NSSTC opens, then expands

Just three months after a ribbon-cutting ceremony to celebrate the grand opening of the National Space Science and Technology Center (NSSTC), the national laboratory is expanding. The construction project will add an 80,000-square-foot annex to the original 120,000-square-foot building.

The NSSTC is a partnership of NASA's Marshall Space Flight Center and Alabama's research universities. The laboratory is a clearinghouse for cutting-edge research in space science, Earth sciences, information technology, optics and energy technology, propulsion, biotechnology and materials science.

Some of the addition's special features include:
• A special "shock-absorbing" foundation to protect sensitive research from disturbances and vibrations, such as those caused by traffic and wind.
• A high-bay area extending into the second-floor to give scientists adequate space to develop and assemble large, balloon-borne prototypes for the next generation of high-energy astrophysics space telescopes.
• Crowning the new annex will be a glass-enclosed observation facility. Built to withstand the strain of severe weather, it will offer an ideal vantage point for watching lightning during thunderstorms.

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A change in the weather?

Deforestation is changing the weather over parts of Costa Rica, and may be damaging cloud forests and other ecosystems hundreds of kilometers from the logging.

Scientists at UAH and Colorado State University found that clearing large areas of lowland forest reduces cloud cover and causes clouds to form at higher altitudes. Both results reduce the amount of water deposited in Costa Rica’s mountain forests.

Their findings were published in the Oct. 19 edition of the journal “Science.”

“We’re seeing that when you deforest the lowland, it affects the environment several hundreds of kilometers away,” said Dr. Ron Welch, chairman of the Atmospheric Science Department at UAH. This information could have a significant impact on conservation plans throughout Central America.

Using data from both on-site sources and satellites, the scientists developed models that show how clouds form over Costa Rica’s Caribbean lowland and are carried into the mountains by persistent trade winds. During the annual dry season, low flying clouds that envelope the mountains are an essential source of water for the forests that grow there.

By putting water into the air through transpiration, the disappearing Costa Rican lowland forests play a key role in processes that form these low flying clouds, according to Dr. Robert Lawton, a professor of biology and tropical forest botanist at UAH.

In addition to supplying water vapor that goes into forming new clouds, the evaporation process also cools the air. This cooling lowers the height of the cloud base. When forests are cut down the amount of water vapor available for cloud formation is reduced and the air may warm, driving the reduced cloud layer to a higher altitude.

“And the persistent trade winds effectively ‘conveyor belt’ these effects off the lowlands,” said Lawton. “This isn’t a dodgeable effect. It’s a straight hand off.”

For the delicate ecosystem of Central America’s cloud forests, these would be bad things.

“The past 25 years, the data suggests that the cloud base has risen, there has been an amphibian ‘crash,’ and the dry season has gotten a couple of weeks longer,” said Welch.

Logging may damage forests miles and miles down wind

In addition to the environmental concerns, changing the cloud forest environment might also have major economic and social impact back in the lowlands.

“There are some important potential hydrologic impacts,” said Lawton. “Dry season river flows might change. Reduced cloud interaction with the mountains might mean a substantially reduced supply of water for urban water systems, reduced water for irrigation and reduced water for hydroelectric development. “What portion of the annual precipitation is due to dry season cloud interception? We don’t know. We do know that if the clouds miss the mountains entirely, you eliminate the cloud forests completely.”

At the same time, deforestation in Costa Rica’s eastern lowlands has been underway since the 1930s and most of the forests in the region have been cleared, leaving little room for additional damage, Lawton said. “It may be that our cloud forest is as screwed as it’s going to be.”

To look at the influence of land use on local climate the research team, which includes Dr. Roger Pielke Sr., a professor of atmospheric science at Colorado State, and Udayankur S. Naik, a CSU doctoral student working with Welch at UAH, input the land use data into a regional atmospheric modeling system developed at CSU.

A $450,000 grant to fund an extensive, three-year follow-up study was recently approved by NASA. That work will include an inventory of biological diversity in both the cloud forests on the windward side of the mountains and in dump lowland pockers that routinely get water from clouds rolling over the mountain tops.

