



FedEx
INSTITUTE OF
TECHNOLOGY
THE UNIVERSITY OF
MEMPHIS

2015
2014

Annual Report

“I love Memphis. It has an old soul.”

From the Interim Executive Director

“I love Memphis. It has an old soul.” This is a quote from a member of the FedEx Institute’s corporate advisory board. This might seem like an unusual way to introduce the annual report of a tech-focused organization. But our work at the FedEx Institute (FIT) matters because it contributes to future technologies that will improve the lives of people across the globe and because it has an effect on the city that so many of us love. We never lose sight of that local impact.



FedEx Institute of Technology
The University of Memphis
365 Innovation Drive
Memphis, TN 38152
memphis.edu/fedex

Editor
Cathy Carrigan

We celebrate the accomplishments from the past year that will continue our global and local impact. One of our most notable achievements is the opening last November of the Crews Center for Entrepreneurship (CCE). The CCE is off to a great start with workshops and weekend startup events. All students and faculty are invited to join our rapidly growing entrepreneurship community.

The technology licensing office, which is housed in the FIT, is responsible for commercializing inventions made by researchers from all across campus. Several new inventions are described on pages 12 and 13. We are proud that Educational Testing Service licensed a software tool developed by Drs. Art Graesser and Carl Cai in the Institute for Intelligent Systems and Department of Psychology.

One of our primary responsibilities is to carefully invest the funding provided by FedEx Corporation for translational research. Last year we were able to provide continued support to these inter-disciplinary groups: Center for Smart Biomaterials, Center for Translational Informatics and the chemical sensors group called Sensorium. The Center for Technology and Research in Alzheimer’s Care (CTRAC) is the newest group to be funded by FedEx’s gift. CTRAC, which will be led by nursing professor Sunghee Tak, Ph.D., will develop and test software tools to assist Alzheimer’s patients and their care-givers.

A key role of the FIT is to broaden the connections between the university and the community. At the Memphis Research and Innovation Expo last October, the university’s incredible range of research capabilities was on display along with innovations from local companies. This set the stage for interaction and rich conversation between creative people from a multitude of research disciplines.

The birth of the Memphis Innovation Bootcamp (MIB) is another successful program from the FIT. We bring together organizations with real-world challenges and a skilled collection of experts. This collaboration creates compelling points of view for addressing problems and opportunities. The ultimate goal of the MIB is to increase the number of innovators in Memphis.

Please watch our website and CONNECTIONS newsletter for updates on all of these FedEx Institute programs and how they are helping make Memphis the place with an “old soul” and an exciting future.

— Kevin Boggs

Support from FedEx Corporation

We would like to express our gratitude to FedEx Corporation for their significant support. This is the ninth consecutive year that FedEx has given the FedEx Institute the vital resources that allow us to invest in technology commercialization, corporate engagement and entrepreneurship programs. These combined efforts enhance the university's capacity to affect the economic growth of our community. We would like to thank Rob Carter and the leadership team at FedEx for their continued confidence and commitment to the FedEx Institute.

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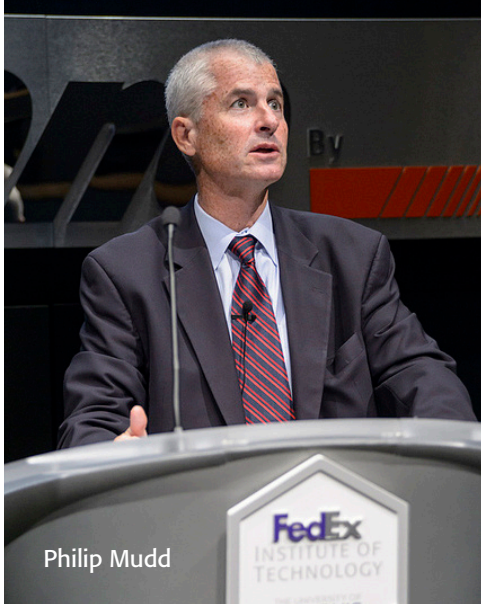
The FedEx Institute Celebrates 10 Years

The FedEx Institute held a "birthday" party on November 19 to recognize the opening of the building 10 years ago. Students, faculty and staff were invited to stop by for a slice of birthday cake and enjoy entertainment provided by the Rudi E. Scheidt School of Music.



