Technology

Steven I. Benowitz reports from Gallaudet College in Washington, D.C., at the Symposium on Hearing Technology

Hearing aid on a chip

Getting the maximum value out of a hearing aid is for many people a frustrating experience. Hampered by ill-fitting devices, inadequate adaptation to background noise and high cost, many either do not buy the hearing aid or just leave it in the bureau drawer. But according to research audiologist Allen Montgomery of Walter Reed Army Medical Center in Washington, D.C., help is on the way. "It's inconceivable that with a multi-million-dollar hearing aid industry and the powerful computer technology now available, the two aren't married," he says. But not only is the marriage in the works, the children are already being planned.

One of these up-and-coming technologies is digital signal processing, which entails placing silicon chip-based microprocessors into wearable hearing aids to more efficiently translate sound waves into usable energy. The first such hearing aids, expected to be commercially available within three to five years, should help the hearing impaired to better understand speech, Montgomery says, by simultaneously making sound more discernible and reducing background noise.

A. Maynard Engebretson and colleagues at the Central Institute for the Deaf in St. Louis are working on a hearing aid that will employ a complex microcircuitry technique called Very Large Scale Integration. The technique, says Engebretson, will make it possible to design hearing aids that can be programmed to precisely fit the patient's auditory needs. In addition, such aids will be able to immediately adapt to changes in the characteristics of the sounds encountered. Current devices aren't custom made — they only roughly approximate the user's needs, Engebretson points out, and subsequent adjustments must be made manually.

Of the 16 million hearing-impaired persons in the United States, only a quarter wear hearing aids. But as Ralph Naunton, director of the Communicative Disorders Program at the National Institutes of Health in Bethesda, Md., notes, "As the over-65 population grows, the demand for better hearing aids will be increasing rapidly. The new technology is very promising, and things are moving fast."

Cochlear implant: The first step

The cochlea, a snail-shaped, fluid-filled organ of the inner ear, is the last station in the complex relay system that is hearing. It converts sound vibrations into an electrical signal that stimulates the auditory nerve, which in turn transmits the message to the brain (SN: 10/20/84, p. 252). But when this process fails, the result is profound deafness, a problem that affects up to 2 million persons in the United States.

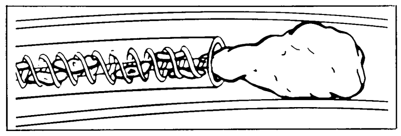
Last month, the Food and Drug Administration (FDA) approved the implantation of an electronic device that simulates the cochlea's transforming function and may enable 60,000 to 200,000 profoundly deaf adults in the United States to hear sounds such as sirens and automobile horns. The battery-powered cochlear implant system—the first device the FDA has ever approved to replace a human sense—is manufactured by the 3M Company of St. Paul, Minn., and is based on the work of William F. House of the House Ear Institute in Los Angeles.

The FDA approval comes in the wake of several years of animal and human experimentation at nine centers worldwide (SN: 11/27/82, p. 340). According to F. Blair Simmons of Stanford University Medical Center, the device's usefulness is limited at present, but will help many as an aid in lip-reading. Simmons says the current model — a somewhat unsophisticated single-electrode type — may eventually be replaced with a multi-electrode system that will permit a greater range of hearing. But for now, says Simmons, "you're trying to cram a lot of wires into a [cochlear] space the size of a half a split pea. We'll have to wait until technology can make them smaller."

Biomedicine

Joanne Silberner reports from Washington, D.C., at the Radiological Society of North America meeting

The turn of the screw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In the third century B.C., the Greek scientist Archimedes devised a helical screw that when rotated would pull water up and out of the holds of large ships. Since then, Archimedes's screw has been used for everything from the Romans' elaborate irrigation systems to modern sewage plants.

So why not in blood vessels? Irvin Hawkins and colleagues at the University of Florida in Gainesville have been working for 10 years on a model to remove plaque buildup and clots in arteries and veins. Clots can be deadly in the heart and lungs, and cause great pain and diminished function in the legs.

"You maneuver a standard catheter into the clot, slide a flexible spiral through the catheter and attach the spiral to a drive mechanism," explains Hawkins. "A little vacuum gets the clot into the tube, where the spiral transports it." Because the spiral is within the catheter, perforating the vessel wall isn't a problem.

In tests of the most recent of six models, the device efficiently removed clots from the pelvis, legs and aortas of six dogs. The researchers hope to try it on humans "shortly."

Spying on fetuses

Magnetic resonance imaging (MRI) is being aimed at just about everything these days — including fetuses. The sophisticated system, which uses magnets and radio waves instead of the ionizing radiation employed in X-rays and computerized tomography (CT) scans, is now being used at a handful of U.S. institutions in cases where the pregnant mother or her fetus is known to be at risk.

With ultrasound a near-ubiquitous method of following problem pregnancies, why MRI? Ultrasound has its limits, says Jeffrey C. Weinreb of the University of Texas Health Science Center in Dallas. It doesn't work well when there is little or no amniotic fluid, a condition that threatens the pregnancy. "And if a pregnant woman is very obese, it's hard to see the baby with ultrasound," he says. For pregnant women with medical problems, the inability of ultrasound to visualize the head, lungs and extremities leaves physicians "blind."

Use of MRI in pregnancy is at the stage of determining the best technique and monitoring for side effects. Weinreb and his colleagues used MRI on 22 women with medical problems; all the babies have been born and all are normal. "We're almost certain there's no [harmful] effect, but it's not something that should be done routinely," he says. University of California at San Francisco researchers report their use of MRI in nine pregnancies. They were able to confirm cases of intrauterine growth retardation.

Defining the end of the road

A diagnosis of brain death is one of the weightiest pronouncements in medicine, given the usual sequela of heart death following the removal of life support systems. Howard Yonas at the University of Pittsburgh says that CT scans can speed up the diagnostic process and leave less room for doubt.

Yonas and his colleagues used CT scans to track the movement of inhaled xenon gas into the brains of 30 vegetative or comatose persons and plugged the information into equations to determine the amount of blood flow to the brain. Low flow values always correlated with standard criteria of brain death.

In addition to aiding the family with a quick determination, Yonas hopes a faster, more certain diagnosis will aid in organ retrieval. "There are many organs that go to the grave because the standard legal certification process is a very difficult one to meet so it becomes a lengthy process," he says. "These things can go on for weeks."