Nimmi Ramanujam, 35

University of Wisconsin-Madison

Uses light to help make diagnosing breast and cervical cancer faster, more accurate, and less invasive

DO I have cancer? Is my unborn child in trouble? University of Wisconsin-Madison biomedical engineer Nimmi Ramanujam believes that the millions of women who face these questions each year deserve more accurate answers than those afforded by today's diagnostic technologies. Consider breast biopsies. Doctors sometimes miss the tumor cells they're trying to sample, so Ramanujam has developed a device that can help guide a biopsy needle to just the right spot. An optical fiber threaded through the needle shines light of different wavelengths on cells at the needle's tip; molecules in cancer cells respond by fluorescing in characteristic ways, and sensors register the fluorescence. Ramanujam and her colleagues are already testing the technology in patients undergoing breast cancer surgery and plan to test it in patients undergoing breast biopsy within the next year. A cervical-cancer detector she began developing as a graduate student uses a similar approach; it is now in large-scale human trials. Ramanujam is also harnessing light to noninvasively monitor how well oxygen is getting to fetuses, an important—and currently unmeasurable—indicator of when emergency cesarean sections are needed. With Ramanujam's help, those babies will be born into a world where medical questions get better answers.

Shuvo Roy, 33

Cleveland Clinic Foundation

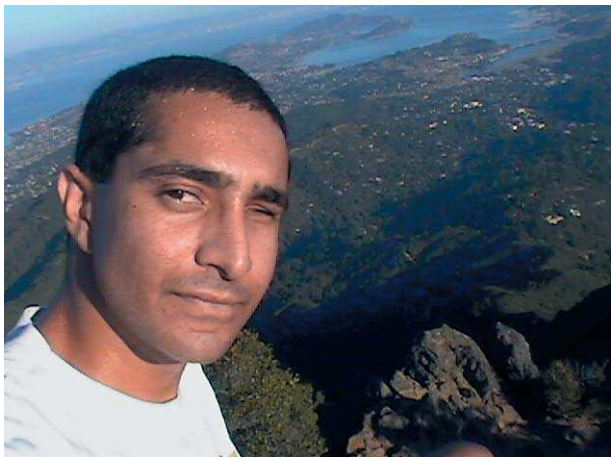
Builds tiny machines that can warn of impending heart attack and monitor healing after surgery

AS A graduate student, Shuvo Roy developed microelectromechanical systems (MEMS)—tiny machines like sensors and actuators—for airplane and rocket engines. He had an aerospace job lined up, but inspired by his father, a public-health physician, he wanted to "impact people's lives more directly." The Bangladesh native switched career paths in 1998, cofounding a laboratory at Ohio's Cleveland Clinic Foundation devoted to clinical applications of MEMS. Roy's efforts have yielded several innovative devices and one patent—with seven others pending. Among his inventions is a wireless strain and pressure microsensor that can be inserted into vertebrae during spinal-fusion surgery (a main surgical option for back patients) to monitor bone fusion. Additionally, Roy shrunk ultrasound imaging technology into a high-resolution transducer small enough to glide through arteries on a catheter; the device can spot arterial defects called vulnerable plaques, considered the leading cause of heart attacks. Roy also developed durable silicon membranes that could replace short-lived polymers as blood filters in dialysis machines—a step toward creating implantable artificial kidneys. "Shuvo doesn't care about recognition," says lab codirector Aaron Fleischman. "He just wants to get technology that can help people into the hands of doctors."

Ram Samudrala, 31

University of Washington

Wrote algorithms that can predict the functions of proteins from the sequence of a genome



SINCE BEFORE University of Washington assistant professor Ram Samudrala was born, scientists have been striving to predict from an organism's DNA sequence the identities and workings of its many proteins. Such an understanding could lead to improved treatments for diseases, which are often caused by malfunctioning proteins. Samudrala has advanced that effort by producing algorithms that can predict the structure and function of every protein encoded by an organism's genome. By modeling changes to specific genes or proteins, researchers can try to determine what causes proteins to go awry. One set of algorithms Samudrala devised, with $4 million from federal and private agencies, is called Bioverse. Samudrala has used Bioverse to model the functions and interactions of the proteins of more than 30 organisms; other researchers are using Bioverse to find which proteins in pathogens would be good targets for new drugs. Posted on the Web, Bioverse receives 1,000 hits daily. Samudrala made the algorithms free because he is opposed to intellectual-property restrictions, as explained in his "Free Music Philosophy" statement, which he published on the Web in 1994—long before the rise of Napster.

Christophe Schilling, 29

Genomatica

Transforms microbes into fine-tuned manufacturing machines

WHEN HE was just 26, bioengineer Christophe Schilling won a small-business grant from the National Science Foundation. His plan was to reengineer the genomes of microorganisms such as bacteria and yeast, which are used as living chemical factories, to produce new or better products. With his university mentor, Bernhard Palsson, Schilling raised $3 million to launch Genomatica in San Diego in 2000. Today, the company is attracting partners such as Dow Chemical that want to engineer microbes to churn out chemicals used to make everything from drugs to soaps. Although that goal is not unique, Genomatica's tool is: software dubbed SimPheny that decodes a microorganism's genome data into a "parts list" of molecular components and enables the construction of computer models of the microbe's metabolism. Corporate clients can then tap the models to predict a particular organism's industrial potential. Genomatica also plans to release the software to select university labs by 2004.