They are here today.

Robots are not the stuff of science fiction.
They’re not your father’s robots. Not those familiar staples of science fiction from the 1950s, the thinking machines in humanoid form. Tom Sugar is a robot maker. Glance around his laboratory. Take a closer look. There is not much visible to the layperson to suggest the presence of robots. No Robby. No C3PO. Not even anything close to an R2D2. You will see a variety of metal rods and springs, circuits, motors, and what appears to be a random assortment of high technology odds and ends. They are robots in the making. Sugar’s lab is full of robotic devices in various stages of completion, all designed to fulfill some useful purpose.

>> By Melody Cavanary

<< Robot designer Tom Sugar stands on the omni-directional platform he and his students devised. They use the platform to gain understanding of human balance for applications in robotics.
“There are three aspects to robots,” explains Sugar, an assistant professor of mechanical engineering at Arizona State University. “Robots need to do sensing, just as we need to sense our environment. They must be able to make decisions based on that sensing information. And they must be able to take action based on those decisions.”

Sugar's special focus is on creating robots that can help the rehabilitation of stroke patients. The ASU researcher is collaborating with a local bioengineering firm to create robotic therapy devices.

Sugar has designed what he calls a “compliant actuator.” The device is a soft and springy pneumatic muscle that safely interacts with people. It can push as well as pull the particular part of the body targeted for treatment.

Sugar's platform demonstrates an especially important element of robot building—having a creative eye for adapting technology. He and the engineers at Kinetic Muscles are collaborating on the development of several new robotic therapy devices. One is an apparatus that fits over the shoulder and arm. “We are taking the same technique and moving it up the arm. Once the patient has hand function back, we'll coordinate that into tasks,” Koeneman says.

The tasks are simple. Most of us take them for granted on a day-to-day basis. Think about picking up a glass to take a drink. Or holding a fork or spoon to feed yourself. Or the reaching/grasping movement needed to place an object on a shelf. The new device will help individuals do as much as possible on their own and assist them when they can’t do the motion correctly.

“It’s been a real nice collaboration,” Sugar says. “They’ve got the bioengineers and industrial designers to develop the device. We’re working together to build a viable exoskeleton for the arm.”

The ASU engineer is also busy perfecting another actuator that could be applied to the ankle. The device would help move the ankle back and forth and assist people who have problems walking.

Sugar says the devices are not years away. “We are moving very quickly from the lab bench to a real device that can be used by the stroke patient,” he says. “I think you’ll really see people using these robotic exoskeletons within the next year or two.”

In his ASU robotics lab, Sugar and his team of students are occupied with some very different kinds of robotic devices. “We are studying the concept of human balance,” he says. “To help, we devised an omnidirectional platform.”

To demonstrate how the platform works, a student is suspended by a harness attached to the ceiling as he stands on a low, table-like platform. The robotic platform jerks and jolts randomly. It interacts with the subject’s feet, trying to catch him off balance, and can move without warning in any direction.

“We want to study human balance so that we can understand what causes people to fall,” Sugar says. “If we can understand that, then perhaps we can devise a robotic exoskeleton that can help to prevent falls.”

Sugar’s platform demonstrates an especially important element of robot building—having a creative eye for adapting technology. The ASU engineer relishes the technical challenges of his work, which marry mechanical engineering, electronics, and computer programming with a healthy dose of creativity.

“I really get excited about building something. I like putting the pieces together and having the final product work the way you want it to work,” he says. “I like inventing. I like looking at something and thinking, ‘If I added electronics, or if I added a slightly different mechanical system, I could make a much better product.’”

Sugar built industrial robots before joining the ASU faculty. He finds his current avenue of research much more satisfying. “We now have the ability and technology to develop robotic devices that can really help people,” Sugar says. “That is compelling.”

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Kevin Hollander quickly wheels his bike into the ASU robotics lab. “I bought a tool,” the doctoral student announces to everyone already at work. In a place where ingenuity is more readily available than petty cash, even a modest $15 expenditure for pliers does not go without comment. On first glance, Hollander’s workbench clearly is that of someone who has mastered the art of doing more with less—and turning it into potentially very useful technology.

