Biomedical Engineering

About the Department

Biomedical engineering at Ohio State began in 1971 as a center within the Department of Electrical Engineering. Professor Herman Weed pioneered the center and developed a graduate program to address the applications of engineering to health care and agriculture. The center is also meant to address the basic science approach in physiology, engineering and physics.

Biomedical engineering combines engineering expertise with physical, chemical and mathematical sciences to solve problems in biology, medicine, behavior and health. Biomedical engineers are employed by pharmaceutical industries, government agencies, biomedical product companies, universities, medical center labs and emerging high-tech industries.

Careers

Current hiring and long-term trends for biomedical engineering careers continue to have a positive outlook. According to the U.S. Bureau of Labor Statistics, the number of biomedical engineering jobs is predicted to increase by 72 percent between 2008 and 2018, a much faster rate than the average growth for all occupations.

A majority of all biomedical engineers are employed by manufacturing industries, primarily in the medical instruments and supplies industries. Many pursue further professional training in medicine, dentistry, veterinary, law, and business, or further their education in graduate school. Biomedical engineers find jobs in health services, government agencies, or as independent consultants.

Newer areas of biomedical engineering are experiencing rapid growth, such as computer-assisted surgery and cellular/tissue engineering. In addition, the rehabilitation and orthopedic engineering specialties are growing, increasing the need for more biomedical engineers.

Degrees Offered
Research

Biomedical engineering research at Ohio State covers a wide array of technological and medical applications. Today, 17 scientists serve as core faculty of the Department of Biomedical Engineering, and more than 60 researchers throughout the university collaborate to provide extensive resources. Their research and teaching covers tissue engineering, micro- and nanotechnology (biomaterials), and imaging on a cellular and molecular scale.
Muscle stimulator helps paraplegics walk again

By Steve Benowitz

Researchers at Ohio State are helping paraplegics to get out of the wheelchair and walk again.

The work centers on restoring the ability to walk in individuals who, through accident or disease, have become partially or totally paralyzed below the waist.

According to Herman Weed, professor of electrical engineering and preventive medicine and director of the University's Bio-Medical Engineering Center, an individual who has damaged a spinal cord in a car accident, for example, often has leg muscles that can still work. But the patient's legs are lifeless because the brain's instructions — in the form of electrical impulses — have no way to reach them.

University researchers, in effect, are bypassing this interrupted route by establishing a new, artificial pathway.

A battery-powered muscle stimulator the size of a Walkman portable radio sends electrical signals through electrodes running from the stimulator to the patient's legs.

Electrodes also run from the stimulator to specially modified crutches, which in turn provide balance.

The patient starts each step by pressing one of two switches on a crutch handle, Weed explains. The muscle stimulator fires electrical impulses to the muscles in the patient's calf to bend one leg at the knee and flex the foot.

The individual can then move forward by swinging his body through the step. Releasing the switch stiffens the leg again after it comes down, and a second switch stimulates the other leg to bend.

"For the paraplegic who can't get out of a wheelchair, just to stand up is major progress," Weed says. "Walking is phenomenal."

With the aid of electronic stimulation, two patients have walked more than 150 feet at a time, Weed says.

Such use of modern electronics is not brand new. A similar project at Wright State University in Dayton grabbed national headlines in 1982 — the year after Ohio State launched its program — when paraplegic Nan Davis took her first computer-controlled steps.

But the Wright State system is different, Weed explains, in that it employs a large stationary computer to control the patient's movement. The computer measures certain angles and distances before sending messages, he says. The Ohio State approach relies on "using the brain of the disabled person as the computer."

In making the system "as simple as possible," Weed explains, the patient's eyes and sense of balance are used to Continued on page 8.
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control the firing of electrodes and guide the entire walking process.

External wiring is kept to a minimum, Weed points out, and all of the electronic equipment is portable and can be attached to a belt or worn around a shoulder.

A number of muscle stimulation projects are underway at institutions throughout the country and the world, though the field is barely a decade old. In addition to research efforts at laboratories in California, West Germany, Yugoslavia and France, a third university in Ohio — Case Western Reserve in Cleveland — is also involved in such work.

