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The BLEEX project: robotics enhancing human capability.

## Biomechatronic Man

Faster, better, stronger: It's not just for television anymore.

BY LANCE ULANOFF

The 1970s television shows *The Six Million Dollar Man* and *The Bionic Woman* hold nearly equal positions in the pantheon of pop culture, but their premises have been little more than pipe dreams. That pipe is blowing more than smoke these days, as scientists across the country work on human augmentation robotics technology, also known as *biomechatronics*—in other words, the merging of body and machine.

Following in the footsteps of household robots like the iRobot Roomba and the Sony AIBO entertainment robots, as well as battlefield robots like the iRobot Packbot, robots are now starting to show up on the human body. At MIT's Media Lab in Cambridge, Massachusetts, assistant professor Hugh Herr and his biomechatronics team have spent the past five years developing the Active Ankle-Foot Orthosis (AAFO). Made of plastics, a motor, a microprocessor, and a power supply, this robot can reanimate a paralyzed ankle.

Unlike a prosthesis, an orthosis doesn't replace missing limbs. Instead, it attaches to a paralyzed limb and may eventually enhance healthy ones. The 3-pound AAFO covers the leg from below the knee to the toes and restores natural motion.

Across the country, a team at the University of California, Berkeley, Robotics and Human Engineering Laboratory is working on the Berkeley Lower Extremity Exoskeleton (BLEEX), which fits over the

wearer's legs and assists in carrying heavy loads over long distances. It uses sensors, actuators, a network, and complex algorithms to compute the exoskeleton's motion. It's designed to imitate the torque, speed, and motion of a 165-pound person walking.

Homayoon Kazerooni, a Berkeley professor who invented the concept in the early 1990s, says that the prototype can support about 80 pounds in a special backpack. "You simply walk, and it walks with you," he says. The device, funded by the Defense Advanced Research Project Agency (DARPA), has applications in defense, firefighting, and rescue and recovery operations.

Both devices are several years away from commercial use, and the AAFO will be costly to deploy. But as MIT's Herr sees it, human performance augmentation is the shape of the future:

"In the coming decade we will see body amplifiers that expand human endurance and strength. We will see novel transportation devices that do not rely on wheels, where our own limbs are augmented, where we can traverse very rough terrains with a very high metabolic economy or efficiency. I predict that people for certain situations will not want to use wheels anymore, because their legs, augmented by technology, far outperform wheeled vehicles."

Maybe Lee Majors and Lindsay Wagner were born just a little early.

# TOP 10

# TECH TRENDS

## Wireless USB

Get ready for point-and-shoot video streaming.

BY SEBASTIAN RUPLEY

Wi-Fi liberated your notebook from a tangle of cords, and now Wireless USB is poised to free your camcorder. Soon you will be able simply to point your camcorder at your PC and stream video to it—wirelessly.

Wireless USB is based on ultrawide-band radio technology, which operates in the 3.1- to 10.6-GHz slice of the radio spectrum; its success depends on the throughput it can achieve at various ranges. Unlike Bluetooth, a short-range technology with lower data-transfer rates, Wireless USB is designed to do the heavy lifting required to transmit multiple video data streams throughout a home.

Wireless USB could threaten Bluetooth, but Jeff Ravencraft, a technology strategist at Intel, stresses that too much has been made of the Bluetooth comparison. "The key here is that consumer electronics companies are clamoring for high-data-rate wireless technology."

Just how fast can Wireless USB get? Initially, speeds will reach 480 megabits per second at a range of 2 meters and 110 Mbps at 10 meters. A speed of 1 gigabit per second is slated to arrive by late 2007. Current wired USB connections reach about 480 Mbps; Bluetooth offers only about 12 Mbps, and Wi-Fi can technically reach 54 Mbps, but its actual speed is much slower.

When will the first products roll out? According to Ravencraft, they will start shipping around the end of 2005 or the beginning of 2006. The first products will be add-in cards for existing USB gadgets. Backward compatibility is a key priority for Wireless USB, since over 1.5 billion USB-equipped devices have shipped worldwide.

It won't be long before very few of the connections you make will be wired.

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