WELCOME TO THE SMART FUTURE

2016-2017 ANNUAL REPORT

FedEx Institute of Technology

The University of Memphis

WHAT IS *SMART?*

As an acronym, SMART stands for Self-Monitoring And Reporting Technology. But the word has come to mean much more. Smart homes don't just report: they give you remote control. We have smart devices that connect to other devices and networks to enhance access and information sharing. Smart vehicles drive themselves. Smart cities use multiple forms of information and communication technology to plan and manage city assets and enhance quality of life.

Smart is connected, predictive, proactive and efficient. Smart saves energy, time, labor and money. Smart promotes healing, deepens understanding and increases security.

Ultimately, smart empowers each of us, our companies, our communities and our governments to thrive in a world where social, environmental, and economic challenges are ever changing.

With a unique interdisciplinary research network, strong corporate connections, and an ongoing commitment to community outreach, the FedEx Institute of Technology stands at the doorstep of the smart future. And we're eager to usher you in.

Emerging Technology, Converging Innovation

Research sometimes can appear to be a rarified and lonely pursuit. The odds of a breakthrough can be long. The fruit of the labor difficult to reach. Advanced research can be so narrowly focused that the layman may not be able to see the impact it could someday have in real world applications. For these reasons, we have sought in this year's annual report to show just how the interdisciplinary research clusters we support create a vibrant energy that ripples across campus, throughout the Memphis area and beyond. You'll see how they complement each other in profound ways, how innovation and advancement in one area can converge with that of another to create far-reaching and transformative changes in health care, urban living, sustainability, environmental stewardship, business and commerce, and other key aspects of life.

This point of convergence is what we're calling the Smart Future, a digitally-driven transformation that is giving us the tools we need to solve complex problems, from crime and disease to cyber theft and pollution.

It's an exciting time for the Institute, made even more so this year by the addition of our newest innovation research cluster–Smart Cities. It joins the Cluster for Advancement in cyber Security and Testing (CAST); the Biologistics Research Cluster; Drones, Robotics and Navigation-Enabled Systems (DRONES); Mobile Sensor Data-to-Knowledge (MD2K); and the Institute for Intelligent Systems.

Smart Cities is making a strong contribution straight out of the gate and fills a real need for research that's focused on using smart technology to connect people with their communities, improve our cities, enhance health care, and more.

We seed-funded 37 exciting new research projects in 2016–17, involving 53 faculty researchers from 15 departments across nine colleges and schools across campus.

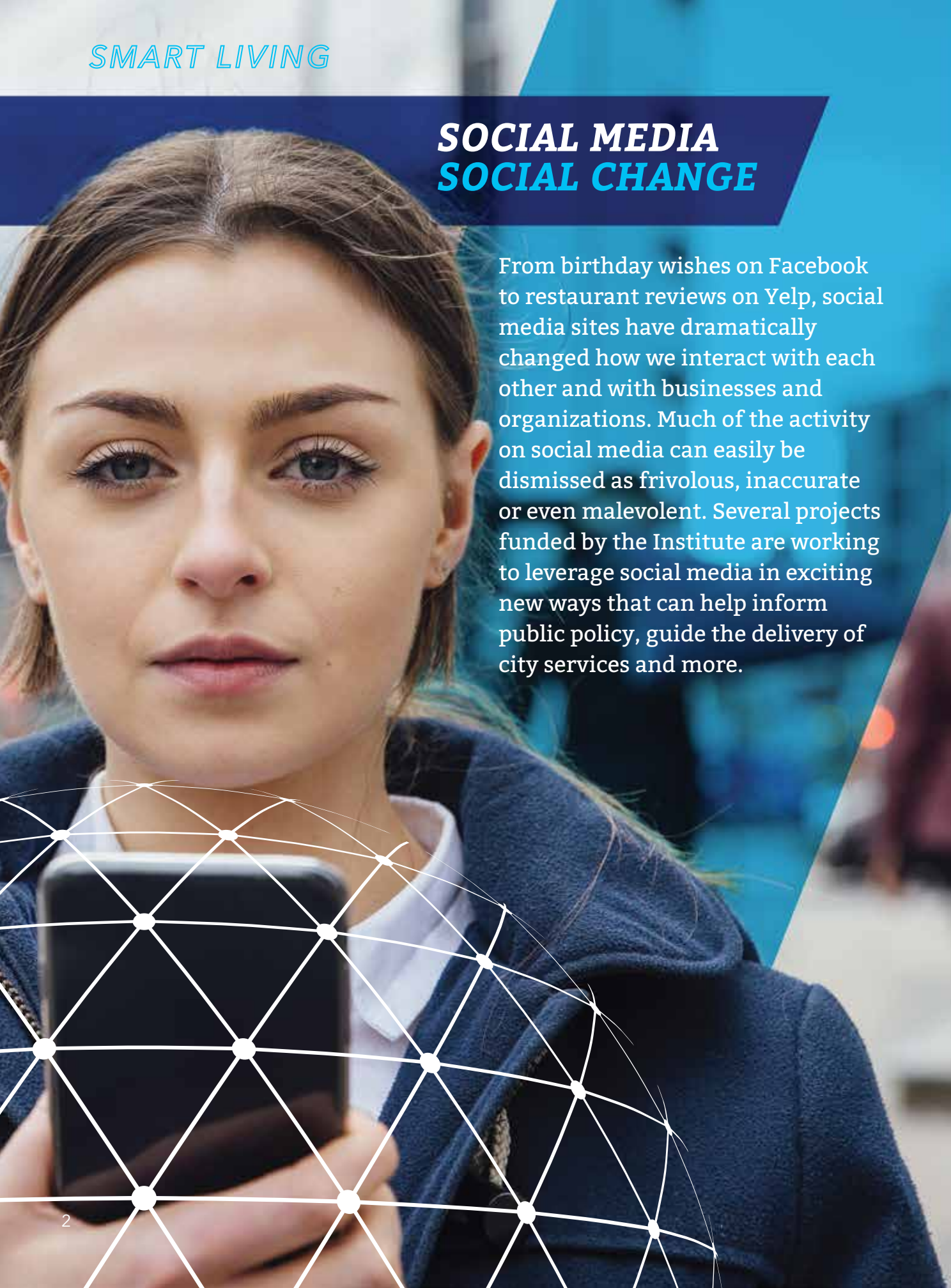
Of course, supporting ground-breaking research is just one part of our mission here at the Institute. We also serve as a hub for the exchange of knowledge and the advancement of business and government in the region, providing the educational resources for meetings, workshops and other events. We work with our primary research sponsor, FedEx Corp, as well as other corporate partners, to explore, develop and disseminate innovative thinking across the Mid-South.

As the Institute leads Memphis into another year of exciting innovation and technology advancement, we thank those who have partnered with us and look forward to building new relationships to forge an innovative future for our city. Welcome to the Smart Future.

Jasbir Dhaliwal, PhD.
Executive Director
FedEx Institute of Technology

SOCIAL MEDIA SOCIAL CHANGE

From birthday wishes on Facebook to restaurant reviews on Yelp, social media sites have dramatically changed how we interact with each other and with businesses and organizations. Much of the activity on social media can easily be dismissed as frivolous, inaccurate or even malevolent. Several projects funded by the Institute are working to leverage social media in exciting new ways that can help inform public policy, guide the delivery of city services and more.