While the researchers strive toward a common end — restoration of lost muscle control — their means often differ.

"Walking is more difficult, generally, than moving one's arms," Weed points out. "You not only have to move the legs, but you have to have a sense of balance as well."

As a result, some research projects focus on restoring control of the upper body.

"Many researchers feel this might be more useful to the disabled person who can't feed himself or dial a phone," Weed says. "A wheelchair, they feel, while it's not walking, is not a terribly inefficient way of getting around."

Some researchers believe that unless they can stimulate now-useless muscles in the disabled to work in the same manner as those of the non-disabled person, the research has been unsuccessful.

Weed disagrees.

"Our feeling is that if we can get a person out of the wheelchair and he can get across the floor on his own two feet — even if he doesn't walk like you and I — then we've been successful," he says.

Since the University program's inception four years ago, eight patients have participated. Two patients are currently enrolled. Both are only partially paralyzed and, in fact, can walk without outside stimulation, using stiff braces and crutches.

"Their legs are like sticks," Weed says. "It's much rougher (than with the artificial stimulation), but the individual can move sideways and walk."

Every Thursday the two patients undergo therapy at Dodd Hall and exercise on their own at home.

The next step, says Weed, is to program into the stimulator-computer a sequence of six or eight signals. In contrast to the jerky bending-stiffening movements produced now by single signals, a multi-signal program should produce a smoother gait, and perhaps eventually permit the user to climb stairs.

Because every movement is under the patient's control, potential candidates for the program are screened carefully, including evaluations of muscle and bone strength. The individual must possess a certain degree of "mental and physical dexterity," Weed says.

"If the patient is paralyzed by an accident more than a year ago and has not undergone any active muscle stimulation, the leg muscles may have atrophied and be considerably weaker," Weed says. "They may have to be built up."

Certain bones that have lost calcium may require strengthening as well.

"It can involve an awful lot of hard work," Weed says. "Quite often, patients may decide it's not feasible."

A major obstacle — and a key to the success of the project — involves finding the proper model of electrode to transmit the electrical signal effectively from the stimulator to the muscle.

In general, three separate arrangements are available:

Ohio State researchers use electrodes that are attached to the patient's skin surface, supposedly on top of the desired muscle. However, these electrodes often have difficulty transmitting signals to a deep-rooted muscle. In addition, problems exist in pinpointing on the surface the exact spot to be stimulated.

A second type of electrode may be embedded directly in the muscle, with only the trailing wire visible. A muscle can be stimulated directly this way, Weed says, and would require less electrical current.

But such a system carries a greater risk of infection, he says, as well as added discomfort for the patient. Also, as the muscle flexes, the wire tends to break.

A third method, which has met with very limited success, involves an electrode implant that is completely encapsulated "like a heart pacemaker." The main problem in this case is that the capsule inevitably leaks, ruining the delicate equipment.

The ultimate goal of the project, says Weed, is to provide the disabled person with a normal range of muscle control and movement. Because the muscle stimulation apparatus is constantly being improved, Weed notes, just when a company may want to commercially market the equipment is not known.

"It's easy to build up the hopes of the public," Weed says. "But then the disappointments that inevitably come along may cause it (the research) to lose acceptance and the willingness of people to participate. We have to be cautious and realize just how much we can really do."

OSU researchers giving quadriplegics

By Diane Schilling
Lantern staff writer

After Ty Payne's diving accident in June, 1984, doctors told his mother her son would never walk again.

However, through bio-medical research like the kind being conducted by the OSU Bio-Medical Engineering Center, partially paralyzed people like Ty Payne are getting the chance to walk again.

Payne, 21, and another patient, Charlie Clark, 27, are walking with the help of a stimulator which sends an electrical signal and excites the nerves in their legs.

David Haradem, a graduate student in bio-medical engineering, has been conducting the research with the two quadriplegic patients.

Haradem eventually hopes to begin working with paraplegic patients.

The research is centered around a muscle stimulator connected to a belt the patient wears around the waist. This is where the electrical signal originates, he said.

