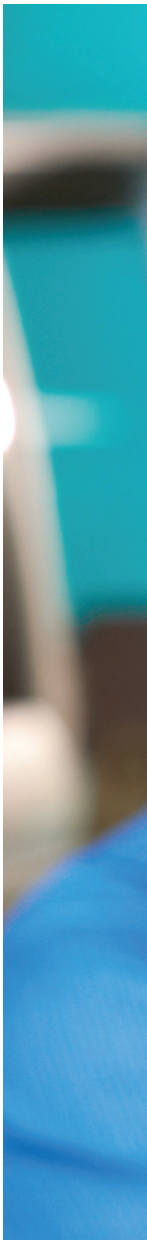
One night two years ago, Jesse Morella, 16, felt ill. He took a nap. Ten minutes later his mother, Maureen, heard him gasp. She called 911 for an ambulance. The doctors saved him, but said he'd remain in a "vegetative state." Jesse's brain, denied oxygen for 10 minutes when he suddenly stopped breathing, had suffered very serious damage.

Yet the first thing Jesse did upon returning home after spending nearly a year at Children's Specialized Hospital in Mountainside, New Jersey, was to log onto his computer. He remembered his favorite computer game and learned to communicate by pointing to letters on an alphabet board and forming words.

"I knew right then that there was hope for Jesse," says Maureen.

