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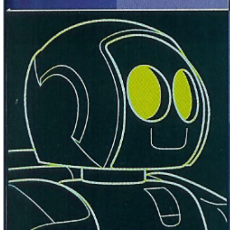

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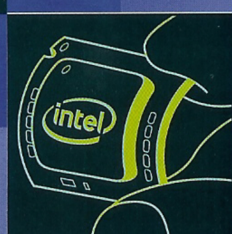
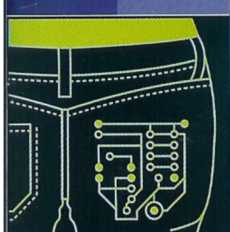
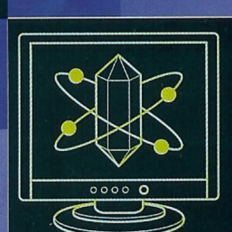




SMART PANTS

NANO-CRYSTAL DISPLAYS



10 AMAZING TECHNOLOGIES THAT WILL CHANGE YOUR LIFE

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THE 10 COOLEST TECHNOLOGIES YOU'VE NEVER HEARD OF

Ever heard of bacterial photography—it's not as gross as it sounds—or chaos computing? Neither had we. For this story, we set out to find the coolest technologies that are flying under the radar, and what we found impressed even us. We'll tell you about a new technique for making silicon that can bend and stretch—and the promise it holds for a new generation of gadgets. We'll update you on a groundbreaking research project for modeling the human brain and take a look inside a telepresence lab in California that has broadband connections 5,000 times as fast as what you can get today. We also caught up with three of the smartest guys in the computer industry, who offer their predictions for the future. Get ready for mesh networks with millions of nodes blanketing the Earth—and our bodies—a robot revolution, a nation of super-learners, as well as some fantastically futuristic ideas.

Photograph: Getty Images

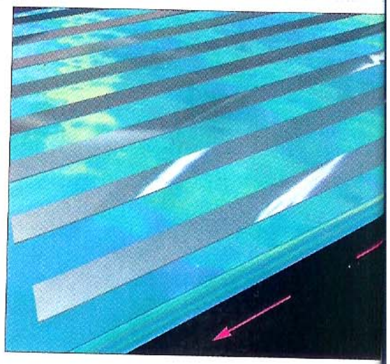
Stretchable Silicon

1 OVER THE YEARS WE'VE MANAGED TO DO A LOT OF nifty things with silicon, yet we've never gotten around one problem with the stuff: it's rigid and brittle. Silicon is great if you want to build electronics, but lousy if you want to wear them.

Dick Tracy aside, there are plenty of people who could benefit from wearable electronics. Surgeons, for example, could operate with enhanced sensitivity—and increased reaction time—if they had warning sensors built right into their latex gloves. All sorts of life-saving health monitors could be developed.

Fortunately, the wait may finally be coming to an end now that researchers at the University of Illinois at Urbana-Champaign are working on a technique that stretches silicon. The trick, says John Rogers, a professor in the school's department of materials science and engineering, is to use very, very thin silicon—100 nanometers, to be exact, or 1/1000 the thickness of a human hair.

To get silicon so thin, Rogers and his team first make a transistor the conventional way: on a silicon wafer, using standard processing methods. The breakthrough comes in the next step: A special etching technique slices off a layer of silicon that's ultrathin yet contains the entire transistor. This is placed on a flat piece of rubber that has been prestretched a little. "You're basically replacing the silicon wafer substrate with rubber," says Rogers. Once they are placed in contact with each other, the silicon bonds with the rubber. At that point, the stress in the rubber is released by letting it snap back. The rubber and the silicon, now attached, buckle into waves that resemble an accordion-like form. "Once the silicon device is in that geometry you can stretch it back and forth," he says.



One. Silicon transistors bond with a substrate of prestretched rubber.

Chaos Computing

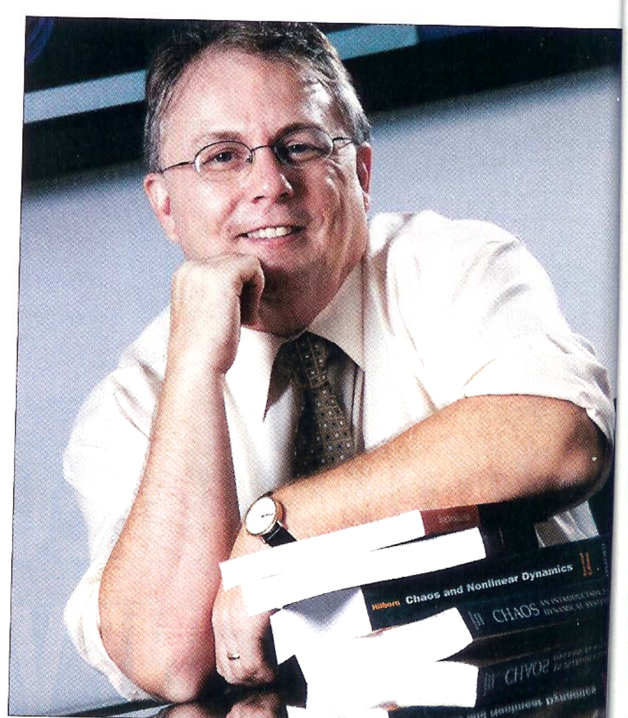
2 THE WORD CHAOS, AS ANY GET SMART FAN WILL tell you, tends to evoke negative connotations—it's a disordered situation we want to avoid. But if William Ditto is right—and both the U.S. Navy and private investors are betting he is—the word may soon be seen in a whole new light.

