

## **Session 2 Focus on Science Robotics**



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Can we create something that will mimic human capabilities? This question has two sides. The first involves building some external contraption, an artificial human that will perform our tasks for us-carrying water, striking our enemies, playing chess. The second has us designing internal replacements for malfunctioning or defective human parts-hearts, kidneys, ears.

Vision seems essential to the "artificial human" style of robot, and yet the human eye is a fantastic construction. The advent of photography and the further development of electronic cameras and television has made it seem plausible that machines ought to be able to "see" in some way. Nevertheless, what seems plausible at first blush can prove to be a difficult problem, and that has certainly been the case with machine vision. It's not hard to take a picture-the fundamental trouble is getting the machine to understand what the camera is looking at.

The technology is both daunting enough and important enough that there are large professional organizations devoted to it, such as the Automated Imaging Association and the British Machine Vision Association and Society for Pattern Recognition. There are also lawsuits over machine-vision patents that involve hundreds of millions of dollars. As the British society's name indicates, much machine vision work involves training a machine-which is to say, the computer inside the machine-to recognize patterns in images. The goal might be catching manufacturing defects in silicon wafers, running a preliminary screen on a mammogram, or comparing fingerprints to find a match. These are by no means simple procedures, and each is tremendously valuable if it can be made reliable. Yet they are relatively straightforward compared to asking a computer to find a picture of a stormy afternoon, something a person could do far more easily than matching fingerprints.

Cochlear implants are in a certain sense the mirror image of robot vision-not people devising simulated sight for a machine, but technology wired directly into a person's nervous system to simulate hearing. The electrical properties of nerve impulses have been studied, analyzed, and modeled for years. With the past half-century's miniaturization of circuitry and controlling devices, nerve-dependent hearing loss was a natural target for electronic replacement. The cochlear implant is the pioneering attempt at a "neural prosthesis"; in the past 15 years, tens of thousands of people have had the procedure. The results are remarkable. For some, it is the first experience of sound. Now the technique is being used on very small children-two years old, and even younger.

As is the case with robot vision, the obstacles have been considerable. Just as getting a computer to recognize a storm cloud leads to questions of meaning and interpretation, so the subtleties of neuronal transmission go beyond simple on/off impulses. The implant is actually a set of devices: an external microphone to capture sound as electrical signals; a speech processor that uses sophisticated analytical circuits to turn those signals into impulses that neurons can interpret as sound; and a set of fine electrodes that bring those impulses to functioning nerve ends in the inner ear. Buoyed by the cochlear implant's success, there are teams working on a retinal implant-an even more formidable challenge.

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### **Automated Imaging Association**

<http://www.machinevisiononline.org/>

### **The British Machine Vision Association and Society for Pattern Recognition**

<http://www.bmva.ac.uk/>

Many of the lawsuits revolve around the patents of American inventor Jerome Lemelson

<http://www.lemelsoninfo.com/home.html>

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[http://www.med.harvard.edu/publications/On\\_The\\_Brain/Volume3/Number4/Cochlear.html](http://www.med.harvard.edu/publications/On_The_Brain/Volume3/Number4/Cochlear.html)

Clark, Graeme M. "Cochlear Implants in the Third Millennium." *American Journal of Otology*, 1999 (Volume 20, Number 1)  
Dr. Clark is one of the pioneers in cochlear implants. His company, Cochlear, has information on its website <http://www.cochlear.com/>

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