“These eddies are as persistent as a river,” Lawton said. “Because they carry this water so reliably, it makes for spatially predictable microclimates. We’re desperate to start some mapping of these biological communities to get them before they’re impacted by the rising clouds, to see if they change.”

— Phil Gentry

Dr. Norine Noonan named NSSTC executive director

A former assistant administrator for research and development in the Environmental Protection Agency during the Clinton administration, Dr. Norine Noonan has been named executive director of the National Space Science and Technology Center in Huntsville.

Noonan says she is excited about her new assignment, and understands the challenges ahead.

“This center brings together outstanding scientists from NASA and academia in an innovative organization that fosters and encourages cutting-edge research,” she said. “It’s already doing great things. I believe it can be a new model for productive research collaborations between government, academia and industries.”

NSSTC is a partnership between NASA’s Marshall Space Flight Center and the Space Science and Technology Alliance (SSTA), a consortium of Alabama research universities which includes UAH, Alabama A & M University, Auburn University, The University of Alabama, The University of Alabama at Birmingham, the University of South Alabama and Tuskegee University.

NASA’s Marshall Space Flight Center gives the center a core of science and technology expertise, focusing on space science, Earth sciences, information technology, optics and energy technology, propulsion, biotechnology and materials science.

“We are pleased Dr. Noonan will be leading the National Space Science and Technology Center,” said Art Stephenson, the Marshall center director. “The NSSTC is making great strides in research topics ranging from solar storms in space to weather right here on Earth.

“I’m confident that under her leadership we will continue to see outstanding results from the scientists and engineers dedicated to this research.”

Noonan received her undergraduate degree from the University of Vermont and received master’s and doctoral degrees from Princeton University.

From 1998 to 2001 she served as assistant administrator for research and development in the U.S. Environmental Protection Agency’s Office of Research and Development. From 1992 to 1998 she was vice president for research and dean of the graduate school at the Florida Institute of Technology.

From 1983 to 1992 Noonan was chief of the science and space programs branch of the U.S. Office of Management and Budget. She is a member of Sigma Xi and Phi Beta Kappa, and a fellow of the American Association for the Advancement of Science.

— Ray Garner
Some professors are entrepreneurs, but with class(es)

Dr. Milton Harris is CEO of a successful biotechnology company, but his dress and appearance are reminiscent of a university professor. There's good reason: He spent most of his professional life in classrooms and research laboratories at UAH.

"You can take the professor out of academia, but you can't take academia out of the professor," he acknowledges with a hint of a smile.

But no one would want too drastic a change, including Harris. His career path from chemistry professor to the top executive of a biotechnology company is a successful example of how research universities provide economic benefits to the communities they serve, as well as benefits to society in general.

The process has a number of buzzwords. The most common are technology transfer and intellectual property development. It hasn't been a common occurrence at UAH, but Dr. Harris is the university's most successful example to date.

He started his company, Shearwater Corp., while still teaching and conducting research at UAH. As the company grew it commanded more of his attention. He retired from UAH in 1997 — 25 years after becoming an associate professor in the chemistry department.

The company conducts research on methods of delivering pharmaceutical drugs by attaching them to polyethylene glycol (PEG) polymer chains. The technique has been applied to a broad range of drug advancements. Attaching those polymer chains increases the time the chemicals spend circulating in the bloodstream, thus improving the drug's effectiveness. This reduces the frequency of doses, improves safety and stability, and makes drug formulation easier.

With an annual payroll of about $5 million, Shearwater remains in its formative stage, primarily because of the slow movement of pharmaceutical development and the U.S. Food & Drug Administration. However, the company has grown to about 120 employees. Earlier this year Shearwater was sold for $119 million to Inalise Therapeutic Systems, Inc., a California company.

Not a bad turn of events for a chemistry professor and others who wisely invested in his venture. Despite the buyout, Harris remains Shearwater's CEO.

From personal experience Harris knows that research universities play an important role in economic development in a variety of ways, including professors who develop and commercialize their "intellectual property."

