Profiles of Success

THE MATCHING GRANTS RESEARCH PROGRAM has helped scores of companies innovate amazing technologies. Here's a look at what six pioneering firms are creating across Florida's High Tech Corridor.

Simiosys
Virtual innovations for urban classrooms

RESEARCH ACROSS SEVERAL DISCIPLINES at UCF is leading the way to help teachers improve their performance and retain teachers in the urban classrooms that typically suffer the highest turnover. In an innovative blend of high tech meets low tech, sophisticated computer algorithms and basic human behavior are merging to create a tool that may revolutionize education.

Roughly 50 percent of teachers in urban schools quit within three to five years, according to the Haberman Educational Foundation, which focuses on educators who serve students at risk and in poverty. Most teachers blame the challenge of classroom management when leaving the field.

Located at the hub of the nation's modeling and simulation industry, the University of Central Florida was a natural place for the Haberman Foundation to seek partners for a novel solution to teacher attrition. The latest innovations developed in association with UCF's Institute for Simulation and Training (IST) and Media Convergence Laboratory (MCL) are being applied to create a new product called the STAR Simulator under a proposed Broad Agency Announcement award from the U.S. Department of Education (DOE). The prototype was developed with a Small Business Innovation Research (SBIR) grant from the DOE.

The Haberman STAR Classroom Management Simula-

tion mixes computer technology with a human role-player. "We're building a virtual classroom to train teachers how to manage a difficult class," says Chris Stapleton, president of Simiosys and founding director of the Media Convergence Lab. "We develop virtual students that act out key behaviors based on grounded theories of psychology in the classroom.

"The model for Simiosys is dependent upon university research in order to create a constant flow of radical innovation. In the product development, you need three key things from the university – next generation technology, techniques and talent. Without the new techniques and talent, technology transfer is like leaving a baby in a basket at the doorstep. It will not likely be adopted."

Simiosys is using students from the College of Education as instructional designers and subject matter experts to help understand the audience. The company also has engaged performers from the university's Interactive Performance Lab and computer science students to develop code, mixed reality engineering and sensors to track teacher movements.

"We're basically building a video game," says Stapleton, "and we need to make it robust and accessible. What we're trying to provide is a realistic student. So speech, body language and facial expression are very important. We had to create a theoretical framework for the automated students."

Reaching into the community, Simiosys asked a group of Advanced Placement interns from University High to develop a board game that would help the research effort figure out the mechanics of difficult student-teacher interaction.

"Now, these AP kids are great students," says Stapleton, "but you know they have it in them to act up! The game they came up with was 'Sink the Sub,' the objective being to undermine the substitute. This provided scripting for the virtual students. We have more scientific methods and flow charts, of course, but this process gave much more depth to the interplay, and made it feel more real."

Progress Energy
Storing the sun for later

WITH GROWING GLOBAL DEMAND to reduce carbon dioxide emissions, perhaps no area shows as much promise as harnessing the power of the sun. Progress Energy is collaborating with the University of South Florida on green, renewable technologies designed to meet the future needs of its power customers across the state.

"This research project will evaluate the effectiveness of storing solar energy for consumption during times of peak demand," says Christopher Gillman, manager of energy analysis and alternative energy for Progress Energy. "One limitation of solar energy is its on-demand availability. The efficient ability to store generation, including renewable generation, is critical to meet the future energy demands of our customers."

"The continued development of renewable energy is part of our balanced approach to meeting growing customer demand, and it will play a vital role in our energy future," says Jeff Corbett, Progress Energy Florida's senior vice president of energy delivery. "This system will allow storage of renewable energy for later use, when it is needed the most, such as very hot or very cold days. This partnership with USF will help enhance utilities' use of renewable energy, and it will also serve as an educational platform for USF students."

In addition to the environmental benefits of using solar power, a breakthrough in storage could impact consumers in

a number of ways, including lower cost, improved reliability and more efficient maintenance.