Make it go away

It's an unfortunate reality. Cities have a difficult time knowing what their citizens want or need until they complain. Many crimes go unaddressed because they are never reported. Service issues often take weeks or longer to resolve, simply because no one filed a formal complaint. We do have 311. It allows Memphians to call in and request services, such as curbside debris pickup. But what if the city could know sooner about existing blight, litter and crime?

Drs. Leah 1 and Alistair 2 Windsor of the Institute of Intelligent Systems and the Smart Cities innovation research cluster are exploring how social media can play a role.

"Because there is a lack of formal reporting, citizens feel like their needs are not being met," explains Leah Windsor. "So they turn to social media like Twitter to alert friends and neighbors about local problems."

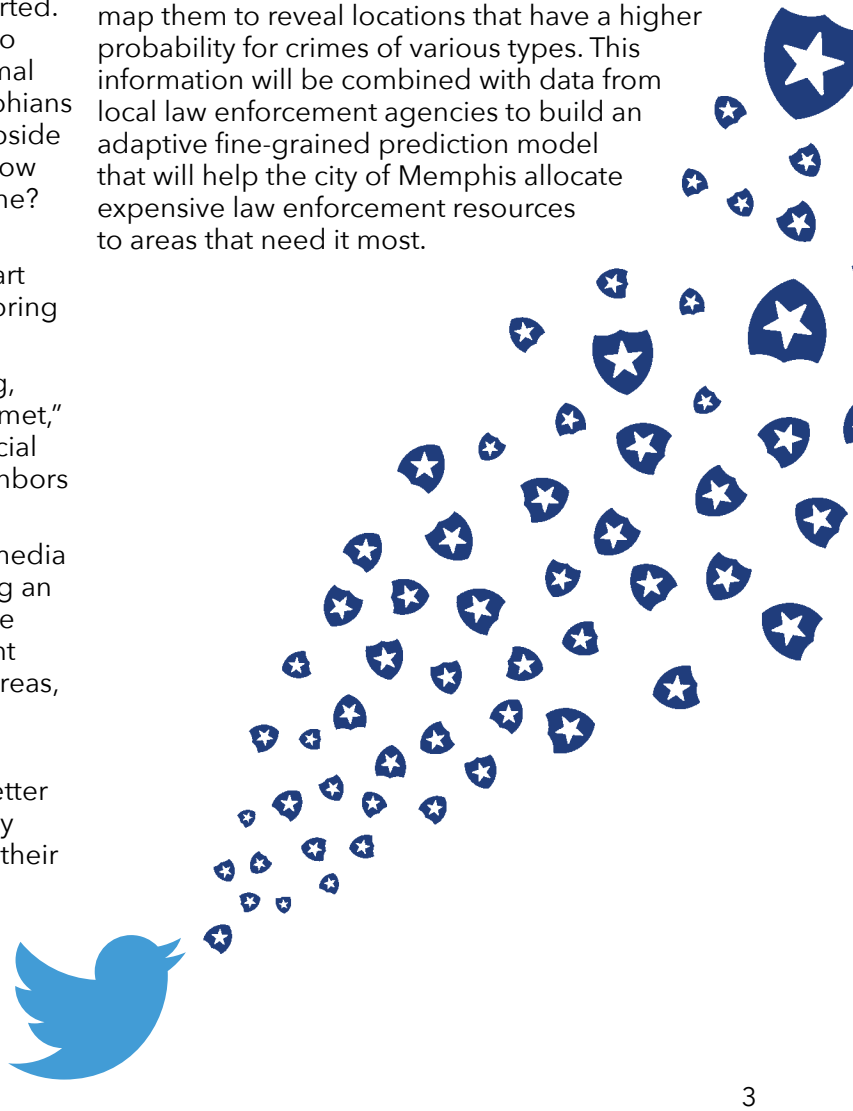
The Windsors are probing existing social media outlets with the hope of eventually building an automated tool that can collect and analyze information from these sites to detect latent problems, reveal patterns in problematic areas, and track emerging patterns in new areas.

With that kind of information, says Alistair Windsor, "Community resources can be better allocated, increasing government efficiency and improving the citizens' relationship to their neighborhoods and their city officials."

Crime in the tweets

The Windsors aren't the only researchers who are trying to tap into the predictive power of social media. Dr. Deepak Venugopal 3 of the Smart Cities Cluster says Twitter has more than 100 million users generating more than 300 million tweets each day. Subject matter covers a wide range of topics, and he believes these messages can be mined for information that can help our communities fight crime. According to Venugopal, Twitter data has already been used successfully to predict election outcomes, predict disease outbreaks (such as the spread of flu in a specific community), and more. "Why not use it to predict crime?" he asks.

Venugopal's goal is to build an information extraction system that can assess a wide variety of tweets, from crime reports by news agencies to tweets expressing hate or other emotions related to destructive and violent behavior, and map them to reveal locations that have a higher probability for crimes of various types. This information will be combined with data from local law enforcement agencies to build an adaptive fine-grained prediction model that will help the city of Memphis allocate expensive law enforcement resources to areas that need it most.



Face to Facebook

Another way to find out how citizens think and feel is to ask them. That's the idea behind the traditional public opinion poll. However, according to Dr. Michael Sances 4, also of the Smart Cities Cluster, traditional phone polls aren't just old-fashioned; they are cost prohibitive for city governments.

"Yet knowing how citizens feel about key issues can make all the difference in delivering services and increasing quality of life for residents," he says.

Sances' tool of choice? Facebook. More specifically, the Facebook Ads platform, which enables a city to create targeted advertising for an online poll. According to Sances, Facebook estimates that 490,000 Memphians are reachable via Facebook, or about 75 percent of the 2015 population.

"The potential for responses is high compared to conventional phone polls," he says. "The viewer sees the ad, clicks on it, and is taken to a questionnaire. It's targeted. It's affordable. And it holds a lot of promise for success."

The study will compare the results and the costs of the online polling with those of previous phone polls conducted by the city of Memphis.