Memphis Research and Innovation Expo

The FedEx Institute hosted the 3rd Memphis Research and Innovation Expo on October 3. More than 400 people visited the expo which provided the opportunity for leading local scientists to explain their research, innovations, and creations. The FedEx Institute lobby was filled with 26 booths, with many offering attendees a hands-on, interactive experience. In addition to University of Memphis departments and colleges, local research-oriented companies were present including Buckman, Smith & Nephew, and St. Jude Children's Research Hospital. Two speakers were on the morning agenda. Former FBI and CIA counter terrorism expert Philip Mudd spoke about risk management and how it parallels the work of federal agencies tasked with countering risks to the U.S. from terrorist organizations. Procter & Gamble CEO A.G. Lafley talked about business strategy and shared examples from his experiences at P&G including the decision to divest all their food businesses. The afternoon session featured a panel of local entrepreneurs who discussed issues such as strategic partnerships, raising capital and business plans in launching a high-growth startup.



Philip Mudd



A. G. Lafley



Crews Center for Entrepreneurship

The Crews Center for Entrepreneurship (CCE) is dedicated to helping University of Memphis students and faculty commercialize their ideas, inventions, and research through early-stage entrepreneurship. The facility features a conference room, prototype development lab, and dedicated office for Entrepreneurship MBA students on the first floor while a co-working space encompasses the entire second floor.

On November 21, approximately 150 guests from the university and the community attended the grand opening of the CCE. U of M interim president Brad Martin spoke at the event and stressed the importance of entrepreneurship and how it brings together all the resources of the university. Other speakers included Ben Bryant, executive-in-residence of the FedEx Institute, Brian Summerhill, a student entrepreneur, and Hilliard Crews whose generous gift helped make the Crews Center possible. Additional donors include the First Tennessee Foundation,



Mitchell and Janet Spurlock, Jim and Ann Vining, Glen and Sherry Herald, Reynolds, Bone & Griesbeck, Mitch and Lynn Lewellen, Farris Bobango, Rick and Sandy Spell, Ben Bryant, Triumph Bank, Lisa and John Bobango, and Gil and Sybille Noble.

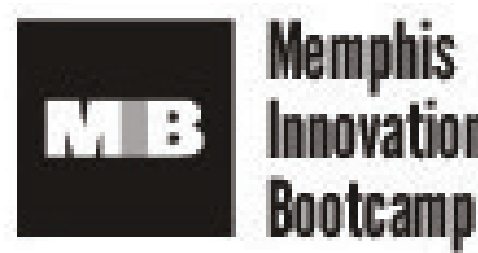
During the spring semester, the CCE held sessions on "How to think like an entrepreneur" and "Social media strategies for entrepreneurs". The CCE also hosted IDEAS Weekend, a 3-day event where students pitched new ideas and created startups around those ideas in competition for a \$1000 cash prize. The Crews Center is a program of the FedEx Institute.



Center for Smart Biomaterials

The Center for Smart Biomaterials has been developing new implantable materials that can release a drug “on-demand” by clinicians, using a noninvasive external stimulus. These implants can deliver drugs locally, directly to injured or affected tissue, which avoids the common problems of toxicity and dosing scheduling that are common when drugs are injected or ingested orally. Currently available local delivery implants for antibiotics, such as bone cement beads and calcium sulfate pellets, have many drawbacks including poor degradation, burst release of drug, and short time period of release. The “smart” implants will incorporate polymer systems, stimuli-responsive nanoparticles, and pharmaceutical agents

to create a system that can be delivered through injection, deliver the appropriate amount of drug at the location and time that it is required, and then degrade within the body. The research team is exploring different methods of fabrication, characterizing the material properties, and evaluating release of dye to model drug release. Among the external stimuli that are being explored are electrical pulses, magnetic fields, and ultrasonic energy. The multidisciplinary team of physicists, polymer chemists, electrical engineers, and biomedical engineers has found that by varying the formulation of implants and by using specific strengths of electrical stimuli, release of dye from the implants can be controlled. These systems can be used to deliver antibiotics, pain medications, and protein growth factors, among other agents to improve medical treatments and patient healthcare outcomes. The research team includes Drs. Warren Haggard, Sanjay Mishra, Tomoko Fujiwara, Amber Jennings, Joel Bumgardner, and Bashir Morshed.