Along with the muscle stimulator, four electrodes are placed on different parts of the leg. Two are placed over the patients' quadriceps, the muscle running along the top of the thigh, one on the side of the knee and one on the side of the lower leg, Haradem said.

The electrical stimulator constantly sends an electrical signal to the quadriceps allowing the patient to stand.

"When the electrical signal is sent it excites the quadriceps forcing the leg to extend," he said.

"By pressing a trigger connected to the handle of the forearm crutch, a signal is sent to the other two electrodes on the lower leg initiating a normal step," Haradem said.

The muscle stimulator is constantly sending the electrical signal to the quadriceps unless one of the triggers are pressed, he said.

The patient then releases the trigger and the stimulation returns to the quadricep, returning the patient to a rigid stance position.

Once the step is taken the patient will push the other trigger allowing the other leg to take a step, he said.

The patients continue their work at home using the stimulator to keep the muscles toned up, Haradem said. The muscles will get smaller if they are not active in some way.

The research not only helps the patients to walk, but makes their bones and muscles stronger, he said. "If you receive no exercise, chances are the bones will become more brittle and the muscles will decrease in size and strength."

It was after recuperating from his diving accident that Ty Payne, from Centerburg, was recommended for the research.

His mother, Judy Payne, said her son was very excited and wanted to get involved.

Payne said he works out once a week and afterwards feels energetic for the rest of the day.
ability to walk again

It is hard work but it's worth it, he said.
"Ty looks forward to his work out every week. It is amazing to see him walk," his mother said.

When Payne first began the treatment he could not walk at all. Now he is walking 240 to 250 feet, Haradem said.

Clark, who has been involved in the program since the beginning of October, said he walks about the same distance Payne does.

Clark said at the beginning of his training he was frightened and his muscles did not know how to react.
He has now progressed from four people holding him up to just one person walking behind him, Clark said.

Haradem said he can see a time in the future where this procedure will be used in everyday life and Payne and Clark can walk all the time.

Further research and reducing the size of the stimulator need to be completed before they can use this device outside the lab, he said.

David Haradem, right, a graduate student in bio-medical engineering, supports his patient Ty Payne, a quadriplegic from Centerburg, as he walks with the help of a muscle stimulator.
Future doctors, engineers use research for education

By Pamela Roliff
Lantern staff writer

Sight aids for the blind, new hip joints and muscle-stimulation for people who have lost the ability to walk are some developments being researched by future doctors and engineers at OSU.

A bio-medical engineer “applies engineering techniques and technology to medicine and the life science areas,” said Richard M. Campbell, director of the department of bio-medical engineering.

According to Campbell, biomedical engineers have not always been involved in research. “Hospitals originally hired biomedical engineers to operate medical equipment, to oversee maintenance technicians and to consult on equipment purchases,” Campbell said.

Julie Burkey-Zwick, a graduate student from Columbus, works with Campbell and Robert Hamlin, the acting chairman of the department of veterinary physiology. The two departments work together frequently because “it is easy to work with animals. It’s good hands-on experience that you can’t get in the engineering lab,” Burkey-Zwick said.

Burkey-Zwick is involved in research of atherosclerosis, or hardening of the arteries. “We hope one day doctors will be able to look at the frequency spectrum of heart sounds to determine whether a patient has atherosclerosis or any other heart disease,” Burkey-Zwick said.

Student researchers have a number of working examples to encourage them, according to a recent article in Potentials magazine. These include the pacemaker, an electrical pulse stimulator which has been in use since the early 1960s, and the artificial heart, one of the newest advances in medical and engineering technology.

Ohio State is one of approximately 150 universities across the country involved in bio-medical engineering research. The university is also helping to educate underdeveloped countries in this field.

Project Hope, a non-profit international organization, specializes in initiating medical and medical-related programs in Third World countries. Doctors in these countries are being taught open heart surgery. Equipment is needed to perform these operations, said Belinda Wallace, secretary for the university’s bio-medical engineering department. Bio-medical engineers are involved in training nurses, doctors and technicians to use the equipment.