Online reviews, off-track responses

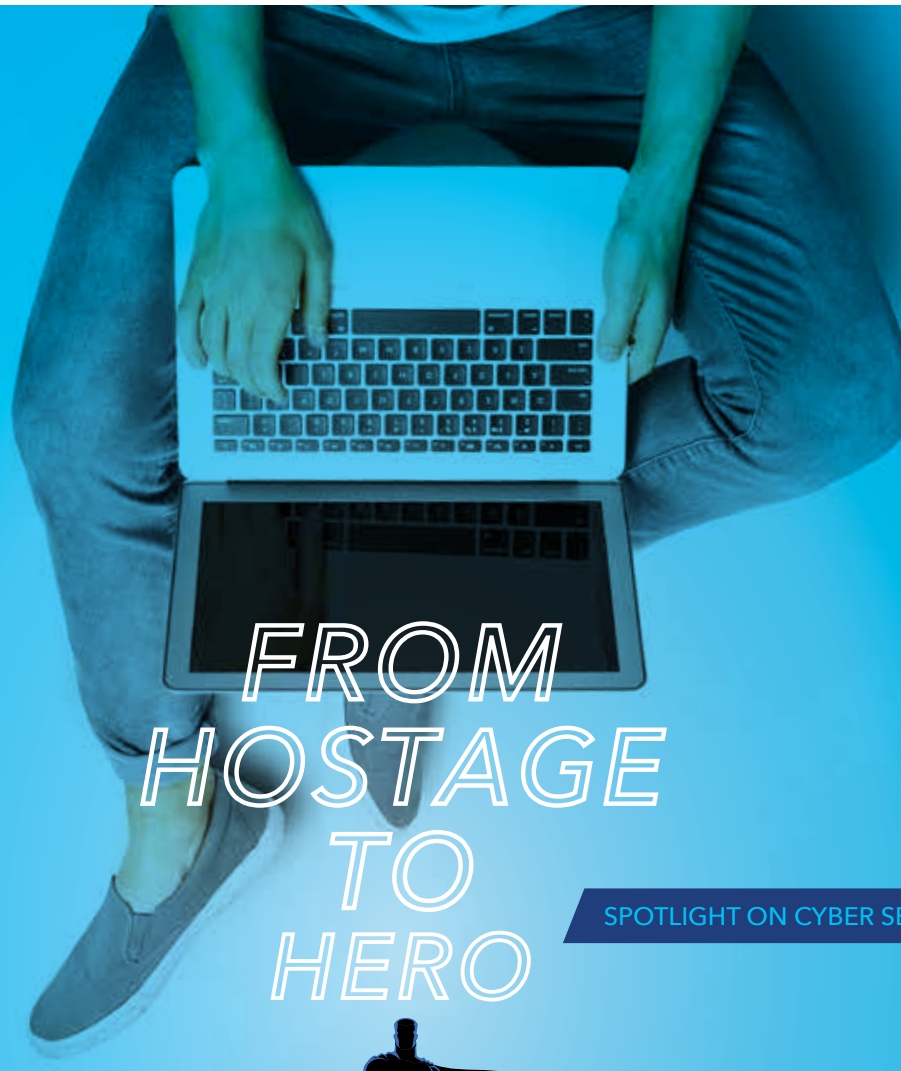
Cities aren't the only ones needing to know what people think. Businesses and their customers do too. Thanks to online review platforms, such as Yelp, we can see how others feel about products and services. These opinions can guide businesses to improve and help consumers make good choices.

But what about the sincerity and accuracy of the responses businesses provide? Drs. Naveen Kumar 5 and Deepak Venugopal 3, working within the cybersecurity cluster CAST, are studying the automated response behavior of business owners.

"Our goal is to use machine learning to detect anomalies in these responses," Venugopal says.

Machine learning involves the ability of a computer to recognize and "learn" patterns so that anomalies or outliers can be flagged.

"The benefits are three-fold," Kumar says. "Consumers can have more confidence that the responses they get from businesses are genuine. Online platforms can improve their credibility and reputations. And business owners can better understand the potentially damaging effects of responding ineffectively to online reviews."



FROM HOSTAGE TO HERO

SPOTLIGHT ON CYBER SECURITY

Ransomware has been in the news a lot lately as governments, corporations and individual computer users grapple with how best to protect themselves from those who want to take their data hostage. Drs. Dipankar Dasgupta[6] and Bo Chen[7] of CAST say paying the ransom doesn't guarantee you'll get your data back. "And even worse," says Chen, "it encourages ransomware makers to improve their attacks."

If computer users periodically back up their data using external storage media or public cloud services, ransomware attacks aren't an issue. However, says Dasgupta, "Because people don't think it will happen to them, or because it takes time, effort, and money to back up data to another drive or the cloud, many people don't bother."

The results can be disastrous with companies and individuals having to choose between the difficult and often fruitless attempt to recover encrypted data or paying hundreds or thousands of dollars in Bitcoin, the untraceable cyber-currency.

Chen and Dasgupta's goal is to make backup easier by developing a self-contained backup system. Chen says, "*The idea is to use free space on the computer, itself, to store backup data and disguise it using special isolation techniques and cryptographic secrets so that it can't be detected by the ransomware.*"

Such a solution will significantly reduce the risk of ransomware attacks, potentially saving companies millions of dollars in lost time and productivity, not to mention the ransom money they will no longer be tempted to pay.

GETTING FROM POINT A TO POINT B AND FROM SICK TO WELL

One area of health care that is changing rapidly today is biologistics: the transporting of blood specimens, human tissue, organs and other fragile and temperature-sensitive materials long distances for analysis, diagnoses or transplant. The interdisciplinary research clusters supported by the FedEx Institute of Technology are hard at work developing improvements to advance this critical step in the health care process.

Handle with care

Successful biologistics start with the packaging material itself. Dr. Firouzeh Sabri 8 and her team in the Biologistics Research Cluster are continuing to make progress on developing special packaging made out of *aerogel*: a synthetic, ultralight material with strong thermal insulating capabilities that can insulate cold chain shipments better while protecting contents against the shocks of travel.

Still, once the shipment arrives at the lab, how can doctors be sure it hasn't been compromised by temperature changes, contamination, or other forces? Dr. Sabri is working on that too, developing low power, wireless sensing gear that can be placed in the package to track pressure, humidity, vibration and most importantly, temperature.

"The cold chain supply industry is facing tighter regulations by the government," says Sabri, "and a key parameter that needs to be continuously monitored and recorded with a high degree of accuracy is the storage temperature of the shipped goods during transit and upon delivery."

Sabri says this research also has exciting applications for drones that can be employed to carry emergency services and sensitive cargo in extreme conditions.

Batteries included

Of course, all this on-board monitoring and recording equipment must be powered. That's why Dr. Sanjay Mishra 9 of the DRONES cluster is leading the research and development of nanobatteries: small, light, and long-lasting energy sources that can reliably power sensors throughout the journey.

More specifically, Mishra is pursuing an oxide-based energy storage device.

"It has nanostructured electrodes that are energy dense," he says, "to provide reliable, long-lasting power to climate-controlled packaged specimens, tissue samples and more at a low cost and with a reduced environmental footprint."

Scaling up cancer detection by scaling down the equipment

Getting the specimen to the lab is one way to go about screening. But when it comes to early cancer detection, Dr. Prabhakar Pradhan 10 of the Biologistics Cluster has a different idea: ship the screening technology.

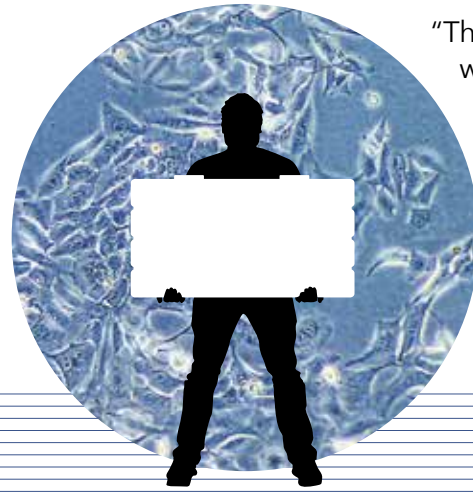
The earlier cancer is detected, the better. However, the equipment used to detect nanoscale alterations in cells that indicate early carcinogenesis is the enhanced particle wave spectroscope (EPWS), a very large and cumbersome piece of equipment. Not every facility has one. So for facilities without this technology but in need of cancer cell screening, cells must be collected from the patient, fixed and preserved, and shipped carefully in a temperature-controlled package.