Memphis Innovation Bootcamp

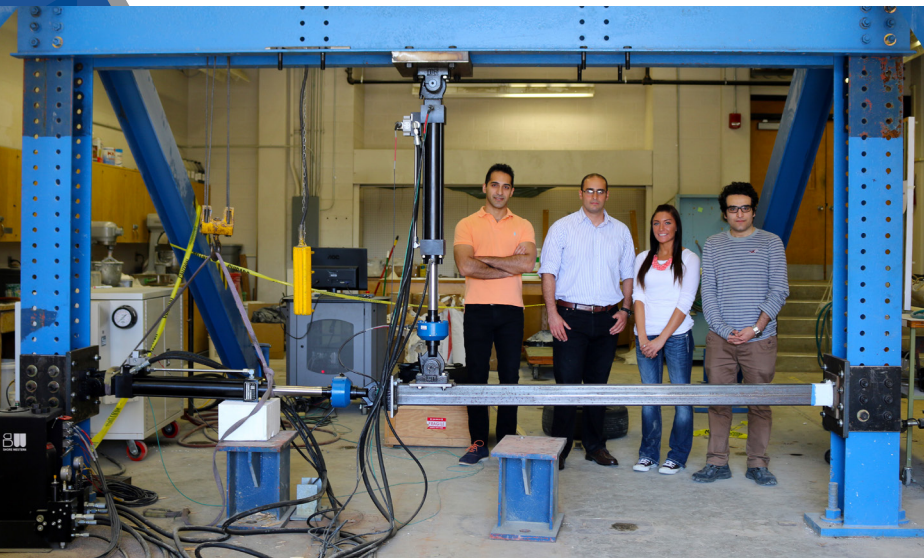
The Memphis Innovation Bootcamp (MIB) was held in November and March with over 40 participants at each session. An eclectic collection of experts from the academic, arts, scientific, and corporate arenas served as facilitators. During the 3-day MIB, participants learned about the human-centered design principles of empathetic data collection, how to create compelling points of view to address problems and opportunities, ideation, fast-cycle prototyping with constant customer interaction, and how to learn quickly from failure. These principles were applied to a hands-on design challenge, a real-world problem that could benefit from the collaborative and innovative energies of the MIB teams. They took on the design challenge of re-imagining the daytime Beale Street experience and then presented their ideas to an executive panel. The goal of the MIB is to increase the number of innovators in Memphis. The MIB is a program of the FedEx Institute.



Multi-Axial Testing and Simulation Facility

The Multi-Axial Testing & Simulation (MAT-SIM) facility is used to conduct experimental tests on specimens that represent structural components of buildings and bridges that are prone to natural and man-made hazards, such as hurricanes, earthquakes, and explosions, in order to assess their performance, improve their design and increase their safety.

Catastrophic events have had devastating consequences on society in terms of damaged infrastructure. In order to build a safer environment, the performance of vulnerable structures to earthquake shaking has to be well understood. Current design specifications and existing numerical models may not be adequate to fully represent the complicated behavior of structures subjected to complex earthquake loading conditions. Therefore, there is a pressing need to evaluate the performance of these structures in the laboratory.



The special features of the MAT-SIM facility have been deliberately designed with the objective of mimicking the “real” boundary and loading conditions imposed on tested structural components as if these components are in the building in the field. The emerging hybrid simulation testing technique is utilized to achieve this objective.

The MAT-SIM facility includes two linear actuators capable of imposing any displacement and/or force on structural components. The tests conducted by these actuators could be displacement control, force control or both displacement and force control. The facility is equipped with a strong reaction steel frame which enables testing of full-scale sub-structures. The frame can handle high static and dynamic forces with minimal/negligible deformations. The actuators are mounted to the strong frame at one end and to the tested specimen at the other end. The strong reaction frame provides almost infinite stiffness and strength and enables testing of stiff specimens of high force capacities. The FedEx Institute provided funding for the actuators, pump, controller, and data acquisition system.