The USF research project is designed to deal with a solar energy challenge that most people wouldn't expect to encounter in Florida. Despite its moniker, "the Sunshine State" experiences frequent clouds and humidity, factors that make it difficult to consistently collect solar rays that can be converted into electricity.

"Specifically, we're evaluating the storage of intermittent solar photovoltaic energy," says Alex Domijan, Jr., Ph.D., professor of electrical engineering at USF and director of the College of Engineering's Power Center for Utility Explorations. "And using that energy at a time of maximum benefit to customers of utility power systems.

"The idea is, seeing if you can store the energy until a time you can use it. Peak demand is the most expensive energy. We're installing two solar power plants in downtown St. Petersburg," says Domajin. "One is on the USF campus and the other is a park across the street from Progress Energy's headquarters."

Domijan, who also serves as editor-in-chief of the *International Journal of Power and Energy Systems*, has been studying power generation for more than 20 years. "This is a pilot study with a small scale power plant," he says. "There will be ongoing research for the next few years, but we will have initial feedback within half a year, which will enable us to determine whether we can increase the size of the sites, and how beneficial this storage is."

"Professor Domijan has always been innovative in working with the utilities to advance energy technologies," says Gillman. "The results of this study are a first step into enhancing the potential for large scale solar, as well as traditional generated energy storage.

"Research partnerships between federal and state governments, universities and industry leverage the strengths of all to ensure cutting-edge technology can be examined, enhanced, and advanced to the marketplace," says Gillman. ●

Lockheed Martin
Cars with a mind of their own

CARS DRIVEN BY HEALTHY, capable human beings get into accidents all the time, so how can a vehicle successfully negotiate obstacles *without* a driver?

Lockheed Martin is sponsoring matching grant research at the University of Central Florida that intends to answer that question. "The need for an autonomous vehicle comes from the military," says Kevin Conrad, program manager for combat maneuver systems at Lockheed Martin. "In fact, Congress has mandated that a third of all ground combat vehicles will be robotic by 2015.

"We know the unmanned vehicles need to be able to conduct themselves safely around humans. They need to have self-security, be integrated with a squad, and act independently through teaming and collaboration. Each of these areas is fairly well understood; however, a vehicle being able to balance all of these elements and make decisions is *not* understood."

"Our project is to make the vehicle's operation autonomous – either ground or aerial," says Zhihua Qu, Ph.D., principal investigator on the project and a professor at UCF's School of Electrical Engineering and Computer Science.

"Our research focus for the past two to three years has been enabling the vehicle's capability to not only move to a specific target, but also to handle dynamically changing environments. For example, at a crossroads, this vehicle must be capable of making decisions. Should it stop, go straight, turn, and if so, how fast? As the car drives, its sensor collects information instantaneously and generates a new route. For example, maybe it needs to change lanes to go around a slower vehicle.

"The best example of this is the DARPA Urban Challenge," says Qu. Sponsored by the Defense Advanced

Research Projects Agency, the Urban Challenge is a prize competition for driverless cars. "What they're doing is, there are 20 driverless cars or so, and each has a route provided just a few minutes before the competition. The course simulates urban driving. Vehicles actually have to go off-road, park, etc.

"UCF has a car in the Challenge – and one of my students programmed a real-time, path-planning algorithm for 'Knight Rider' based on the research outcomes that were partially supported by Lockheed Martin," he says.

"In our research, we don't use the actual vehicle. Instead, we develop the algorithms, the code, and use 3-D visualization tools to demonstrate how it operates. Some of this research takes years to do, and the Corridor funding makes this possible," says Qu.

Says Conrad: "It's an opportunity to leverage cutting-edge research within the academic domain to accelerate fielding and proliferation of this technology." ●

BioEnergy LLC
Deeper shades of green

THE ENVIRONMENTALIST'S CREDO – reduce, reuse, recycle – has a strong proponent in BioEnergy LLC, which is conducting research at the University of Florida's Center for Renewable Chemicals and Fuel.

The company is working to produce clean, environmentally beneficial fuels and specialty chemicals from traditional starch-based feed stocks and cellulose, which is a chief substance in the cell walls of all plant tissue.