Ohio State’s department of biomedical engineering, with 70 students in degree-granting programs in graduate and doctoral studies, works with seven colleges and 34 departments, including anatomy, dentistry and psychiatry.
Computer-simulated models study impacts on bone joints

By Michael C. Adolph
Lantern staff writer

Two biomedical engineering graduate students have been studying the effects of physical forces such as jumping, running and landing on hip and ankle joints.

What makes their studies so special is that they have been done with computer-simulated models of bone joints rather than with people.

David Fronk, of Columbus, and Carol Dingman, of Cedar Rapids, Iowa, will complete their project July.

Fronk, who received his undergraduate degree in mechanical engineering from Ohio State, will earn a master's degree in biomedical engineering this summer.

Fronk has been studying the impact forces experienced by gymnasts during dismounts. He got the idea for his work from Dr. Wilhelm Zuelzer, an orthopedist for the OSU gymnastic team.

"Dr. Zuelzer noticed a lot of ankle problems occurring in gymnastics and wanted an idea of how much force ankles were subjected to throughout the year," Fronk said.

He estimates the average OSU gymnast performs 200 dismounts per week.

"My project is comparable to a preliminary step of Carol (Dingman's) work. I come up with the stress loading data and then someone uses this data to see how these forces affect the joints," Fronk said.

"I'm doing a computerized stress analysis of the effects of muscle loads on the stem of the hip bone," said Dingman, who will earn her master's degree in mechanical engineering this summer. She is also working toward a doctorate in biomedical engineering.

Dingman's work can be divided into three general areas:

* pre-processing, where a model of the joint is generated on the computer screen
* processing, where data involving stress factors is applied to the model
* post-processing, where graphic displays of the stress effects are printed out.

"You used to have to use an actual bone or physical model to do this work and if something went wrong, you'd start over from scratch," Dingman said.

"Now, with computers, we can add or delete data and change things around. This makes our work faster, easier and less expensive," she added.

Eventually, Fronk hopes to find a way to minimize the ankle stress involved in gymnastics. He believes his data could be used to develop better mats, or to convince gymnastic judges to lessen the importance of dismount scoring.

The computers have been a blessing, but they do have certain disadvantages.

"My main problem is finding time on the computer. It takes around four days to run my program," Dingman said.

"The biggest thing about our work is that doctors are getting to know engineers and engineers are getting to know doctors, and that's important," Dingman said.

"People have really started to think about the applications of our work. The interest is definitely up."
Biomedical engineering students want department status, benefits

By Cynthia L. Reza
Lantern staff writer

Because the Bio-Medical Engineering Center is not sanctioned as a department by the university, students majoring in the field are concerned about the progression of the program.

Biomedical engineering combines the disciplines of medicine and engineering to provide an understanding of medical problems that require engineering solutions. The program has existed at Ohio State for 20 years.

Currently, biomedical engineering is considered a center, not a department, which means it cannot hire its own faculty or have its own courses, said Steve Barnicki, a Ph.D. candidate and president of the OSU Bio-Medical Engineering Society.

Faculty members working in this academic area must be tenured in another department and must answer to the administration of the engineering department.

The concern, fostered by the impending retirement of center director Herman Weed and possible retirement of Richard Campbell, assistant director, has been brought before the engineering department administration by a letter and personal visits by students. Both Herman and Campbell are tenured in electrical engineering.

Donald D. Glower, dean of the College of Engineering, responded to the letter.

In the letter, Glower said he agreed with the arguments presented, but said the strongest program he could provide for students would be one combining different engineering disciplines.

Barnicki, however, expressed his and other students' opposition to this idea, saying that the strengthening of the discipline could not be fully achieved by Glower's plan. Because it is a center and not a department, it does not have its own budget and, therefore, cannot add needed courses and cannot force other departments to add biomedical engineering to its curriculum, Barnicki said.

"Several years ago, Thomas Seliga, professor of electrical engineering, fought for the departmentalization of his atmospheric science program," said Barnicki.

"He finally gave up and moved the students and the program to the University of Pennsylvania. I don't want to see that happen here."

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Glower said he was also willing to talk to the OSU Bio-Medical Engineering Society members to answer their questions.