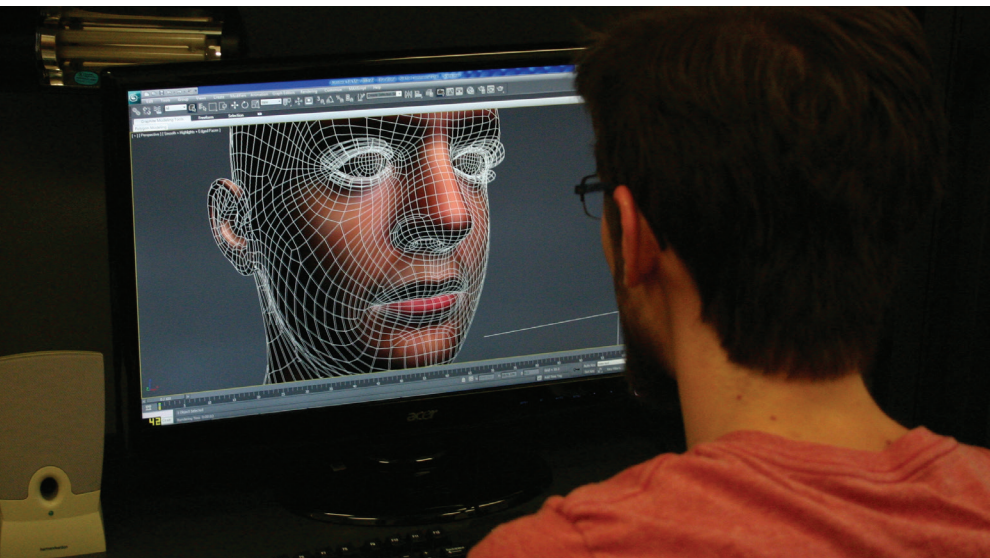
Additional projects in the MAT-SIM facility include testing of a new type of steel connection that would absorb damage in structures, research on the construction of more sustainable buildings with lower carbon footprint, and a study of the seismic performance of precast segmental bridge columns that will be implemented and used in new highway bridges in Tennessee. Dr. Adel Abdelnaby, assistant professor in the Civil Engineering Department, oversees the MAT-SIM facility.

Institute for Intelligent Systems



The Institute for Intelligent Systems (IIS), which is housed at the FedEx Institute, is a research center officially recognized by the Tennessee Board of Regents (TBR). Since its inception in 1985, the IIS has dedicated itself to advancing the state of knowledge and capabilities of intelligent systems, including psychological, biological, and artificial systems. By conducting cutting-edge research and publishing their findings in peer-reviewed venues, IIS contributes to the science and, ultimately, to the public. In doing so, they are also training the next generation of scientists.

This past academic year, IIS made significant progress toward their objectives. IIS has grown to 39 members from a diverse 13 departments. These researchers were awarded \$3.7 million in new grants and published 291 papers in peer-reviewed journals.



FITKids

Memphis FITKids is a web-based tool that helps parents understand and reduce their children’s risk of obesity by making healthy changes. FITKids was developed through the support of the FedEx Institute, and Blue Cross Blue Shield’s Tennessee Health Foundation which awarded a three year demonstration grant to launch FITKids in the Memphis community. Parents will be able to access FITKids through interactive kiosks in Memphis Public Libraries, the Pink Palace Museum, and the YMCA. Parents can also access FITKids through their personal computer or iPad. The tool is easy for parents to use. They provide their child’s height, weight, age, and gender and then answer questions related to their family’s eating and activity habits. The tool gives parents personalized recommendations on how to make lifestyle changes to reduce risk and support healthy behaviors. FITKids was conceived by Drs. Ken Ward and Lisa Klesges from the School of Public Health and Dr. Ramin Homayouni, director of the Center for Translational Informatics.