"If you look across the country, there are a large number of new companies that are developed through research universities," Harris said. "A lot of intellectual property development takes place at universities and that can be a critical part of a community's economic engine."

Harris conducted basic chemistry research while teaching at UAH.

"Our research in polyethylene glycol was the accumulation of years of advances in that particular field," he said. "That research included writing a lot of papers and making a lot of presentations. It wasn't a single discovery where the light bulb came on, but basic research that slowly revealed its commercial applications.

"We had been working on various active forms of PEG. Most of our research was looking at combining PEG technology with popular compounds used in the pharmaceutical industry. We came up with a molecule that has some really nice properties. It is stable in water, and a lot of our work was being done in water. So we knew what we had would be useful. That's when we began discussing the commercial applications and we patented our idea."

Harris got strong support from UAH.

"They did their part for me," he says. "They provided great facilities to file the initial patents, and we had good students."

He says the key to making research universities provide economic benefits is the same as successful companies: People.

"This process works best by having knowledgeable people," he said. "The management at the university must bridge the gap. It's important to have people who have been in academia, but who also have experience with industry. People who know how to facilitate interactions between the university and industry will be a tremendous plus."

Harris says providing a business incubator is also important in moving research from the laboratory to the marketplace.

"The incubator was worthwhile inadequate when I was there," he said. "There were rules on paper, but it didn't really work. We started Shearwater outside of the university. It wasn't that the university didn't want to help. It did. But the mechanisms for a professor starting a company through the incubator at that time was not viable. Making it easier for professors to do this would be a tremendous idea, and would benefit the university too."

UAH is already providing assistance in licensing and patent issues. In fact, Shearwater's first product is based on a patent held by the university.

But Harris has other suggestions as well that will encourage the commercialization of university research, cooperating with professors on licensing issues at reasonable terms, providing more laboratory space, and helping professors who have entrepreneurial ideas meet the venture capital community.

"UAH can't provide start-up money for companies, but they can help provide a link to people with money," he said. "The university can also provide cheap space for an equity position in the company. If you have to go out and find facilities, it's very tough for a start-up company to make it."

Harris says many university foundations have become investors:

"Foundations are very active in licensing intellectual property for start-up companies," he says. "I think in most cases, it's not a large amount of money, but it could become very lucrative with the right idea."

"Biotechnology and information technology are a couple of prime targets for such investments, according to Harris. "There are a lot of bright people with good ideas in those fields. And anywhere you have intellectual property involved — chemistry, optics, physics, software, hardware and biomaterials — you can produce patents with commercial applications."

While other universities have taken a more active role in commercializing intellectual property, Harris believes UAH is in a good position to take advantage of similar developments.

"UAH may be a small place, but that can be a real advantage," he said. "I found it to be fairly easy to work within the system. You know everybody and there aren't a lot of rules. You can deal more with individuals rather than with a large system that is more rigid."

Meanwhile, Harris advises professors who might want to become entrepreneurs to be patient.

"A lot of work has to be done to move something from the research laboratory to commercial reality," he said. "Let's say you develop an idea conducting research with a graduate student. You are able to demonstrate the idea and how well it works. But to take that idea and reproduce that idea on a large scale, day by day, is a new world."

But that world is within the grasp of professors with entrepreneurial traits. That is the world that Milton Harris has created at Shearwater Polymers.

— Ray Garner
**HOT TOPICS**

UAH-led team bids to help NASA get answers to burning questions

Roaring into the upper reaches of the atmosphere at faster than five times the speed of sound, a third generation launch vehicle opens wide a great mass of an intake and ram thousands of cubic meters per second of the evanescent atmosphere into its engines.

The friction of the air rushing through the intake ducts and over the spacecraft's skin generates enough heat to melt aluminum or to turn titanium white hot. To breathe into the intake ducts and over the spacecraft's skin generates enough heat to melt aluminum or to turn titanium white hot. As an air-breathing "combined-cycle" launch vehicle such as this one exists, NASA is considering for a future launch system. There is, however, a few questions about all of the systems under consideration. Such as, how do you make it work reliably and at a reasonable cost?