"The shipping and handling of cell samples can result in compromised cells that can affect the outcome of the screening or prevent screening entirely," says Dr. Pradhan.

That's why he and his team are working to perfect a smaller, portable tabletop version that can be easily shipped to where it's needed.

"The challenge is to make the EPWS portable, while still ensuring efficient screening and accurate results," says Pradhan.

Although focused on lung cancer screening and management, Pradhan sees wide applications for other kinds of cancers as well.



Whether it's focused on shipping specimens or shipping the equipment needed to accurately study them, research supported by the FedEx Institute of Technology is finding a way to faster, more accurate lab results, which, in turn, will lead to better patient outcomes.

A CURE FOR SICK HOMES

Basic healthcare starts with a healthy home environment. Unfortunately, in Shelby County, Tennessee, 22 percent of households have incomes below the federal poverty level, including one-third of all children. And as one might expect, homes in poverty-stricken areas tend to be compromised by moisture and mold, rats and mice, and other triggers for asthma and disease and are more likely to expose their occupants to lead paint. In addition, occupants are likely to suffer from *energy insecurity*, which results from the constant struggle to keep utilities up and running.

The FedEx Institute of Technology is funding two research projects that address these home health issues.

Integrating intervention

Asthma and lead paint are common threats to pediatric health in Memphis, and they often go hand-in-hand. But seldom have they been addressed together in an integrated intervention program. Dr. Pratik Banerjee [11] of the Institute of Intelligent Systems and the Smart Cites Cluster is poised to do just that, equipped with new tools for the job. The National Institute of Occupational Safety and Health has developed a special bioaerosol collection and assessment method and made it available to the University of Memphis School of Public Health.

"We have exclusive access," Banerjee, says. "So I'm converging this method with HUD-approved protocols for lead and indoor allergens sampling to develop a robust, integrated health homes assessment regimen that properly addresses asthma and lead paint issues together."

The new assessment regimen will offer a more complete picture of a home's health issues so that a more comprehensive solution can be provided efficiently and effectively.

Heat or eat

Just as asthma and lead poisoning haven't been adequately addressed, neither has the impact of energy insecurity on these and other health issues. According to Dr. Churong Jia [12] of the Smart Cities Cluster, the inability to adequately meet household energy needs is often accompanied by food insecurity, poor health, high rates of hospitalization and developmental risks.

"These low-income householders are often faced with a 'heat or eat' dilemma," Jia says.

Jia is working to assess the built environment, energy insecurity, and health outcomes together to position energy insecurity as a major public health concern. Eventually this work could lead to scalable policy changes that could improve energy efficiency, reduce exposure to adverse conditions, and improve health and wellbeing in socioeconomically disadvantaged households.

A HIP REPLACEMENT THAT'S OUT OF THIS WORLD

Metal additive manufacturing is a new way to make metal products quickly using metal powders and 3-D printing technologies. It has the potential to streamline the production of medical devices for companies like Smith & Nephew and Wright Medical. It could help NASA in its work with lightweight structures. And it could help organizations such as FedEx streamline aircraft parts production and maintenance. However, for additive metal manufacturing to be truly effective in these applications, manufacturers need to be able to control the rapid solidification of the metal powders that come together to form the finished project.

Ebrahim Asadi 13 of the DRONES Cluster is exploring ways to do just that.

"Understanding and predicting microstructures during rapid solidification," he says, "is extremely important in many metal additive manufacturing techniques and can open up new opportunities to optimize the finished metal and control quality."

According the Asadi, only with a real-time measurement tool for on-the-fly monitoring of rapid solidification of metal powders can the potential of metal additive manufacturing be fully realized. In fact, this is one of the main obstacles to widespread industrial acceptance of the process despite its huge potential to revolutionize traditional metal manufacturing technologies.

That's why Asadi is working on a predictive and quantitative computational framework and tool. The idea is to use this tool as a virtual rapid solidification laboratory with real-time microstructures to investigate how these microstructures behave in a variety of situations here on earth and under the effects of different gravitational forces, such as the gravity of Mars. The goal is to find the best possible environment for successful, predictable rapid solidification. And the more far-reaching implication? Off-earth additive metal manufacturing could someday become a reality.

KEEPING HEALTH CARE DATA HEALTHY

Protecting the privacy of patients and the security of health care data is becoming increasingly difficult as new cybersecurity threats emerge. Drs. Soumitra Bouyan 14, Marian Levy 15, and Dipankar Dasgupta 6 of the CAST Cluster believe the first step to creating viable solutions to obtain an accurate assessment of the concerns of senior hospital administators. To achieve this goal, they are using an advanced statistical method called Q-methodology to systematically identify, categorize, and assess the adminsitrators' opinions and concerns about information privacy and security.

"With this information, we will be in a much better position to create effective tools that can empower health care workers and mitigate the challenges of healthcare information security," says Dr. Bouyan.

These tools might include interdisciplinary workshops at the UofM in healthcare cyber security to increase awareness and competencies among the healthcare workforce.

UNDERSTANDING, MAINTAINING AND IMPROVING OUR ENVIRONMENT

Much of the research funded by the FedEx Institute of Technology is focused on finding more efficient ways to ensure air quality, manage infrastructure, improve waste management, and address other issues of sustainability and quality of life in cities like Memphis.

Storm troopers

The performance of storm water systems depends upon maintaining reliable flow, and that depends upon being able to see and assess every mile of stream. Typically, a Visual Stream Assessment (VSA) must be conducted every five years to determine the stream and riparian zone's overall health as well as document individual impairments, including outfalls, erosion, exposed pipes, trash and fish barriers.

According to Dr. Scott Schoefernacker 16 of the DRONES Cluster, the VSA effort involves sending teams into the stream to document impairments using paper forms and digital photographs, which must be transcribed and entered into a database at a later time.

"That's not only expensive," he says, "but also it takes months to complete."

Schoefernacker and fellow researcher Brian Waldron 17 have a better idea—drones. They are examining the application of commercially available multi-sensory unmanned aerial vehicles (UAVs) to navigate streams, create photographs and maps, and identify impairments.

"This could significantly reduce costs," Shoefernacker says, "while speeding up the process."

L–R: Caleb Harris, Clayton Smith, Bradley Cowan, and Dr. William Alexander conducting field trials of their prototype water-sampling drone.