Center for Information Assurance

Dr. Dipankar Dasgupta and the Center for Information Assurance (CfIA), which is housed in the FedEx Institute, will receive part of a 3-year, \$800,000 grant from the Federal Emergency Management Association. CfIA will join forces with the University of Texas at San Antonio



Center for Infrastructure Assurance and Security and the University of Arkansas System’s Criminal Justice Institute on research into helping states and communities better prepare for, detect and respond to cyber attacks. The funding will support development of a new training course and the updating of five existing ones through establishment of the National Cybersecurity Preparedness Consortium. The Texas A&M Engineering Extension Service and the Norwich University Applied Research Institutes will also be part of this group.

Dr. Dipankar Dasgupta

Center for Technologies and Research in Alzheimer’s Care

The Center for Technologies and Research in Alzheimer’s Care (CTRAC) is a new multidisciplinary research center committed to research and development of innovative technologies to improve the health and quality of life of persons and families with Alzheimer’s disease and other dementias. Partners include Alzheimer’s Association local chapter, Baptist Memorial Hospital Memory Care Clinic, Aging Commission of the Mid-South, and Alzheimer’s Day Services of Memphis. In response to the recent national plan to reduce the devastating



Dr. Sunghee Tak

impact of Alzheimer’s and other dementia on patients and families, Dr. Sunghee Tak from the School of Nursing is collaborating with a core group of U of M faculty with significant expertise in the relevant technical areas: Dr. Bashir Morshed (Electrical and Computer Engineering), Zhiqiang Cai (Institute for Intelligent Systems), Dr. Gavin Bidelman (Communication Sciences & Disorders), Dr. Art Graesser (Psychology), and Dr. Satish Kedia (Public Health).

The FedEx Institute has provided funding for CTRAC. Major research activities of the center include:

- Development of an automated and adaptive software system that assists persons with Alzheimer’s or cognitive impairment in performing computer activities and games
- Explore the feasibility of an innovative new flexible neuro-sensing micro device for continuous tracking of cognitive neurological changes
- Test the effects of a therapeutic computer-assisted stimulating activity program on cognitive and behavioral improvement in persons with Alzheimer’s disease and other dementia.

With an increase in the aging population and persons with Alzheimer’s disease, care technologies have tremendous potential to impact the lives of patients and their families.

Office of Technology Transfer

The Office of Technology Transfer (OTT) works closely with University of Memphis faculty researchers to identify commercially-valuable inventions being developed in their laboratories. OTT hosted a Lunch and Learn in the spring to review intellectual property basics for researchers and graduate students.

Since OTT opened in 2008, it has received 110 invention disclosures, filed 156 U.S. provisional, utility and foreign patent applications, received 16 issued U.S. patents, and signed 11 licenses and exclusive options. Also during the past year, OTT submitted 15 patent applications, was granted 4 issued patents and received 12 invention disclosures from our faculty.



OTT finalized an intellectual property license to Educational Testing Service. The license is to a software-based educational tool initially used for research. It was invented by Drs. Art Graesser, Xiangen Hu and Zhiqiang Cai of the U of M Department of Psychology. If the tool shows promise in early testing, ETS has the right to develop it as a product in the education market.

Inventions of Note

“Synthesis of Iron Oxide-gold Core-shell Nanoparticles in Different Shapes” invented by Dr. Saheel Bhana and Dr. Hiaohua Huang, Department of Chemistry. Hybrid nanomaterials possessing dual magnetic/optical properties are of considerable interest to many areas, ranging from material science to medicine and biology. They are promising for a broad range of applications including medical diagnosis and treatment. A key advantage of these particles is that they can be made into a wide variety of non-spherical shapes. This allows them to be detected at incredibly small concentrations. This, in turn, may allow them to be used to detect single cancer cells in a blood sample.

“Efficient FIB Caching Using Minimal Non-overlapping Prefixes” invented by Dr. Lan Wang, Associate Professor and Yaoqing Liu, Research Assistant, Department of Computer Science. This technology has the potential to save money for internet service providers by reducing their need to buy, maintain and constantly upgrade expensive memory cards in internet routers.

“Wireless Analog Passive Biosignal Sensors” invented by Dr. Bashir Morshed, Assistant Professor and Sergi Consul-Pacareu, Research Assistant, Department of Electrical and Computer Engineering. This technology will be the basis of unpowered and wireless sensors that can be worn by patients, athletes or anyone wanting to monitor a variety of body functions. The researchers are refining the technology to reduce the size and improve the adaptability of the sensors.