Ed Jarmul, a Ph.D. candidate, said there is no plan to move biomedical engineering into a department or division.

A previous attempt to hire a biomedical engineering faculty member as a step toward establishing a separate department was stopped at a higher administrative level, Barnicki said.

"It's not like we're striking new ground by adding a biomedical department," Jarmul said. "Other schools have one. Case Western (University) comes to mind as one example."

The students said the move for departmental status was student-initiated and no faculty were involved. They also said they hope to help in choosing a replacement for Weed.

To ensure the 66 students' interests were maintained, Glower said he would allow one or more students to review the candidates with the search committee, Julie Swick, a master's candidate, said.

After what she said were other unfulfilled promises from the dean, Swick said "she'd like to see this one come through."

Weed and Campbell are the only in-house faculty who spend the majority of their time with the biomedical program and they both are nearing retirement, said Ronda Roberts, a Ph.D. candidate.

Barnicki said the program is not in danger of being terminated. But still, the students are concerned about the growth and progression of the major, he said.
Biomed program won't get status

By Cynthia L. Reza
Lantern staff writer

The biomedical engineering program does not have enough students to justify its movement to a divisional or departmental status, said Donald D. Glower, dean of the College of Engineering.

Students majoring in biomedical engineering have attempted to gain departmental status. Currently, the Bio-Medical Engineering Center is not sanctioned as a department and no faculty in the field are tenured.

Biomedical engineering combines the study of medicine and engineering to provide an understanding of medical problems that require engineering solutions. There are 66 biomedical students at Ohio State.

Biomedical engineering students are important, Glower said, but other departments are overpopulated and biomedical engineering is not. There just aren’t enough full-time students and faculty to justify taking action.

“They (biomedical engineering) have a nice program, loosely connected,” Glower said.

The process of becoming a department is complicated, said Herman Weed, professor of electrical engineering and director of the center.

Weed made no comment on the student-initiated push to become a department except to say the students are some of the most highly motivated and dedicated he’s worked with. He said the students are very involved with the workings of the center.

Normally, following a recommendation from the dean, an academic area must first have division status before becoming a department, Weed said. There are several levels of divisional status such as a division within a department, college, or the university, Weed said.

Once reaching division status, the academic area can hire its own faculty and have its own courses.

Steve Barnicki, a Ph.D. candidate, said the department does not have its own budget, and therefore, cannot add necessary classes or hire faculty.

There once was an attempt to hire a biomedical engineering faculty member. However, Glower said the candidate selected did not have the credentials to be approved.

“We’re going to build the program,” Glower said. “But, you have to be realistic.” Glower said an overpopulated department with a high student-to-faculty ratio is not going to want to give up money to a program, such as biomedical engineering, which has a lower student-to-faculty ratio.

After getting divisional status, an area can later request a provost with the intention of becoming a department. Weed said, “There are no prescribed time limits on the process,” he said. “It might take a few months or more than a year.”

Weed said many divisions elect to remain divisions rather than become departments. The nuclear engineering division within the engineering school was one example, he said.

Barnicki and other students have said they would be happy with a plan for movement into division status.

The biomedical students said the center’s current status could impede its forward growth in the field.

Glower said he has no doubt the field will be very important in the next few years. He added that the center’s progress will continue to go forward even at its current status.

Complaints about departmental status are not beneficial to the program, Glower said.

What the Bio-Medical Engineering Center has to do is “pull itself up by its bootstraps,” Glower said. “They should pull together and build rather than stand around (gripping).”
Device to give blind sensory data

Researchers at Ohio State are developing a device to provide blind people with visual information.

Herman Weed, director of the Bio-Medical Engineering Center, said the tactile visual substitution system will not allow the blind to see, but rather will give visual information through other senses.

The device uses a computer to translate a picture from a video camera into an “image” produced by vibrators against the blind person's skin, he said. About one picture each second will be conveyed in this way.

In theory, the information could be used to signal the nerve system directly if a person had a functional optic nerve, Weed said.