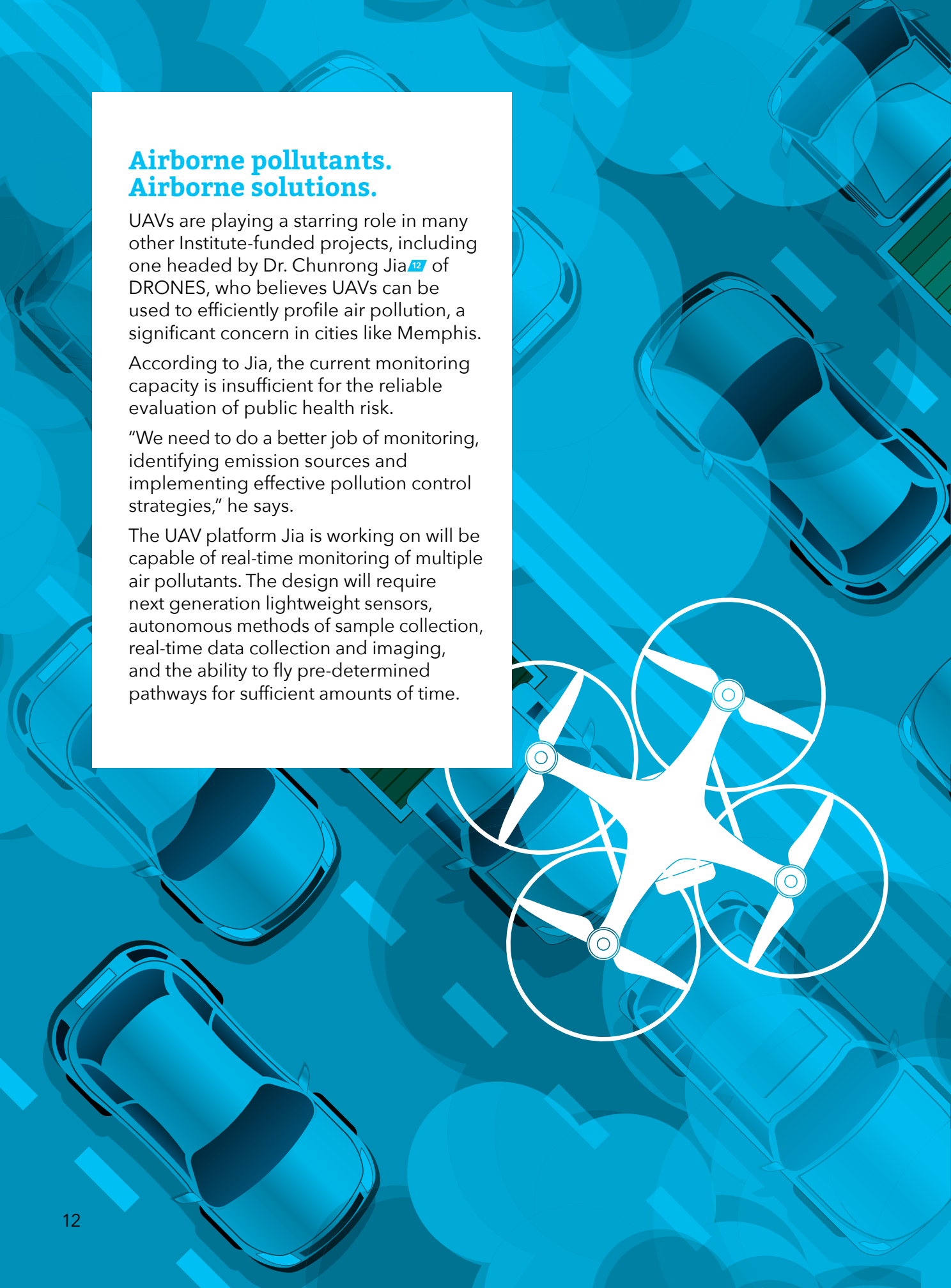
Airborne pollutants. Airborne solutions.

UAVs are playing a starring role in many other Institute-funded projects, including one headed by Dr. Chunrong Jia[12] of DRONES, who believes UAVs can be used to efficiently profile air pollution, a significant concern in cities like Memphis.

According to Jia, the current monitoring capacity is insufficient for the reliable evaluation of public health risk.

"We need to do a better job of monitoring, identifying emission sources and implementing effective pollution control strategies," he says.

The UAV platform Jia is working on will be capable of real-time monitoring of multiple air pollutants. The design will require next generation lightweight sensors, autonomous methods of sample collection, real-time data collection and imaging, and the ability to fly pre-determined pathways for sufficient amounts of time.



A new method for methane

In a different DRONES project, Dr. Prabhakar Pradhan [10] is exploring how UAVs can be used to monitor environmental methane gas.

"The impact of methane on climate change has been estimated to be 25 percent higher than carbon dioxide over a time period of 100 years," Pradhan says. "Monitoring and controlling the methane concentration in the atmosphere is extremely important."

Pradhan's solution is a drone-based spectroscopic sensor that will use a laser scattering and absorption technique to detect gas molecules. It will be more sensitive and accurate than existing techniques and allow easy monitoring of areas that may be difficult for humans to access.

Fresh thinking for recycling

Drones aren't the only innovative way to view and assess geographic areas from above. Satellite-based Geographic Information Systems (GIS) also have a role to play. Dr. Esra Ozdenerol [18] of the Smart Cities Cluster is interested in using the technology to bolster recycling in Memphis.

"Improving the market development of recyclables in Memphis is a complex and challenging task," she says. "Making it less costly and more rewarding is imperative."

Her research includes interviews with restaurant owners, apartment complex managers, private recyclables collectors, public works employees and others at the state and federal level to collect relevant recycling and transportation data. It also includes teaming up with a private collector and designing a GIS-based plan that can determine "least distance" and "least cost" routes for collecting recyclables and getting recycled material from processor to manufacturer.

"By determining optimal transportation routes," says Ozdenerol, "we can begin to develop an ideal recycling infrastructure for the city."

Spray-on solar cells?

As drones are employed to take on more complex tasks, they must be able to fly for greater distances and with higher payload capacities. A powerful but light power source is essential. One solution is solar energy. But conventional solar panels can be cumbersome. Drs. Ranga Gopalakrishnan [19] and Jingbiao Cui [20] of the DRONES Cluster are studying a promising alternative: perovskite, an abundant and environmentally friendly mineral made up of calcium titanium oxide.

"Perovskite can be synthesized as nanoparticles," says Cui, "and sprayed directly on the painted surface of the UAV, creating a very thin solar cell that adheres well and is light enough for all types of applications."

If that sounds "out of this world," Cui says the costs won't be. He believes that this procedure can be applied for a cost low enough to enable mass production.

MAKING GROWTH SMART

The phrase "smart city" was coined in the early 1990s to illustrate how urban development was turning towards technology, innovation and globalization to meet the needs of a growing population. At the heart of any smart city is a plan for smart growth that best utilizes both natural and technological resources. The Institute is funding two very different studies with just that goal in mind.

Mapping change

"The menacing consequences of human-made urban sprawl are comparable to those of the naturally occurring disasters like floods, hurricanes, and earthquakes," says Dr. Reza Banai 21. That is why he and Dr. Youngsang Kwon 22 of Smart Cities are using GIS to map how the natural and urban landscape changes over time. Of particular concern is how the metropolitan region is particularly vulnerable in built-up areas near rivers, creeks and wetlands.

"These areas become impervious and pose increased risk of local flooding during intensive-rain events in neighborhoods, damaging both the ecosystem and personal property," says Kwon.

By mapping what's called Land Use/Land Cover Change or LUCC, particularly as it transforms from undeveloped land to urban development, and by looking at other indicators such as per capita consumption of land, Banai and Kwon's study will help inform smart long-term planning and zoning for future smart growth and environmental sustainability.

Driving understanding

As technology advances, transportation will change forever. But the transition from conventional automobile travel to a world of autonomous vehicles and smart travel infrastructure won't be instantaneous. Or easy. That's the impetus behind the research of Dr. Sabya Mishra 23 of Smart Cities.

Up to now, existing methods of analyzing travel behavior haven't taken into account emerging technologies. It is Mishra's goal to incorporate smart and connected city infrastructure in the analysis of travel behavior to see how it changes when users of new technology share the road with those still using traditional technologies.