Hollander suffered a serious knee injury when he was an undergraduate engineering student. Ever curious about the way things work, he studied the anatomy of the human knee. “I immediately saw the brilliance of that design,” he recalls. “That got me into the realm of bioengineering. It was all spawned from that initial interest.”

A robust 6’4”, Hollander finds the challenge of aiding those with physical limitations, such as the elderly, a particularly compelling one. “I always thought that there’s got to be a way of helping people out beyond what we were doing,” he says. “I had certain ideas when I came to ASU. I want to find a way to use robotic type devices to help people with their walking. I want to help them function in their daily lives and do it in a way that’s not intrusive or obstructive.”

Hollander’s doctoral research is all about realizing his ideas. He is working to develop a prototype device that would help people who need assistance rising from a sitting to a standing position. His robotic mechanism relies primarily on “spring power.” It will be light in weight, quiet, and potentially very user-friendly. “Using the underlying principle of the spring, I’m trying to change and manipulate its behavior,” Hollander explains. “By controlling the amount of force that the spring gives back, I can use that force to provide power to an individual.”

Hollander’s robotic device would be compact enough to wear inside of clothing. It would rest along the outside of the leg. Power is provided by a small motor and batteries that could be carried in a fanny pack.

Melody Cavanary
People really want to learn about Mars. Especially kids! The proof is in the numbers. The successful landings of twin rovers on the Red Planet’s surface only increased the public hunger for more information. NASA reports billions of hits to its Mars-related Internet sites. And that’s just since Spirit and Opportunity began rolling around Mars in early 2004.

If the public’s hunger for science news can be measured in web site hits, it also can be measured in weight. Just ask planetary geologist Phil Christensen. His large office at Arizona State University is filled with mail crates. The crates are full of rocks — rocks collected by young science enthusiasts from all over Planet Earth.

Christensen is lead scientist for the mini thermal emissions spectrometer (Mini-TES) instruments on board each of the rovers. The very heavy special delivery is the result of a public announcement Christensen made in February. He and his colleagues are encouraging kids to participate in Mars science through a new NASA-funded program called “Rock Around the World.”

“We get about ten cartons a day, maybe as many as 100 packages,” Christensen says, pointing to the piles of rock-filled crates stacked in every available space. “We process them and get them moved out as quickly as we can, but we’re still behind. The mail carriers have been really tolerant.”

Rock Around the World is a partnership between ASU and NASA’s Jet Propulsion Laboratory in Pasadena, Calif. Children are asked to collect a rock from their hometown. They must gather information about where they found the rock. Then they send rock and report to ASU for analysis.

In the lab at ASU’s Mars Space Flight Facility scientists use the same thermal emission spectrometry that is being used on the surface of Mars by the rover’s instrument. Christensen and his team will compare the data from this global sample of Earth rocks with data he’s getting from Mars.

More than 4,000 rocks have arrived from 20 countries and all 50 states. But it is the high level of involvement from the kids participating in the program that astounds Christensen. “We asked them to tell us where the rock was found.

Students send rocks from all over planet Earth. The ASU Mars team analyzes the rocks. They post to the web site the graph of the infrared reflectivity spectra and a photo of the rock. The spectra records amounts of different infrared wavelengths reflected by the rocks. For more information about the Rock Around the World project, or to see a growing list of minerals submitted by children, visit the web site at: HTTP://MARS.JPL.NASA.GOV/ROCKWORLD

The image below shows the landing site of the Mars exploration rover Opportunity in Eagle Crater, on Meridiani Planum. Colorized Mini-TES data is applied to a black and white navigation camera mosaic. These data show the varying abundance of coarse-crystalline hematite. Red and yellow hues indicate more hematite in comparison to green and blue hues. Such maps were used during MER operations to plan rover trips throughout the crater and to examine different surface compositions. Courtesy NASA/ASU Mini-TES Team.