This would not produce a picture in the person’s mind, but rather some form of signal that would have to be interpreted, much as a foreign language is learned, he said.

The vibrators remove the need for surgery and are less complex than direct nerve connection.

“It's beyond our technical capability at the moment to build and to implant a stimulator which could make prearranged connection with a million nerve cells,” Weed said.

The sense of touch was chosen to convey the information because people already interpret signals from their skin in terms of left, right, up and down.

“It's already coordinated up here,” he said, pointing to his head.

The system consists of a video camera about an inch in diameter and three inches long, a computer, and 256 vibrators — each slightly larger than a pencil eraser — in a square grid about eight inches on a side.

Weed said the grid is placed against a person's stomach, which is large and relatively flat compared to the more sensitive palm.

A number of difficulties have been overcome in the three years of research already done, he said. For instance, the vibrators are driven at 250 cycles per second, which is very near a piano's middle C.

“A hundred vibrators singing middle C is very noisy,” he said.

The system has been modified to eliminate the noise by changing the electrical signal used to drive the vibrators, said Ed Jarmul, a graduate student in biomedical engineering.

Jarmul said the plans call for a camera about as big around as a marking pen and half as long, and a specifically-made computer about the size of a portable cassette recorder.

A battery pack will be added to make the system portable. Weed said the vibrators consume a great deal of power, draining the battery pack.

It was discovered that people felt the stimulation better when the vibrators were run for only a fraction of the time and by continually switching the vibrators on and off, power consumption was reduced to less than onetenth what it had been.

Jarmul said the number of vibrators also limits the information which can be transmitted.

The system will ultimately give “about the same kind of detail that you have in the comics,” Weed said.

Following testing with blind people over the next several months, the process of miniaturization will begin. The complete system should be ready in about a year, Jarmul said.

It remains to be seen whether anyone will want to manufacture the system, Jarmul said. They've been trying to keep the system affordable to those who want it, he said.

“I haven't found a single blind person who isn't absolutely ecstatic” about the system, Weed said.

Jarmul said the research is being funded by private donations and a grant from the Blind Guild of Ohio.
Center gets new director

Associate professor wants cooperation between colleges

BY NICOLE R. HAMPTON
Latern staff writer

The new director of the Bio-Medical Engineering Center said he would like it to become more of a cooperative effort between the colleges of Engineering and Medicine.

Dr. J. Fredrick Cornhill, whose appointment was announced Monday, said such cooperation would help the Bio-Medical Engineering Center to get more research materials. The center is officially a part of the College of Engineering.

"The center needs the extra help from the College of Medicine because the College of Engineering is only equipped to deal with the engineering side of the center, such as research in new types of medical equipment and technology," he said.

The college is not equipped to help with the bio-medical aspect of the center, such as heart-disease studies, Cornhill said.

"Bio-medical engineering is different than mechanical engineering and electrical engineering because of the bio-medical aspect," he said.

Donald Glower, dean of the College of Engineering said Cornhill will become chairman of the bio-medical engineering program and director of the center July 1. He is, however, already starting to look for ways to improve the program.

The center's current director, Herman R. Weed, professor of electrical engineering, is retiring from the position. He has been the director for nearly 15 years.

Cornhill said the center has virtually no faculty, no laboratory space and no new equipment to serve the more than 50 graduate students who work there.

He said he hopes to change this by recruiting new faculty and badgering the College of Engineering for equipment and space.

"I'll send them requests until they scream for me to stop," Cornhill said.

He said he plans to use a small group of graduate students to advise him about student needs.

These students will be involved in all areas of the program except for certain personnel areas, he said.

Cornhill said he was the center's first choice for director. He originally turned down the offer because he felt someone from outside the university should be appointed in order to contribute new insights and ideas.

When the center lost an outside candidate for director, Cornhill said he accepted the position.

Cornhill has been an associate professor of surgery at Ohio State for 11 years.
‘Air chair’ adds mobility to plane ride

By Steve Benowitz

Engineers at Ohio State have come up with an easier way for people who use wheelchairs to get around on an airplane.