"We hope to be able to predict the probability of citizens adopting innovative transportation technologies and, as new technology is employed, see how behavior changes in a wide range of circumstances, including travel for work, shopping and leisure," Mishra says.

WORKING SMART

Over the past year, the UofM FedEx Institute of Technology developed and hosted a number of community-focused educational resources designed to drive innovation and growth throughout our region. Here are a few of them.

Helping companies enter the Agile Age

The Agile Academy

The Agile methodology has become popular among a wide range of corporations. It's a collaborative approach that results in adaptive systems that are flexible, fast and responsive. While SAFe certification prepares participants with a strong base in Agile, the nuances of integration in different settings across the company can be daunting. That's why the FedEx Institute of Technology has established the Agile Academy in partnership with FedEx IT Education and Training.

The Agile Academy provides supportive continuing education to help apply Agile integration more broadly across their companies, especially in areas in which the benefits are difficult to recognize at first or in which implementation is particularly challenging. By taking fuller advantage of Agile, companies enhance their ability to solve problems and achieve goals through smart collaboration and teamwork.

Booting up innovation

Memphis Innovation Bootcamp

We hear a lot about innovation these days, but what is it? How is it done? Where do you start? The Memphis Innovation Bootcamp at the Institute is a hands-on and immersive three-day introduction to the fundamentals of innovation that incorporates interdisciplinary collaboration and human-centered design. Our flexible approach includes repeatable activities drawn from a wide array of proven design thinking frameworks, including the Stanford d-School, Google Design Sprints, Gamestorming® and more. The bootcamp serves not only as a catalyst to create real solutions to complex local civic challenges, but in the process also empowers teams to lead scalable innovation and problem solving in their own organizations.

Providing real leadership in virtual reality

The VR Lab

The UofM FedEx Institute of Technology, in partnership with the Institute for Intelligent Systems, Memphis Technology Foundation and Memphis Game Developers, is leading the region in developing cutting edge resources in both virtual reality and augmented reality. In fact, we established the first VR Lab in the Mid-South. The lab, located on the 4th floor of the Institute, provides students, researchers and members of the Memphis technology community an opportunity to experience virtual reality spaces and participate in their development.

FOSTERING A SMARTER COMMUNITY

The FedEx Institute of Technology plays a major role in bringing together people, knowledge and cutting-edge ideas from throughout the region and beyond. From innovation workshops to corporate training to conferences both local and global, the institute is helping our broader community engage with emerging technologies and profit from them.

Emerging Innovation Events

We spend our days imagining what's possible for Memphis. Technologies at the cutting edge of innovation are changing the way everyone engages with the world. The FedEx Institute provides opportunities to engage with technologies that are shaping the future of our world.

- Augmented Reality and the Success of Pokémon Go
- Smart Cities: The Future of Technology in Memphis
- Blockchain and Market Competition
- Emerging Innovations in Intelligent Systems
- Promise and Potential of Mobile Sensor Data-to-Knowledge
- Technology Innovations in Orthopedics
- Memphis Grizzlies: Technology Innovation in Professional Sports
- The Future of FinTech
- Technological Advancements Enabling Larger Arrays for Submillimeter Spectroscopic Astronomy
- DNA Data Storage
- International Blockchain Workshop
- Blockchain for Professionals Workshop
- Drones, Robotics, and Navigation Enabled Systems (DRONES) Research Workshop
- Drones, Robotics, and Navigation Enabled Systems (DRONES) Lightning Talks
- Cluster for the Advancement of cyber Security Testing (CAST) Research Workshop
- Cluster for the Advancement of cyber Security Testing (CAST) Lightning Talks
- SMART Cities Meetup
- SMART Cities Research Cluster Lightning Talks
- CAST
- DRONES Connection Lunch
- Social Media Data Scraping Technologies
- Biologistics Research Lightning Talks
- USDOT Smart City Challenge
- Film Innovation Challenge
- Transforming Data with Artificial Intelligence

Corporate Training and Meetings

Memphis is only as strong as the corporate citizens who help drive the city forward. In order to maintain the SMART future of any company, it is essential that we provide an opportunity to grow and develop our personnel. The Institute supported these corporations and organizations by hosting and/or co-developing meetings and training opportunities throughout the year.

- SOLIDWORKS Seminar - What's New
- International Paper Training
- Cylance Security Event
- Memphis Light Gas & Water (MLGW) Training
- NeighborWorks America Software Training
- New Leaders Resident Principal Training
- Agile for Testing
- Agile Project Management
- Memphis Innovation Bootcamp
- Entrepreneurship Master Class
- ServiceMaster HR Training
- Shoemaker Financial/Financial Literacy Retirement Planning Today Seminar
- Southernsun Asset Management Ransomware Workshop
- Teach For America (TFA) 2016
- TPSU Program
- TN Legal Community Foundation presents YLD Ethics - The Business of Lawyering
- University of Edinburgh Executive Education Program
- West TN Structural Engineers Seismic Design Workshop
- MIT Technology Review
- ALSAC Leadership Summit
- Mid-South Healthcare Executives CEO Roundtable
- City of Memphis Division of Memphis Fire Department
- Institute of Supply Management
- Leadership Memphis Executive Class Day
- Medical Anesthesia Group 2016 Retreat
- Memphis Light Gas & Water Annual Meeting
- nexAir Annual Meeting
- PFM Asset Management
- St. Jude Children's Research Hospital
- TN Bar Association Annual CLE - Fast Track
- Tennessee Educator Fellowship
- TVA Business Planning Meeting
- The Campbell Foundation Ingram Memorial Orthopedic Lecture
- Digital Curriculum Sustainability Discussion
- HUD National Data Research Center Kickoff
- UofM Center for International Education meeting with Columbian Ambassador
- FAC West Meeting
- FEMA
- Memphis Tomorrow Board Meeting
- CLARITY/USALEM Technical Exchange Meeting
- Launch TN meeting
- Aerotropolis Institute Meeting
- R IMMERSION Workshop

THE UNIVERSITY OF MEMPHIS Graduate School

Instrumental to the FedEx Institute's research and the development of the technology workforce in Memphis is a close partnership with the **University of Memphis Graduate School**. Housed in the FedEx Institute, the Graduate School enrolls roughly 4,000 graduate students in more than 120 degree programs, many of which are ranked among the best in the nation. Master's degree programs are offered in 53 areas through seven colleges and four schools. The Doctor of Philosophy degree is offered in 26 areas through five colleges and three schools. Education Specialist and Juris Doctor (Law) degrees are also offered.

Community Engagement and Student Success

At the heart of the Institute is the belief that by bringing the technology community together in one place, truly great things can happen. The FedEx Institute partners with community organizations that are committed to making Memphis a center of technology innovation. By providing trainings at no cost to students and the community and by partnering with Tech901, Code Crew, Memphis Technology Foundation and many others, we are building a new tech-driven future for this amazing city.