ENGINEERING HOPE

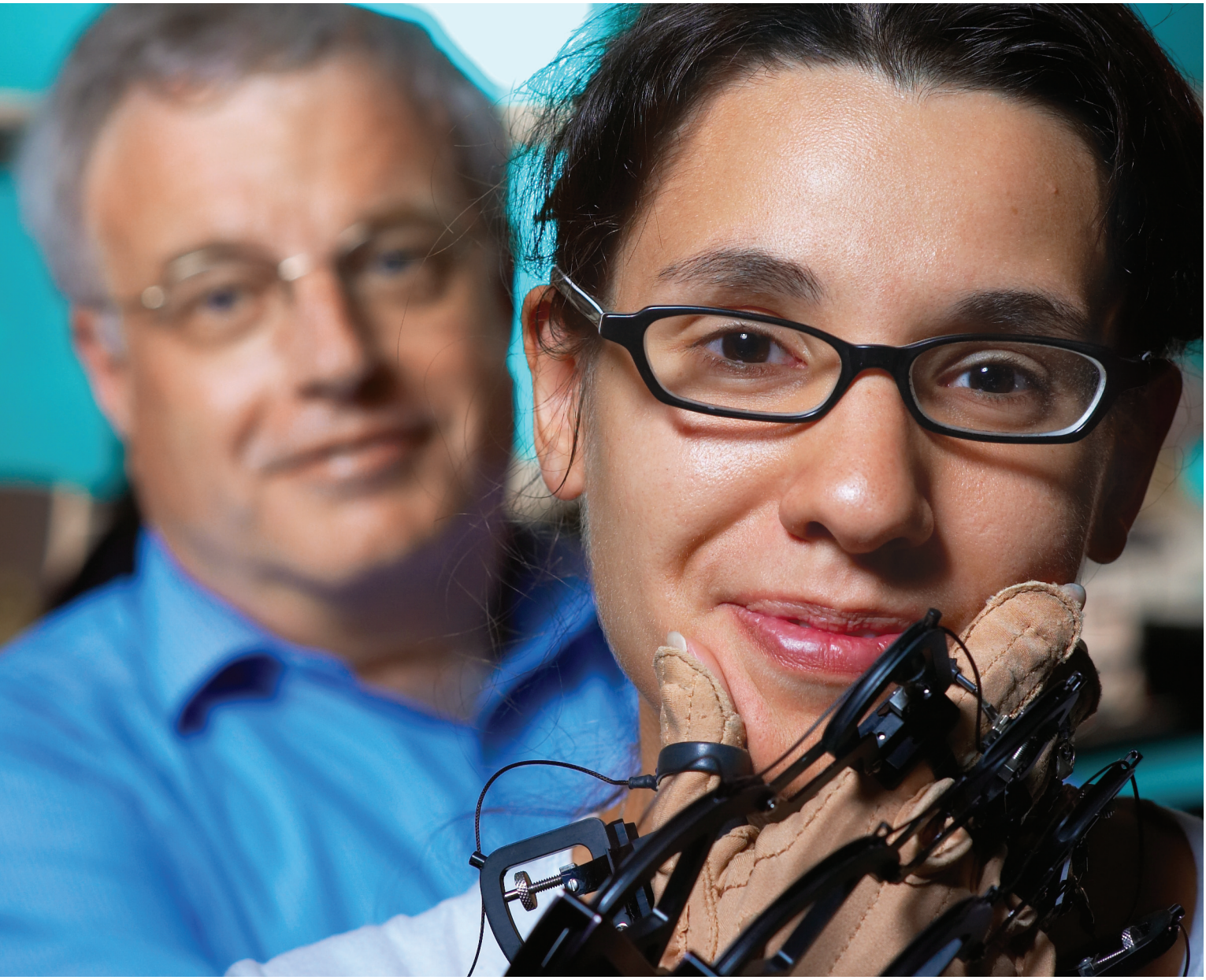


NEW TECHNOLOGY FOR REHABILITA-

A team of biomedic ers seeking . DeCap of th to realize Maureen's hopes. Biomedical engineering faculty Richard Foulds, Sergei Adamovich and Bruno Mantilla co-direct the university's new Rehabilitation Engineering Research Center, which is developing technologies to help children with orthopedic disabilities that result from cerebral palsy, brain injuries and other conditions. The center is funded by a $4.75 million grant from the National Institute on Disability and Rehabilitation Research. Important material support has also been provided under the NJIT Strategic Plan and from other sources, such as the recent $100,000 gift to the biomedical engineering department made by Vincent L. DeCaprio and his wife, Mary Lou, with the provision that it be used to help of Trustees, is also a 1972 graduate of the university.

"In a nation of technological riches, there is no better way for engineers to use their talents than to find new technologies to help people with disabilities, especially children," says Foulds. The NJIT team will first develop therapeutic technologies in the university's biomedical engineering laboratories and then test promising prototypes at Children's Specialized Hospital, the largest pediatric rehabilitation hospital in the country.

During the next five years, some 200 children are expected to take part in the NJIT center's six research projects. The projects are led by Foulds, an associate professor, Mantilla, a special lecturer



NJIT student Liz Mayo is helping to develop CyberGlove technology for an innovative approach to physical therapy that integrates virtual reality and computer games. In the background is Richard Foulds, associate professor of biomedical engineering.

PHOTO: PETER VIDOR

who is also a neurosurgeon, and Adamovich, an assistant professor. All are in NJIT's growing Department of Biomedical Engineering. (See sidebar on page 15.) Other faculty in the department and dozens of NJIT undergraduates and graduate students will contribute to these projects.

Video games and robot arms

Disabled children and adults often have limited use of their limbs due to impaired motor control or joint stiffness attributable to spasticity — involuntary muscle tightness. One approach the center will use to reduce spasticity is to stimulate the balance system in the inner ear and generate neural signals that briefly cause the brain to send signals to relax the muscles. During the short period that spasticity is reduced, researchers will also try to understand how spasticity interferes with movement.

The NJIT center will develop a variety of other technologies: video games for improving arm coordination and motor control by means of a special CyberGlove that interfaces physical movement with virtual-reality gaming software; wheelchair-mounted robotic devices that extend a child's reach and manipulation; and a therapeutic robotic device for increasing the range of motion of a patient's arms and perhaps helping to establish new neural pathways in the brain that improve mobility. The team is also working on a standing device to strengthen the bones of children who spend long hours in wheelchairs.

Associate Professor Foulds and Jesse Morella

PHOTO: KAI CHAN

Jesse's mother believes that her son could benefit greatly from all of these promising technologies, especially the standing device. Since coming home from the hospital, Jesse has been in a wheelchair. He cannot talk; he is fed through a feeding tube; he has limited use of his right arm and cannot move his left arm. Although his legs were paralyzed, therapy is helping him to bear some weight on his legs.

Building the strength to stand

Sitting in a wheelchair for long hours also makes Jesse's bones brittle and increases his susceptibility to fractures and osteoporosis. The standing device under development, however, will offer enough support to allow people who use wheelchairs to shift their weight from leg to leg, comparable to exercising with a slow-moving StairMaster®. Using the device for about an hour a day would likely strengthen bones to a significant extent. In addition, being able to stand longer would make it easier for a caretaker to transfer a person from a wheelchair to a bed, bath or chair.

> "A wheelchair like that, with the robotic arm, would help Jesse do more things quickly and build his self-esteem."

One afternoon, Foulds and Adamovich travel to Children's Specialized Hospital to discuss their projects with hospital administrators. Foulds spots Jesse and Maureen and introduces himself, kneeling beside Jesse's wheelchair to tell him and his mother about the efforts of the NJIT team. Though unable to speak, Jesse stares into Fould's eyes and listens intently to his voice.