They’ve built a 20-lb. aluminum and steel chair — dubbed the “air chair” — that can move down the aisle between the rows of seats on a commercial airliner. The researchers say the chair should allow its user the flexibility of moving about the plane.

“Someone who uses a wheelchair wouldn’t have to be carried on and off a plane, or within the plane,” says Herman Weed, professor of electrical engineering and preventive medicine, who heads the project.

People in wheelchairs don’t “really get around the plane at all right now,” Weed says. Standard-sized wheelchairs are unable to navigate the narrow aisles.

“Airlines have an aluminum ‘dolly’ of sorts that they put people on, and wheel them down the aisle and lift them into the seat. While the paraplegic is in the airplane he or she has to be carried.”

But Weed notes that recent federal legislation may change that.

“The federal government has passed laws basically saying the airlines must do something to improve the access and mobility of handicapped (individuals), but they don’t specify what,” he says.

The first prototype is nearly ready. The chair has a hydraulic lifter and an adjustable, 18-inch-wide seat — “essentially, it’s an exoskeleton for the paraplegic,” Weed says. Both the seat and back probably will be made of “some acceptable fireproof material” to meet federal aviation standards.

Engineers already made sure the chair will fit in the aisles and seats of several airlines, such as USAir, Trans World Airlines and Delta. The chair should be ready for testing on a plane sometime early this year.
Blind, sight impaired might soon see by feeling

By Jeff Merritt
Lantern staff writer

Blind and visually handicapped people soon might be able to feel what they cannot see.

Six years of research at Ohio State’s biomedical engineering center has led to a system that utilizes a vibrating plate to provide its users with real-time visual information, said Herman Weed, professor of electrical engineering and one of two faculty involved in the project.

The system consists of a video camera that sends images to a computer. The images are broken into a matrix and translated into electrical impulses that activate a 16 by 16 grid of tiny vibrators on the plate, he said.

The small plate is strapped to a person’s skin like a piece of clothing and the person “sees by feeling,” Weed said.

Leo Lipitz, professor emeritus of zoology, said researchers have worked with both blind and sighted people to see how they react to the system.

He emphasized the project does not involve the eyes and nothing is implanted surgically.

Several blind people used and critiqued a prototype of the machine at a convention of the American Council of the Blind last month and had mostly positive comments, Weed said.

He said participants were able to recognize shapes and letters and could tell if a person they were looking at wore a moustache or glasses.

Weed emphasized the machine aids blind and visually impaired people.

Claudio Perez, a student majoring in biomedical engineering, is one of three graduate students working on a new vibrating pixel, for the blind or seeing-impaired. This equipment illustrates images on the user’s stomach, he said.

Lipitz said a small chip might eventually replace the computer hardware, which would be a big step toward making the system compact.

Weed said a few logistical problems, the size and weight of the system, its power source and the noise it makes, must be ironed out before a final version of the system can be considered.

He added these obstacles are not unsolvable. In fact, Lipitz added the power necessary for the system has already been reduced to one-hundredth of its original amount.
New wheelchair goes on plane with passenger

BY MAUREEN CUTRIGHT

Columbus News Service

COLUMBUS, Ohio — People confined to wheelchairs may find travel easier if a chair being developed by engineers at Ohio State University becomes available.

The 20-pound aluminum and steel chair provides easier access to a commercial airliner. It also will increase the dignity of a handicapped passenger, said Peter Sikora, a Cuyahoga County Juvenile Court judge and consultant to the project.

Sikora, wheelchair-bound for almost 22 years since he broke his neck in a trampoline accident, came up with the idea of a chair that molded to an airline seat. Through a series of contacts, he presented his concept to Ohio State.

"I was aware there was a need," Sikora said. "I am forever trying to come up with ways to make life easier for those in a similar situation," Sikora said.

Dubbed the "air chair" by Herman Weed, professor of electrical engineering and preventive medicine at OSU, and Alan Mortensen, a graduate research assistant working on the project, the 18-inch-wide seat allows access to airplane aisles and lavatories.

The person will be able to transfer to the chair in the airport, and then is wheeled onto the plane. A hydraulic pump allows the chair to be positioned over the seat and lowered onto it, Mortensen said.