"We're very interested in green technologies, and applying them to the problem of global warming," says Joe Glas, BioEnergy's senior vice president of research and development. "There are three components to our business. Ethanol, which is produced from corn, provides the infrastructure that enables the other two pieces."

BioEnergy is building two plants, one in Pennsylvania and the other in Louisiana, to produce ethanol for the automotive industry. The widely reported oversupply of ethanol in fall 2007 does not impact those plans since the company already has sales contracts in place.

The fascinating part of the company's story is that it's taking advantage of an already green business plan to further conserve energy and reduce waste. BioEnergy hopes to find a more environmentally efficient feedsource for its ethanol biorefineries, and to use the byproducts to obtain chemicals that further reduce our nation's dependence on petroleum.

"Ethanol is a product of the fermentation process, similar to the fermentation process used in creating beer or wine, where cornstarch is converted to a simple sugar and then converted to ethanol by yeast," says Glas.

"In the long term, we want to use cellulosic materials from bio waste such as bagasse, which is what's left behind after extracting the sugar from sugar cane, for example, to replace corn as the sugar source – leaving high-value corn for food."

Along the way, Glas says, "we believe there are a number of important chemicals that can be produced there to replace petroleum. Currently, most chemicals are produced through crude oil or natural gas."

Leading the research at the University of Florida is Dr. Lonnie Ingram, director of the school's Center for Renewable Chemicals and Fuels and distinguished professor of microbiology at the Institute of Food and Agricultural Sciences. Ingram has worked for years to develop economically feasible forms of renewable energy.

He earned worldwide acclaim in 1991 when the U.S.

Patent Office singled him out for the nation's landmark five-millionth patent. The achievement? The ultimate in waste-to-worth recycling; using a harmless form of E.coli to convert biomass trash into a useful chemical. That patent has been licensed to Verenium Corporation, a leading developer of biofuels, but Ingram has obtained patents using E. coli to produce additional important chemicals, such as lactic and succinic acids, that have been licensed to BioEnergy.

Ingram says that lactic acid and other compounds from the fermentation process can be used to create plastics.

"Our organisms have not been put in any product yet, but they've been licensed and production is scaling up by commercial firms," says Ingram.

From a researcher's perspective, the grant has meant expanded options. "Primarily, it's given us the freedom to make changes in direction," says Ingram. "It demonstrates the state's commitment to high tech industry."

WiPower Inc.
Getting a charge out of wireless

IN RYAN TSENG'S FUTURE, freedom reigns. To be specific, it's freedom from the tangled clump of cables that connect our cell phones, laptops and other wireless devices to their all-important sources of power.

The president of WiPower Inc. is excited by the research his company is conducting at the University of Florida, where he first began studying the challenge of wireless power transmission in 2004, and later graduated with a degree in electrical engineering in 2006. WiPower has a patent pending on the technology for its universal, wireless charging system.

Several charging platforms have debuted since 2001, but consumers have yet to see wireless power-equipped devices hit store shelves. That's because device manufacturers have refused to adopt wireless power technology unless the systems meet stringent specifications.

Tseng's interest in the concept grew from his frustration with existing charging solutions and a desire to overcome an engineering challenge: "Everyone told me it was impossible!" he says. "Then, Professor Lin started pulling me in the right direction. The prototype illuminated a small LED in a dark lab, and even then it was so dim you didn't know if it (the light) was on or not."

Tseng's research blossomed into a business plan that ultimately won the university-wide competition sponsored by UF's Center for Entrepreneurship and Innovation. In 2006, he won the Inaugural Florida Collegiate Business Plan Competition, obtained investment backing and earned a $100,000 matching grant research award to build a wireless power transmission system designed to power virtually all consumer electronic devices.

"The matching grant took us from lighting that LED to charging laptops and other large devices and getting the technology to the point where we could talk to original equipment manufacturers," says Tseng.

What's important to the consumer is capacity, which is what allows you to charge a device quickly. Our charger can do this as quickly as corded chargers. And ours can charge devices as large as laptops, which is not typical."

