BIOMEDICINE

Computer modeling of eye disorders

Clinicians and engineers are collaborating successfully in eye hospitals and large hospital eye departments. In the early 1970s, for instance, Johns Hopkins Medical Institutions neurologist David S. Zee and Johns Hopkins engineer D. A. Robinson developed a computer model of normal eye movements and have since been using the model to diagnose and treat rare abnormal eye movements.

One of the patients Zee and Robinson, along with neurologist Richard J. Leigh, have helped is a schoolteacher whose eye movements oscillated and changed direction every four minutes or so. They fed her particular problem into the computer model of normal eye movements, so that whatever was wrong with her eye movements was transferred to the model. Leigh, Robinson and Zee were then able to see that all the abnormalities she was experiencing were due to improper function of a specific eye movement pathway within a certain part of the brain stem.

The researchers then used the model to devise treatment for the schoolteacher. They predicted mathematically, from the computer model of their patient's abnormal eye movements, that they could stop the movements at least temporarily if they rotated her at a certain speed in a chair. The solution worked with the computer model, so they then placed the patient in a chair and moved her at the designated speed. It kept her eyes from oscillating and changing direction for about eight minutes. This was the first time in nearly a decade that she had been freed, even temporarily, from her disorder.

Of course she couldn't spend the rest of her life in a rotating chair, so the researchers had to find some practical solution for her problem. They had heard that a particular drug could help her problem, tried it on her, and it corrected her condition permanently. They are now attempting to determine, with their computer model of her problem, exactly how the drug worked. Might the medication, for instance, interact with the motor pathway underlying her disorder?

One of Robinson's latest projects is to use a computer model of how all the eye muscles themselves cooperate in order to keep the eye in its proper position. He will then cut a muscle in the model to see what happens to the rest of the muscles in hopes of determining precisely how many muscles should be cut and how muscle eye surgeons should cut to best correct crossed eyes — a serious problem among many children. In other words, Robinson hopes to take the possible guesswork out of this kind of surgery.

A whiz of a wheelchair

For the past 12 years a wheelchair that can go over curbs, climb hills and negotiate ice and snow has been available in Sweden. It is called a Permobil, and on January 10 it made its official debut in the United States — at the Museum of Transportation in Boston. Some handicapped Americans are already using it.

The Permobil was invented by Per Udden, a graduate of the Karolinska Medical Institute in Physiology and Medicine in Stockholm. It is manufactured by Saab-Scania, which also makes Saab automobiles and jet aircraft. Saab-Scania claims that the Permobil is the world's most advanced and safest battery-powered motorized wheelchair. It can be driven by children as young as age four, by older persons whose walking abilities are limited and by spinal cord patients who have use of their shoulders and upper arms.

The Permobil can cover 25 miles at eight miles an hour and is safe for downtown driving as well as off-road driving. Although it is designed primarily for outdoor use, it is also helpful at home or work.

SPACE SCIENCES

Ariane on the money

Officials of the European Space Agency, initially pleased by the results of their Ariane rocket's Dec. 24 maiden flight, are even more so following a detailed analysis of the vehicle's performance. The three-stage booster, which represents competition for the U.S. space shuttle for future launch business, exceeded some of its specifications, met the rest and even turned out to be slightly more powerful than predicted.

The launching had been postponed twice. A Dec. 15 attempt was aborted when a touchy pressure sensor automatically stopped the countdown sequence at a point requiring a full "recycling" of the rocket. On Dec. 23, an improperly formatted voltage measurement and a stuck helium valve combined with bad weather to delay the liftoff an additional day.

In the actual launching, however, loads on the payload (an instrumented test capsule) were nominal, and the noise level inside the payload's protective fairing (an indication of vibration stresses) was 6 db quieter than the 142-db design specification. The rocket's third stage stopped firing 20 seconds earlier than planned, but its somewhat higher-than-predicted performance enabled it to put the payload into an orbit with the desired accuracy, and with differences from the exact planned orbit being slightly on the plus side. The orbit's low point was 200.8 kilometers above the earth, compared with an expected 199.9, and its high point was 36,021 km up, versus a nominal 35,752. The inclination and eccentricity of the orbit, targeted for 17.5° and 0.73 respectively, were 17.5559° and 0.73135.

The next three launches are scheduled for late May, late September and December of this year, each carrying two satellites as well as test capsules like that on the first flight. The satellites aboard the latter two launchings (Apple, Meteosat 2, VID and MARECS-A) will be bound for geostationary orbits, access to which is Ariane's principal purpose.

Air-to-ground laser communications

A series of communications tests using a laser beam between airborne and ground-based points has been successfully completed by engineers of the U.S. Air Force's Space Division, who hope that the system, called LASERCOM, will lead to secure satellite-to-ground communications by the late 1980s. From geostationary satellite altitudes of about 22,000 miles, according to the LASERCOM group, the laser beam's "footprint" on the ground will be less than half a mile wide, compared with current radio-link satellites whose footprint spans nearly 200 miles. The narrow beam is expected to make enemy eavesdropping and jamming "nearly impossible."

The tests were conducted between the ground and a C-135 aircraft, which made 10 flights lasting about four hours each, at altitudes centered at about 30,000 feet and lateral distances as great as 30 miles from the ground facility. The aircraft carried an 80-milliwatt, Nd-YAG laser operating at 0.53 microns, while the ground-based laser, also an Nd-YAG type, operated at 1 to 2 watts and 1.06 microns. During one of the flights (which were conducted at White Sands Missile Range in New Mexico) a 50-word message was transmitted "without error" from the ground to the plane at a rate of 100 bits per second. In subsequent tests this year, messages of as many as one billion bits of information will be sent, while engineers evaluate such factors as the speed with which the LASERCOM equipment can lock onto the incoming laser beam, and the effect of atmospheric conditions on the message's signal-to-noise ratio. The recent tests, which program officials believe to be the first successful laser communications through the atmosphere with an air-to-ground link, are said to have worked well in conditions ranging from clear to heavily overcast.