The NJIT center will develop wheelchair-mounted robotic arms, Foulds explains, that could allow Jesse to perform everyday tasks by using a specially-designed joystick to control such a device. When shopping for food with his mother, Jesse likes to take the food from the shelves. The only problem is time. "To food shop takes us two hours," says Maureen. "A wheelchair like that, with the robotic arm, would help Jesse do more things quickly and build his self-esteem."

Foulds talks about another of the NJIT team's projects: an interactive video game designed to assist in the therapy for Jesse's arms. "It's virtual," he says, "so you'll see your arms on the screen and they'll become part of the game." The games will be customized for the children, with their therapists offering guidance on what's needed to help them play. Adamovich says evidence shows that simple manipulation, such as that provided by video games, can help to reorganize a damaged brain. In other words, the video games help to retrain the brain.

Connected to these virtual-reality games, the robotic arm of a therapeutic system called the Haptic Master will guide Jesse's arms through repetitive motions, making therapy engaging and fun, says Foulds.

Sheila Blochlinger, associate director of the Rehabilitation Technology Department at Children's Specialized Hospital, has spent 20 years as a physical therapist helping individuals like Jesse. She is advising Foulds and his colleagues on what technologies would be of most benefit. Blochlinger notes that "the NJIT rehab center will not only help our children but make it easier for their parents to take care of them. That's really important." It's not an easy job, working with disabled children, she says. "But what keeps us going is knowing that we are helping our patients — the children."

As she wheels Jesse out of the hospital, his mother shares an anecdote with Foulds. One day, as she was helping Jesse into the car, he stopped to glance at a teenaged girl, who saw Jesse, smiled, and winked at him. Jesse got into the car and, pointing with his fingers to his alphabet board, spelled out the line: I STILL HAVE IT.

Using breakthrough technology, Foulds and his team aim to help patients like Jesse have as much of "IT" as they possibly can — lives filled with movement and independence. ■

AUTHOR: Robert Florida is assistant director of public relations at NJIT.

BIOMEDICAL ENGINEERING AT NJIT— GROWING ENROLLMENTS AND BREAKTHROUGH

Founded in 2000, NJIT's Department of Biomedical Engineering has programs leading to bachelor's, master's and doctoral degrees. These programs, all with steadily growing enrollments, build on the master's degree program in the field first offered in 1981. Today, substantial funding from state, federal and private sources is helping to support a wide range of research initiatives. Much of this success is related to NJIT's strategic goal of achieving nationally recognized excellence in neural and neuromuscular engineering. Funded research includes:

- Assistant Professor Tara Alvarez's development of visual therapies and exercises for those who suffer from a common eye problem called convergence insufficiency, which makes it difficult to read or view a computer screen without getting headaches as well as blurred and double vision. This condition has also been linked to learning disabilities.
- The work of Assistant Professor Treena Arinzeh, one of the nation's leading investigators into the potential of adult stem cells in areas such as therapy for spinal cord injuries and cartilage damage.
- Research Professor Hans Chaudhry's work with the VA Medical Center in East Orange, New Jersey, to improve
balance in older persons.
- Work by William Hunter, chair of the biomedical engineering department, and Bruno Mantilla, special lecturer and neurosurgeon, to model the flow of cerebrospinal fluid in the brain to better understand the mechanisms that cause hydrocephalus.
- Research Professor Michael Jaffe's exploration of the impact of synthetic substrates on the behavior of cells. This includes working with nanofiber-based medical devices, processing collagen into fibers, films and sponges, and evaluating the relationship between resorbable polymer processing and relevant biological behavior.
- Assistant Professor Bryan J. Pfister's investigation of growing axons, components of the nervous system that interconnect nerve cells. Pfister has been able to greatly accelerate the growth of axonal tissue that could be used for surgical repair of damage to the nervous system with results superior to any other approach.
- Assistant Professor Mesut Sahin's effort to help individuals with spinal cord injuries and diseases such as muscular dystrophy. When these individuals think of moving their arms or legs, the command signals generated in the brain do not reach the appropriate muscles. Detecting and differentiating such signals in the spinal cord and then recording them in a computer integrated, for example, with a motorized wheelchair, could allow the selection of tasks like moving in a desired direction through a simple computer command.
- Research Professor Lisa Simone's collaboration with the Kessler Rehabilitation Institute in New Jersey and