**Some UAH courses are 'rocket science'**

High standards and lofty expectations are the norm in UAH's College of Engineering, but students in one of Dr. Marlow Moser's classes are aiming a little higher: They're designing a reusable rocket to carry microgravity research experiments.

The Student Launch Initiative is a joint project of UAH and Alabama A & M University with funding from NASA's Marshall Space Flight Center (MSFC). UAH is designing and building the rocket while AAMU provides the payload.

Dr. Moser, a senior majoring in computer and electrical engineering, says, "Many of the students stay with the project, even though they went home for the summer."

The project involves students in mechanical and aerospace engineering, computer and electrical engineering, and civil engineering. Their finished product will be a rocket almost 14 feet tall and 6 inches in diameter, and capable of handling a payload weighing as much as 15 pounds.

"When we can keep the payload to 10 pounds, we should reach an altitude of 10,000 feet," said Kurr. "With five pounds, we should get 11,600 feet."

"The future goal of the course will be to build a rocket that will be laser and go higher," said Smith, "We'll eventually want to go four miles (22,000 ft.) and even eight miles (45,000 ft.). This fall we've planned two launches, one baseline launch to test the equipment and one with the payload."

Nine UAH students are involved in the project.

Moser, an assistant research professor of mechanical and aerospace engineering, is the course advisor. He says his students are being given a one-of-a-kind learning experience.

"They're learning how to log up information for themselves," said Moser. "You have smaller teams working on individual aspects of the project, but they're learning to work together. And the answers are not in the back of the book."

A launch site for the rocket has yet to be determined. Availability, cost, and FAA clearance will be major factors.

In addition to NASA funding, financial aid has also come from the Alabama Space Grant Consortium. Other UAH faculty involved in the project are NASA engineers and part-time lecturer Bob Ryan, Luke Schutznerhofer and Jim Blazet.

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*UAH students successfully launched a prototype test rocket that was made of concrete. The full-scale rocket will be almost 14 feet long.*

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*Dave Denton*
Dr. Alan Wilhite sees systems engineering in every direction he looks, whether it involves missile defense, helicopters or the space shuttle.

The university’s new eminent scholar in systems engineering and simulation wants to pull together elements of UAH’s industrial and systems engineering, and engineering management departments, as well as local developments in simulation and modeling to enhance advanced technology programs for both the U.S. Army and NASA.

“Systems engineering is simply pulling together all the disciplines required in the complete life cycle of a system,” Wilhite said. “To make the greatest impact on success you must begin in the early process of development, such as early conceptual design and simulation, and carry that process through to the end, to the eventual retirement of a program.”

The 51-year-old engineer has been involved in that process for much of his career, from launch vehicles to spacecraft design to commercial airplanes to the next-generation space shuttle. Now he is looking forward to expanding that experience to helicopters and missile defense systems.

Wilhite spent the first two decades of his career designing launch vehicles. For much of the past 10 years he managed NASA’s high-speed research program office at Langley Research Center, and was acting director of a $350 million high-speed civil transportation program. Langley houses America’s largest civilian aeronautics program, with more than half of its research focused on improving military and civilian aircraft.

“We put together the systems engineering design to make sure the program made sense,” he said. “We had to make sure a concept could meet performance requirements, but we also had to be sure the program was economically viable and environmentally compatible.”

He said pulling all of that together is what makes systems engineering so important. His research interest lies in systems analysis and engineering, probabilistic risk assessment, launch vehicle concepts, advanced propulsion and aerodynamics — areas important to a wide range of programs at NASA’s Marshall Space Flight Center and at both the U.S. Army Aviation and Missile Command, and the Army’s Space and Missile Command.

“It’s important that we pull together a system where the performance meets standards, but the program means work together, and it all makes economic sense,” he said.

That’s a tough task, especially when engineers and scientists are dealing with conceptual designs of products that won’t be completed for 10 or 20 years.

“It’s tough to know the exact answers,” he said. “In fact, a broad range of error creeps into what you’re doing. You’re looking so far into the future, you don’t know what kind of performance you’re going to be dealing with.”