Says Jenshan Lin, principal investigator of the research and Tseng's former professor in UF's department of electrical and computer engineering: "We have identified the issues and developed a few solutions, and we hope to be the first one demonstrating this."

Professor Lin is inspired by conducting research with such tangible potential results. "It gives us a strong motivation to work on it, knowing that eventually the technology we are developing will benefit millions of consumers, including ourselves," he says.

Magellan BioScience Group
Cures that come from the sea

THE OCEANS THAT COVER MOST OF OUR PLANET may hold a cure for one of the most pervasive and deadliest diseases on dry land. Researchers at the University of South Florida are working with Magellan BioScience Group to identify new marine sources for a drug to combat malaria, which the World Health Organization estimates infects 350 to 500 million people each year – killing one million.

The mosquito-borne disease occurs most frequently in tropical and subtropical climates, and 41 percent of the world's population lives in areas where malaria is transmitted, according to the U.S. Centers for Disease Control (CDC). While prescription drugs do exist to treat malaria, there is no vaccine, and since many of the most impacted countries are already among the world's poorest, the disease maintains a vicious cycle of disease and poverty.

"Malaria is the most important parasitic disease of man," says Todd R. Daviau, Ph.D., co-founder, president and CEO of Magellan BioScience Group. "It's a major cause of morbidity and mortality in tropical and temperate regions worldwide. The majority of deaths occur in children under the age of five, and pregnant women, in sub-Saharan Africa."

Magellan BioScience Group collects and studies marine microbes as a source for developing drugs to treat cancer, infectious diseases and inflammation. The company has collaborators in a variety of fields, including Memorial Sloan-Kettering Cancer Center in New York, one of the world's leading cancer facilities. Daviau believes his company's library of more than 10,000 marine microbes will be the next source of drug discovery for the pharmaceutical industry.

"We've collected microbes from around the world," says Daviau. "We typically collect sediment, sea water, sponges and other invertebrates. Isolating the bacteria from these sources is a long and laborious process that can take several months."

His company's research with USF is a multi-disciplinary study to identify novel anti-malarial drugs. The project teams Magellan BioScience with Drs. Dennis Kyle and Alberto Van Olphen in USF's College of Public Health, and Dr. Bill Baker in the university's chemistry department. The team will characterize lead candidates from Magellan's collection of marine-derived microorganisms by using bioassays, or scientific experiments that measure a substance's effect on a living organism. Once an interesting lead is discovered, the team will explore the molecule's chemistry to develop analog molecules to study how the activity of the drug is improved or affected.

Daviau hopes to discover a lead molecule for future development that is active against malaria. A chemist with several advanced degrees, Daviau worked for years in the pharmaceutical industry and has extensive experience separating, isolating and analyzing novel pharmaceutical compounds. His life-long love of the ocean and diving led him to graduate school at the University of Maryland's Center of Marine Biotechnology (COMB), where he met fellow grad student Dr. John Cronan. The two took different career paths, but kept in touch over the years and ultimately founded Magellan BioScience Group in 1997 to do consulting work and build upon their microbial collection. Cronan serves as the company's chief scientific officer.

"We continued to work full-time jobs and support Magellan while working nights, weekends and holidays in our garages," says Daviau. "We were one of the first tenants in the USF incubator, renting a small office where we could host meetings and meet potential clients. In 2006 we took the plunge and opened our own facility."

Taking the plunge has paid off for an entrepreneur who loves what he does and is inspired by his work. "It's a great feeling to wake up every day and know that you are doing something that you enjoy as well as something that has a long-term potential benefit to mankind," says Daviau.

An $84,000 matching research grant from the Florida High Tech Corridor Council is combining with Magellan's Phase I Small Business Innovative Research Grant (SBIR) from the National Institutes of Health (NIH) to create $350,000 in funding for the project.

"The obvious goal here is the discovery of a lead moleculer class of compounds to combat this deadly disease," Daviau says. "However, the real application lies in the ability of three independent research groups coming together for one purpose."