have mobility issues. "Researchers using the lab want to know how humans can control these wearable devices so that they can enable better mobility outcomes as measured through biomechanics and other clinical measures of human mobility," says Dr Young.

To enable that, Georgia Tech built one of the most adaptable and versatile motion capture labs in the world.

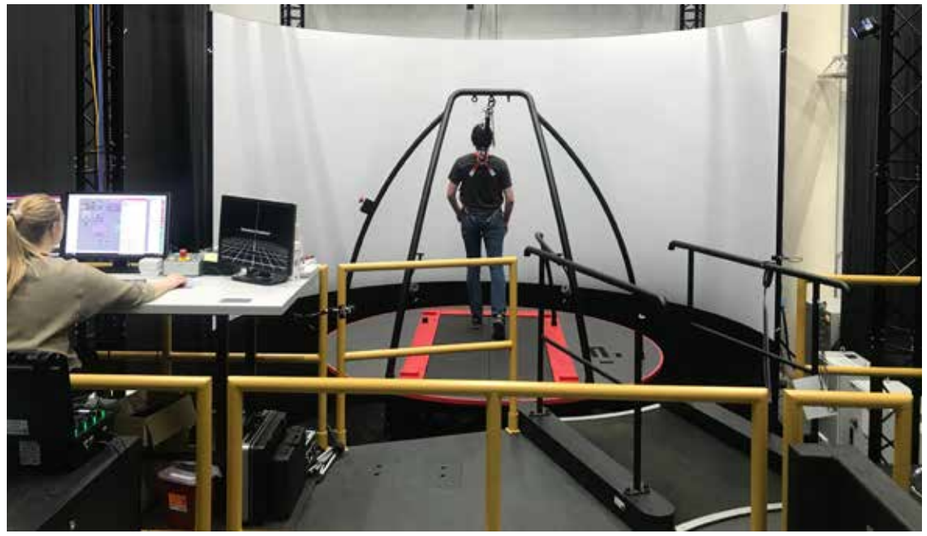
A WORLD-CLASS LABORATORY

The EPIC Lab facility boasts two full Vicon systems, a host of force plates and an array of equipment that can be configured in highly innovative ways to simulate real-world conditions.

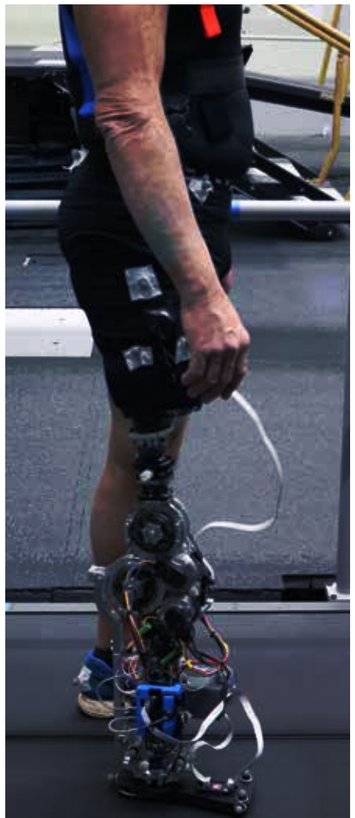
The first Vicon setup is a 36-camera mix of short- and long-range devices in EPIC Lab's overground gait facility. It's a large capture volume made up of four primary walking zones equipped with force plates to complement the Vicon system, and a large overhead harness track. Alongside areas for capturing straight walking and turning, the volume includes a terrain park made up of adjustable stairs and ramps, with the Vicon cameras set up to capture movement across a range of different configurations.

The overground capture area is complemented by the Motek Computer-Aided Rehabilitation Environment (CAREN) system and its 10-camera Vicon setup. This volume is used to analyze subjects in a virtual reality environment, and alongside a large projection screen, it includes an omni-directional treadmill that can be used to test the stability of users and to analyze how they respond to changes underfoot.

RESEARCHERS USING THE LAB WANT TO KNOW HOW HUMANS CAN CONTROL THESE WEARABLE DEVICES"



THESE PASSIVE PROSTHESES THAT ARE MOSTLY THE STANDARD ARE GREAT FOR LEVEL WALKING BUT ARE NOT VERY HELPFUL FOR MOST OTHER TASKS."



"We'll perturb someone using this treadmill and then look at how they recover, and what kind of strategy they use. Whether it was, for example, a stepping strategy versus just using their joint torques to counter the perturbation" says Dr Young.

This data can then inform the programming of stability measures for wearables and prosthetics: a crucial factor for their usability beyond the confines of the lab.

A PREMIUM MOTION CAPTURE SOLUTION

When it was time to equip the lab for optical motion capture, Vicon was a natural choice. Dr Young says that Vicon is seen as "one of the premium motion capture companies and very reliable and accurate for doing this kind of work." As such, many researchers and students have already logged a lot of hours on Vicon systems before they even step into the lab.

Another factor is cross-platform functionality. Vicon data can be easily integrated with Bertec, which is used with a lot of force plates, and the lab's Delsys electromyography (EMG) system.

Finally, Vicon's user-friendly software enables researchers to work quickly. Dr Young points, in particular, to the Nexus Plug-in Gait model which allows researchers to make fast progress during the early stages of projects before they move on to building models of their own.

ENHANCING MOVEMENT AMONG THE DISABLED AND ABLE-BODIED ALIKE

The research at EPIC Lab will help a range of subjects both in groups with mobility issues and among the able-bodied.

One of the larger patient populations that the lab works with is amputees.

Dr Young says amputees tend to favor their healthy side. "This leads to long-term degradation in their joints... and these passive prostheses that are mostly the standard are great for level walking but are not very helpful for most other tasks."

Researchers hope that with the data they capture it will be possible to build smart robotic devices that interpret the user's intent and move in a way that naturally assists them, relieving biological joints of added strain and enabling more natural movement.

The lab also works extensively on exoskeletons or 'wearable robots'. One subject group is children with cerebral palsy, who tend to walk with a crouch-like gait. Rather than correct that gait with ongoing use of a wearable robot that is used by the likes of stroke subjects, the aim of the exoskeleton would be to rehabilitate the child's movement.