He said that’s when statistical analysis is brought to the table.

“As you’re dealing with these uncertainties, statistics will give you a feel for how much error is possible, and how much robustness will be required in a new system,” he said.

“System engineering brings all of those disciplines — vehicle design, aerodynamics, structural analysis and statistics — together at the same time.”

Wilhite said one surprise he found on arriving in Huntsville was the lack of coordination between NASA and the Army.

“I can see a lot of room for cooperation between the Army and NASA programs because they all require the same disciplines, analyses and tools,” he said. “It’s just different applications. That’s an area where I can bring them together.”

— Ray Garner

Declining memory is one of several telltale signs of aging, and a constant source of embarrassment and frustration for the elderly — especially when it comes to remembering people’s names.

A simple memory-improving exercise being studied at UAH, however, might offer some of the memory loss that sometimes comes with aging.

“One way to improve memory is to use mnemonics — simple memory tricks or techniques,” said Dr. Jeffrey Neuchatz, an assistant professor of psychology at UAH. “Although mnemonic devices have been shown to be effective with the elderly, most seniors report that because they require a great deal of effort to use, many seniors do not find them to be helpful in their everyday lives.”

The advantage of the “expanding rehearsal mnemonic,” which Neuchatz and research assistant Emily Hawkins are testing, is that it requires little effort to learn and use. It is a simple rehearsal exercise that has been shown to improve young adults’ long-term memory for names.

With this mnemonic, people rehearse the information they want to remember while gradually increasing the amount of time between successive rehearsals. For example, with an expanding rehearsal schedule a person might try to recall an item immediately after hearing it, then 10 seconds later, then again after 30 seconds, and so forth.

Earlier this year Neuchatz and Hawkins tested healthy residents of Someday at Jones Farm, a senior retirement community in Huntsville, to determine whether expanding rehearsal techniques might improve long-term recall of names with the elderly, as has been found with college students.

“When college students were tested with the expanding rehearsal mnemonic, results indicated that the students retained names and faces well over a two-day period,” Neuchatz said.

Somebody residents were shown color photos and the last names of students from a recent high school yearbook. Participants were asked to imagine they were at a party meeting these people for the first time and remembering their names was important for future business contacts.

In subsequent tests only faces were shown and participants’ recall of names was tested. Between testing periods, seniors were given unrelated tasks to complete for 30 minutes, after which they were again asked to match a last name to a photograph.

Preliminary data seems to suggest that the expanding rehearsal mnemonic improved long-term memory, said Neuchatz. “Although these preliminary results are encouraging, there is much research to be done before we can make definitive conclusions.”

Neuchatz and Hawkins continued testing seniors throughout the summer at senior residence homes and selected church functions for the elderly.

They hope to expand the research to information other than names, such as shopping lists and telephone numbers — items that most people need to remember.

— Joyce Maples
Researchers studying a wide range of debilitating bone diseases, including osteoporosis, now have a new tool with which to work. Developed by scientists at UAH’s Laboratory for Structural Biology (LSB) and at Research Genetics, a new “gene filter” will help researchers study the possible causes of some bone diseases.

Produced commercially by Research Genetics, the filter helps researchers see which of 5,000 genes involved in bone growth are active and which are inactive under specific circumstances. “We hope that every pharmaceutical company and every medical researcher working on osteoporosis will want to buy them,” said Dr. Edward Meehan, LSB director and a professor of chemistry.

The gene filter embeds specific genetic material — in this case 5,000 genes known to play a role in human bone growth — on a nylon membrane. To run a test, RNA is extracted from a biological sample, such as bone or other tissue. The filter surface is exposed to a solution containing the RNA, which binds to “active” genes that would produce that particular RNA.

When the test is done a researcher can look at each gene on the filter to see if the corresponding gene was “active” in the sample. By comparing samples from healthy and diseased tissue, researchers might find genes that are being turned off or on at inappropriate times. If they find, for instance, that a certain gene is overstimulated in people with osteoporosis, researchers might try to design a medicine to regulate that gene’s function.