Ditto, chair of the Department of Biomedical Engineering at the University of Florida in Gainesville, is exploiting the principles of chaos to build a revolutionary computer chip that just may prove faster, cheaper, and far more flexible than traditional designs.

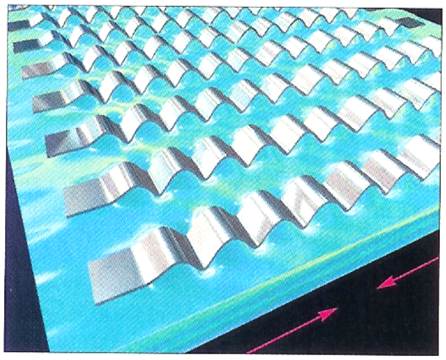
Ditto's chip is like the microelectronic version of a stem cell: It's a device that can assume all sorts of different functions. But a chaotic chip goes one step further: It can morph over and over again. For computer design, this has huge implications. In a traditional chip, the basic elements, called logic gates, are hardwired to perform a single, specific task. In a chaotic chip, each logic gate can be converted on the fly to perform any function.

What this means is that computers will no longer need separate, costly chips for the CPU, memory, video RAM, graphics accelerators, arithmetic processing units, and so on. Instead, one chip will convert itself to whatever functions the software needs at a given moment.

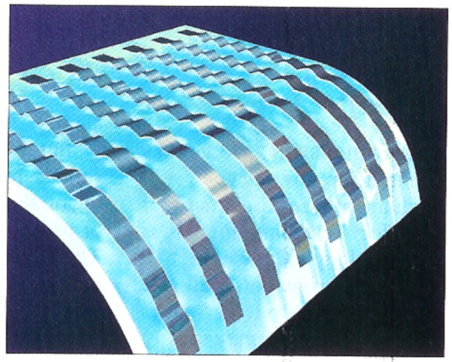
"One of the holy grails of computing is enabling software to actually change the hardware on the fly," says Ditto. "If you're in Photoshop and need a lot of memory



Photograph (top): Janet Sinn-Hanlon, Beckman ITG; (bottom) David Blankenship



Two. The stress in the rubber is released by letting it snap back and buckle into waves.



Three. The silicon then can be stretched back and forth.

Visit go.pcmag.com/stretch to view the video.

The prototype devices Rogers has developed—transistors and diodes—work just as well as their rigid-silicon counterparts, he says. Down the road, he envisions flexible sensors that can curve along the edge of an aircraft's wing, as well as low-cost identification tags. And the payoff won't be just in wearable electronics but also in flexible, roll-up displays—with the look and feel of a piece of paper.

Down the road indeed. The technology is still in an early stage, and Rogers and his team have been working with their stretchable silicon for only a year and a half. Yet the results have been so promising that a spin-off company, Printable Silicon Technologies, was created last year to develop the research further, investigating possible commercial applications and ways to implement the technique in manufacturing. End products, Rogers says, "are still a few years out."—*Alan Cohen*

for two seconds, you can reconfigure the chip to give you a lot of memory. If you need to make a lot of calculations and don't need as much memory, you convert the chip back into a CPU. If you're playing a game, the chip reconfigures into a graphics engine chip."

What makes this mighty morphing possible is Ditto's ability to harness chaos, which, it turns out, also exists in computer circuits. Chaotic systems are actually very organized; they're just irregular. On its own, a chaotic logic gate will generate a huge number of different logic functions incredibly quickly. Since chaotic systems are extremely sensitive to even small variations in the conditions around them (the so-called butterfly effect), Ditto can create the pattern he needs by applying a specific voltage to the gate.

If all goes well, we'll see the fruits of this chaos long before another decade rolls around. Ditto recently formed a company, ChaoLogix, to develop the technology, and he expects to have a demonstration chip ready in January.—*AC*

William Ditto's chaos chip is like the microelectronic equivalent of a stem cell: it can assume a variety of functions.

Home > Features > Cover Story > **The 10 Coolest Technologies You've Never Heard Of**

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Ever heard of bacterial photography—it's not as gross as it sounds—or chaos computing? Neither had we. For this story, we set out to find the coolest technologies that are flying under the radar, and what we found impressed even us. We'll tell you about a new technique for making silicon that can bend and stretch—and the promise it holds for a new generation of gadgets. We'll update you on a groundbreaking research project for modeling the human brain and take a look inside a telepresencelab in California that has broadband connections 5,000 times as fast as what you can get today.

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The 10 Coolest Technologies You've Never Heard Of

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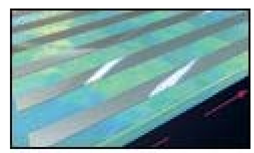

One

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