“Compositions and Methods of Modifying Chitosan” invented by Dr. Joel Bumgardner, Professor and Greg McGraw, Graduate Student, Department of Biomedical Engineering and Dr. Carl Bumgardner, retired. The inflammatory and wound healing response to implanted devices and materials are critical to their clinical success and function. The ability to promote healing has the potential to impact and enhance the success of many implanted biomedical devices, drug delivery systems and tissue engineering/regenerative medicine strategies. This novel material with new/enhanced anti-inflammatory properties may be advantageous to improving the healing response and clinical performance and function of many biomedical implant devices and materials.

“Material Comprising Capped Chitosan Nanofibers” invented by Dr. Joel Bumgardner, Professor and Hengjie Su, Graduate Student, Department of Biomedical Engineering; and Dr. Tomoko Fujiwara, Associate Professor, Daniel Abebe, Graduate Student and Kwei Yu Liu, Graduate Student Department of Chemistry. This invention will support healing and formation of tissues by helping to prevent overgrowth of fast healing soft tissues into areas of more slowly healing tissues such as bone. The novel material it is made from is biocompatible and biodegradable so once tissues are regenerated and healed, a second surgery to remove the membrane is not needed.

Issued Patents

Systems, Methods, and Computer-Readable Media for Detecting and Prediction a Progression of Retinal Pathologies
U.S. Patent 8,632,186
Khan Iftekharuddin
Pinakin Gurnvant Davey
Kim Young

Nanothin Polymer Films with Selective Pores and Method of use Thereof
U.S. Patent 8,519,015
Evgueni Pinkhassik
Benjamin Clayton
Larry Banner
Delia Danila

Spatially-Selective Reflector Structure and Systems and Methods for Use Thereof
U.S. Patent 8,508,592
Eddie Jacobs
Thomas Layton
Orges Furxhi

Pipemidic Acid Derivative Autotaxin Inhibitors
U.S. Patent 8,497,371
Abby Parrill
Daniel Baker
Adrienne Hoeglund

Tidbits

- Kevin Boggs and Art Graesser attended an “Interactive Technology and Innovation Discussion” at FedEx World Headquarters. Speakers included FedEx Chairman Fred Smith and Dean Kamen, President of DEKA Research and Development Corporation and Inventor of the Segway.
- The FedEx Institute was a sponsor of the 6th Cyber Security Expo held last fall.
- The FedEx Institute donated funds for the individual paper awards and the naming contest for *QuaesitUM*, the journal of undergraduate research papers.
- Four new posters showcasing the Center for Information Assurance are on display on the 3rd floor of the FedEx Institute.



- Dr. Ramin Homayouni, associate professor of biology and director of the Center for Translational Informatics (CTI), received a grant from the prestigious Bill and Melinda Gates Foundation that was made possible, in part, by initial funding from the FedEx Institute. The Gates-funded project will explore the use of modeling approaches developed by the CTI for analysis of malnutrition and growth stunting in children across the globe.

- New videos highlighting the School of Public Health and the Department of Anthropology are featured in the lobby of the FedEx Institute.

- Kevin Boggs gave the welcome address at the Business Growth and Procurement Summit (BGPS) which was hosted by the City of Memphis in partnership with the University of Memphis. BGPS was held at the FedEx Institute and was designed to expand awareness about upcoming business opportunities with the city as well as other partner agencies.

- A study on cellular clock genes that could help scientists find new drugs to reset metabolic clocks and regulate sleep was published in *PLOS Genetics*. The research team was led by Dr. Andrew Liu, assistant professor of biology. The study was funded in part by the FedEx Institute.

- Kevin Boggs gave the welcome address in The Zone at the FedEx Institute to the Council of State Governments Entrepreneurship Days event hosted by Senator Mark Norris.

- Researchers from Biomedical Engineering and the University of Tennessee Health Science Center (UTHSC) are collaborating to optimize the effectiveness of evaluation and treatment of motor dysfunction caused by orthopedic disorders. The Motion Capture Laboratory at UTHSC was funded in part by the FedEx Institute.



Motion Capture Lab

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