Research that led to the bone-screen was supported by a grant from NASA’s Space Product Development Office. “When astronauts go into space, they get significant bone loss,” said Meehan. “So bone mineralization is something NASA really wants to get its hands on. We promised NASA that we would identify the genes involved in bone mineralization,” he said. “We want to approach it from the molecular level.”

The same processes of laying down and reabsorbing bone that apparently run amok in “weightless” astronauts, however, may also be at work in a wide variety of bone diseases down here on Earth. The most common of those diseases is osteoporosis. In the U.S., said Meehan, about 40 percent of women over the age of 50 will suffer at least one bone break due to osteoporosis.

The UAH/Research Genetics gene filter went on the market this summer at the bargain price of only $1,400. It was important to keep the price low, Meehan said, so researchers can afford to run several tests to establish what is “normal” behavior for the genes in both healthy and diseased tissues.

— Phillip Gentry

A computer that you wear might warn of heart attack

An elderly man with a history of chest pains is working in his garden when a device attached to his chest starts to beep. Walking into his house, he relaxes in an easy chair and dials 911. A few minutes later paramedics arrive. The man’s condition is stabilized and he is transported to a hospital, where he is diagnosed with having suffered a myocardial ischemia, or silent heart attack.

The small beeping device gave the man about a one-minute warning that he might be having some type of cardiac arrest. By discontinuing his strenuous activity, he might have avoided a more serious heart attack.

Such a scenario is the goal of Dr. Emil Jovanov, an assistant professor of electrical and computer engineering at UAH. Jovanov is developing a biomedical device that will provide intelligent physiological monitoring of humans.

Anyone prone to heart attacks would be an early prime target for this “wearable computer,” but the field could be expanded to a broader array of patients.

“Eventually, the concept is to create a monitor that would provide warnings for many different types of medical emergencies,” said Jovanov. “We believe the body sends warning signals about impending medical emergencies before it is apparent to the individual. We hope this device will warn patients to seek medical assistance, and at the same time, decrease their physical effort.”

“This can help cardiac patients live a more normal life. They can get out of the house and become more physically active without having as much anxiety.”

The device will be designed to detect and analyze the shapes of a person’s ECG signal. Those signals are consistent from heartbeat to heartbeat. Any subtle change would be cause for the device to issue an alert.

Similar devices might also give warnings to epileptic patients, detect drowning, provide physical therapy feedback for stroke victims, and monitor patients for sleep apnea conditions.

There are many hurdles to developing a broad use intelligent health monitoring device. Existing sensors are difficult to wear for long periods of time without irritating the skin. Contact resistance between the electrode and the skin is unpredictable over a period of time. Battery powered, the device must also use little power. Another problem is routing the connecting sensors.

For devices of this type, size does matter. The UAH prototype is 3.8 inches by 2.5 inches. Eventually, the computer will have to be about one-half-inch square.

The entire device, including sensors and a wireless transmitter, must be able to fit on a device that will attach to the skin and be no larger than 1.5 inches wide and 2.5 inches long.

“It is possible to build the device that small with today’s technology, but not with a wireless transmitter,” Jovanov said. “The various technologies can be put on the same chip, but it is not widely available. The wireless technology to make this device possible is probably a couple of years away from becoming available.”

By combining a wearable computer with a wireless transmitter a patient wouldn’t have to make the emergency phone call. A “guardian angel” device would detect a medical emergency, send an emergency distress signal, and transmit the patient’s vital signs to a hospital emergency room, or their doctor’s office.

“Your guardian angel could be connected through the wireless network so that 911 or a specialized medical response service could be contacted in the event of a medical emergency,” Jovanov said. “The doctor or the patient could formulate triggers that cause even more data to be collected, additional sensors to be enabled, or medical personnel to be contacted.”

“Medical monitoring applications for wearable computing offer a powerful new way to keep track of a patient’s medical condition and predict impending events. Our ultimate goal is a system of wireless medical sensors communicating with a central processor to provide continuous real-time feed back and monitoring of a user’s condition.”

— Roy Garner