- City of Memphis Office of Youth Services Orientation
- Code Crew Lost in Space Hackathon
- CodeCrew Tiger Tech Expedition
- UM Computer Science Python Workshop
- GenCyber Camp - Middle School
- GenCyber Boot Camp - High School
- Memphis Chamber Blue Carpet Tour
- Greater Memphis IT Council Innovate IT 2017 Conference
- Tech901 Career Fair
- Grizzlies Foundation Quad Camp
- UofM Computer Science Open House
- Biologistics Research Industry Luncheon
- Memphis Game Developers Presents: Procedural NavMesh Creation
- Memphis Tech Talks
- MEMPass
- HackMemphis
- IT Foundations Class
- University of Memphis Inventor Celebration
- Memphis 3.0
- Memphis Women In Technology
- FIT Tech Camp
- FIT Give Camp
- Ruby Bootcamp
- STEMHub Lending Library
- PHP Bootcamp
- FIT Advanced Technical Skills Program: WebWorkers Meetup
- FIT Advanced Technical Skills Program: Ruby Users Group
- FIT Advanced Technical Skills Program: Machine Learning/Data Sciences/R Meetup
- FIT Advanced Technical Skills Program: Memphis Game Developers Meetup
- FIT Advanced Tech Skills Program: PHP Meetup
- FIT Advanced Technical Skills Program: Python User Group Meetup
- FIT Advanced Technical Skills Program: MEMPass/Power BI Meetup
- FIT Advanced Technical Skills Program: WordPress Meetup
- FIT Advanced Technical Skills Program: Data Management Association (DAMA) Meetup
- Spring Break 'Geek Movie' Series
- SciPhD Event
- Digital Painting with Bob Ross
- Women in Computing Movie Night
- ACM Board Meeting
- Technology Game Tournament
- Paper Airplane Derby
- GSA Professional Development Seminar
- Governor's School Model UN
- ACM Resume Writing Workshop
- Tech901 A+ Class
- Critical Skills Series: HTML/CSS for Beginners
- Critical Skills Series: Social Media Data Collection
- Critical Skills Series: Two Mini-Workshops on PC Systems
- Critical Skills Series: Introduction to Unity
- Critical Skills Series: Teardown – from Case to CPU
- Critical Skills Series: Introduction to Python
- Critical Skills Series: What is Business Intelligence and Data Analytics?
- Critical Skills Series: Drone Racing Tournament
- Critical Skills Series: Ruby for Beginners
- Critical Skills Series: Programming with Tech901
- Critical Skills Series: Basics of Data Management
- Critical Skills Workshop: DAMA presents Data Governance in Cloud Computing

High Impact Conferences

Sometimes the best way to make innovation happen is to bring everyone together. The Institute is proud to host world-class conferences that showcase the talent and drive of the Memphis corporate and research communities. From developer meetings to major international events, the Institute is bringing new opportunities for networking to our city.

- National Conference on Undergraduate Research (NCUR) 2017
- North Atlantic Treaty Organization (NATO): North American Command – Allied Command Transformation
- ACCED-I Educational Forum
- 2016 International Cotton Institute
- 2017 International Cotton Institute
- AMIN 2016 Women's Conference
- 10th Annual Systems Testing Excellence Program (STEP) Workshop
- CBIZ CFO Conference
- CBIZ Annual Conference
- Financial Planning Association (FPA) of Greater Memphis Annual Symposium
- Fish & Associates: Savvy Social Security for Women
- FrameWorks Institute: ACE Symposium
- Gartner - CIO Roundtable
- Safety & Health Expo 2017
- Lokion Interactive Agile Conference
- MCBIOS Annual Conference
- Memphis Bioworks Foundation Musculoskeletal New Ventures Conference
- Methodist Healthcare Annual EMS Conference
- Methodist Healthcare Annual EMS Stroke Symposium
- Methodist University Physician CME Conference
- Methodist LeBonheur Children's Hospital Regional Trauma Conference
- St. Jude's Children's Research Hospital CBT Symposium
- Tennessee Department of Education West TN TSA Regional Competition
- TN Autonomous Vehicle Summit
- STEM Hub Conference
- UM Computer Science Research Day
- UM Computer Science Software Engineering Display
- NDN Conference
- UofM Computer Science Capstone Project Showcase
- Software Engineering Course Project Showcase
- UT Health Science Center Complex Trait Consortium
- Cyber Security Summit 2016
- FedEx Institute of Technology / Mid-South Indie Game Expo
- Intermodal Freight Transportation (IFTI) Institute Conference /Biologistics Summit
- Alternative Fuel Vehicle Conference
- Small Business Procurement Forum
- UofM Psychology Conference
- UTHSC Complex Trait Consortium
- MD2K Annual Conference/Meeting

FedEx Strategic Partnerships

FedEx is a huge contributor to the success of the FedEx Institute of Technology's mission. In consideration of their tremendous support, we are proud to collaborate in bringing the FedEx community together.

- FedEx SVP Platinum Planning Session
- FedEx Unmanned Systems and Robotics Meeting
- VCAEST demo for VR project discussion with FedEx
- FedEx Revenue Services Planning Analysts Meeting
- FedEx IT Operations
- FedEx TechConnect Strategic Revenue Support
- FedEx / FIT Big Data Collaboration
- FedEx Quality Driven Management (QDM) Training
- FedEx IT Services – FedEx Cloud Computing
- FedEx Corporate Communications Meeting
- FedEx Services: HR Training
- FedEx Services Business Services & Network Security Meeting
- FedEx Cloud Day Training
- FedEx Services HR Training
- FedEx Services Workshop
- FedEx Quality Driven Management (QDM) Training
- FedEx Digital Access Global Marketing Meeting
- FedEx Corporation Town Hall
- FedEx Corporation Revenue Services Planning Analysts Meeting
- FedEx Corporate Communications Meeting
- FedEx Express Air Traffic Operations
- FedEx Express Future Plans Project
- FedEx Services PDSM Release Planning Event
- FedEx Freight Team Meeting
- FedEx Services Global Media Relations All Team Meeting
- FedEx Services GTM All Management FY17 Planning Session
- FedEx Services ITASC Planning Session
- FedEx Services MAGIC PI 1 Planning Session
- FedEx Services Marketing Meeting
- FedEx Services First Robotics Competition Kickoff
- FedEx Services IT Mod Vendor Day
- FedEx Enterprise IT Training
- FedEx Services Global Social Media
- FedEx Business Services & Network Security Meeting
- FedEx Trade Networks Officer and Director Meeting
- FedEx Revenue Services Planning Analysts Meeting
- FedEx CLC Labs
- FedEx Services Big Data Collaboration Planning
- FedEx Services Cloud Computing
- FedEx Corporate Communications Meeting
- FedEx Services HR Student Recruiting
- FedEx Services IT Team Meeting
- FedEx Express Planning Session
- FedEx Services Marketing Meeting
- FedEx Architecture Planning/Workshop: International Architecture Team
- FedEx Quality Driven Management (QDM) Graduation Celebration
- First Robotics Competition Kickoff Event
- FedEx Corporate HR Student Recruiting
- FedEx IT Team Meeting
- FedEx Express/FIT Collaboration Meeting
- FedEx Legal Meeting
- FedEx Express Freight Meeting
- Systems Testing Excellence Program (STEP) Workshop
- FedEx Services Architecture Planning Workshop
- FedEx Services U.S. Marketing Workshop
- FedEx TechConnect 3D Printing Workshop

FedEx Institute of Technology
The University of Memphis

The Office of Technology Transfer

The Institute houses the Office of Technology Transfer (OTT), which works with Memphis faculty researchers to invest in and protect, through patents and copyrights, promising inventions and breakthroughs. The OTT also licenses the intellectual property to local and national companies. At the end of our 2016–17 fiscal year, the OTT's intellectual property portfolio had grown to include 170 invention disclosures, 34 issued U.S. patents, eight copyrights and 15 licenses to industry.