The current design does not allow for transfer to a lavatory seat. It only allows the passenger to enter the lavatory for privacy.

"This will give people a way to board and exit in a more human fashion. It will make the passenger less confined to staying in one place on the plane," Mortensen said, explaining that people in wheelchairs are now carried on and off a plane with a dolly-like device, and the employees "wheel them aboard like a TW or a refrigerator."

Recent federal legislation, the Americans With Disabilities Act, might force the airlines to stop this treatment and to improve access to public transportation, said Linda McQuiston, a rehabilitation engineer for the Ohio Rehabilitation Services Commission.

The university design research project, which began in January, 1989, is funded by $50,000 from the commission. Mortensen expects the final prototype to be completed this fall. Additional funding is being sought.

Three manufacturing companies have expressed interest in building the chair for Ohio State, McQuiston said. She would not identify the firms but said one was based in Ohio.

"Airlines, especially USAir, have been cooperative in testing the prototype, Mortensen said.

"This isn't going to work unless airlines say it is going to work. We are wondering how should we make this available? Should it be sold to individuals or airline companies?" said Sikora.

"Our next step is to see how link up with one or more airlines or airline manufacturers who will accept this as an alternative."

The "air chair" is considered much safer than the current method of transporting passengers, Sikora said. "I knew there had to be an easier way."
Ohio State researchers seek to mimic ivy's natural glue

Biomedical researchers at The Ohio State University have been culturing and studying the adhesive and waterproofing properties of English ivy and someday hope to have practical biomedical and waterproofing applications.

By Emily Tate

Looking out at the tangles of green vine overtaking his backyard, Mingjun Zhang wondered how English ivy could be so resilient. He had watched it thrive for years despite extreme conditions — heat, freezing temperatures, wind and rain.

That was almost nine years ago. Today, Zhang and a team of biomedical engineers at Ohio State University are leading the research behind ivy's glue-like secretions and say the implications hold promise for medical and military advances.

The source of ivy's unmatched adhesive abilities — a mystery that scientists such as Charles Darwin have pondered for more than a century — lies at the nanoscale.

Ivy roots are made up of nanoparticles — tiny particles that Zhang described as 1 million times smaller than the width of a human hair. These nanoparticles have bends, bumps and holes on their surfaces but are otherwise uniform in structure.

When millions of them combine, they become highly compact and fit together like a jigsaw puzzle. This is how ivy can cling to almost any surface with a force 1.8 million times its own weight, Zhang said.

"It is one of the largest forces in nature," he said.

The team has identified not only the nanoparticles that comprise ivy's sticky secretion, but the protein the
The more they understand how it works, the easier it will be to create biomedical applications, Zhang said. They could include scarless tissue repair or tissue engineering.

"This is something particularly promising," he said.

Zhang also works with researchers at the OSU Davis Heart and Lung Research Institute. Because of this connection, the team plans to look specifically at treatment possibilities for cardiac diseases, such as congestive heart failure, said Yujian Huang, one of Zhang's doctoral students.

"It's interesting, but also important," Huang said.

The team also is looking at ways to develop water-resistant, environmentally sustainable military coatings for such things as submarines, Huang said.

Zhang said while there are other plants with similar protein secretions, none seem to compare to the strength of English ivy.

"Ivy is the only one we found that has the most uniform nanoparticles secreted from the plant," he said. "That's why ivy generates such stronger forces."

Zhang's research is one of the latest in the field of biomimetics, which translates to "mimicry of life." Biomimetic scientists study and then try to imitate natural processes. They include super sticky gecko feet and lotus leaves, which repel water.

"This field of biomimetics is one that people are becoming very excited about," said Hillel Chiel, a professor of biology at Case Western Reserve University. "Each time you get an idea from nature, you can use that as a novel design, and in many cases those are more robust and effective than the artificial ones."

Chiel said that as this field grows and new ideas emerge, people are realizing there is still a lot to learn from nature. Chiel said the OSU ivy research sounds interesting.

"Novel adhesives could have massive applications, like wound healing," he said. "It looks very, very promising."

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