ISSUED PATENTS 2016–17

- Patent No. 9,491,087
  Devices and Methods for Forwarding Information Base Aggregation
  Xin Zhao/Yaoqing Liu/Beichuan Zhang/Lan Wang
- Patent No. 9,552,526
  Image Processing Using Cellular Simultaneous Recurrent Network
  John K Anderson/
  Khan M Iftekharuddin
- Patent No. 9,557,413
  Surveillance and Tracking System and Method
  Robert Kozma/Orges Furxhi/Khan Iftekharuddin/
  Lan Wang/Ross
  Deming/Serji Consul-Pacareu
- Patent No. 9,566,576
  Metal Complex Catalysts and Uses Thereof
  Xuan Zhao/Charles E Webster
- Patent No. 9,599,092
  Wind Generator System with Multiple Turbines
  Md Maruf Hossain/Mohd Hasan Ali
- Patent No. 9,603,522
  Detecting Neurochemical or Electrical Signals Within Brain Tissue
  Kendall Lee/Kevin Bennet/
  Charles Blaha
- Patent No. 9,642,948
  Compositions and Methods for Delivering an Agent to a Wound
  Warren Haggard/Scott Noel/Joel Bumgardner
- Patent No. 9,662,400
  Methods for Producing a Biodegradable Chitosan Composition and Uses Thereof
  James Keaton Smith/Ashley Parker/Jessica Jennings/Benjamin Reves/Warren Haggard
- Patent No. 9,700,246
  Method and Device for Detection of Bioavailable Drug Concentration in a Fluid Sample
  Edward Chaum/Erno Lindner/
  Jidong Guo

DEVELOPMENT GRANTS 2016–17

- **Fully-Passive Wireless Continuous Temperature Sensing System Using Low-cost Inkjet Printed Disposable Body-worn Sensors**
  Bashir Morshed
- **ENGAGE: An API Capable Data Collection and Analysis System for Education and Behavioral Health**
  Susan Elswick
- **Chitosan Nanofiber Composition, Composition Comprising Modified Chitosan and Method of Use**
  Joel Bumgardner
- **Light Weight Flexible Temperature Sensor Kit for Biologics**
  Firouzeh Sabri
- **The Development of an Adaptive Multi-factor Authentication Framework**
  Dipankar Dasgupta

OUR RESEARCH INNOVATION CLUSTERS

Made up of leading researchers from departments across the campus, the interdisciplinary innovation research clusters supported by the FedEx Institute of Technology are committed to addressing a wide range of technological issues that are critical to the success of our community and corporate partners, everything from preventing cyber theft to advancing sustainable living. Cluster members work together to apply for research funding, seek external research partners and create training and certification programs for the community. All the while, our clusters find ways to encourage junior and senior faculty, students, and community organizations to contribute their ideas and be a vital part of the conversation.

Smart Cities

The University of Memphis and the City of Memphis have partnered to form our newest cluster, Smart Cities, to address the needs of Memphis citizens utilizing emerging technologies and innovations arising from research at the UofM.

Funded projects for 2016-2017 include:

A New Chapter For Recycling: Using Geographic Information Systems and Mixed-Methods Approach to Improve the Market Development and Transportation of Recycled Materials

PI: Dr. Esra Ozdenerol, Earth Sciences, College of Arts and Sciences

A Planning Support System for Comprehensive Planning and Zoning: A Geospatial Simulation Model of Land Use, Land Cover Change for the Memphis Metropolitan Region

PI: Dr. Reza Banai, City and Regional Planning, School of Urban Affairs and Public Policy

Co-PI: Dr. Youngsang Kwon, Earth Sciences, College of Arts and Sciences

Integrated Healthy Home Assessment and Intervention for Children in Memphis

PI: Dr. Pratik Banerjee, Division of Epidemiology, Biostatistics, and Environmental Health, School of Public Health

Predicting Localized, Fine-Grained Crime Types Using Twitter

PI: Dr. Deepak Venugopal, Computer Science, College of Arts and Sciences

Linking Home Energy Insecurity to the Built Environment and Population Health in Memphis

PI: Dr. Chunrong Jia, Division of Epidemiology, Biostatistics, and Environmental Health, School of Public Health

Using New Technologies to Survey Memphis Residents: Identifying and Responding to Local Concerns

PI: Dr. Michael W. Sances, Political Science, College of Arts and Sciences

Modeling Adoption of Technological Innovations and Infrastructure Impacts in a Smart City

PI: Dr. Sabya Mishra, Civil Engineering, Herff College of Engineering

Uncovering Latent Community Issues through Social Media

PI: Dr. Leah C. Windsor, Political Science, College of Arts and Sciences

Co-PI: Dr. Alistair Windsor, Mathematical Sciences, College of Arts and Sciences

Detection of Unusual Objects, Actions, and Events in Streaming Video Surveillance Data

PI: Dr. Bonny Banerjee, Electrical and Computer Engineering, Herff College of Engineering

Cluster for Advancement in cyber Security & Testing (CAST)

CAST is made up of 21 researchers from four colleges and 7 academic departments working together to address one of the biggest challenges of our day: keeping online data secure from cyber theft. With threats growing more sophisticated, CAST is stepping up research, working on the front lines of the cyber war to provide new solutions and software testing expertise that will help protect corporations, Tennessee government agencies and the Department of Defense.

Funded projects in 2016-2017 include:

Collaborative Monitoring of Moving Target Defense Mechanisms for Cloud Computing

PI: Dr. Sajjan Shiva, Computer Science, College of Arts and Sciences

Investigation and Testing of Cyber Security in Protective Relay System of Smart Power Distribution Grid

PI: Dr. Mohd Hasan Ali, Electrical and Computer Engineering, Herff College of Engineering

Co-PI: Dr. Dipankar Dasgupta, Computer Science, College of Arts and Sciences

Exploring Cyber Security Issues and Solution for Energy Storage at Smart Microgrid System

PI: Dr. Mohd Hasan Ali, Electrical and Computer Engineering, Herff College of Engineering

Co-PI: Dr. Dipankar Dasgupta, Computer Science, College of Arts and Sciences

Mitigating Ransomware Attacks by Leveraging Isolation Techniques

PI: Dr. Bo Chen, Computer Science, College of Arts and Sciences

Co-PI: Dr. Dipankar Dasgupta, Computer Science, College of Arts and Sciences

Protecting Data Security in Smart Internet-Of-Things (IoT) Environments

PI: Dr. Lan Wang, Computer Science, College of Arts and Sciences

Impact of Privacy Data Events on Consumer

PI: Dr. George Deitz, Marketing and Supply Chain Management, Fogelman College of Business and Economics

Co-PI: Dr. Mehdi Amini, Marketing and Supply Chain Management, Fogelman College of Business and Economics,

Co-PI: Dr. Subhash Jha, Marketing and Supply Chain Management, Fogelman College of Business and Economics

Design of Gamification for Information Security Awareness and Compliance: An Empirical Study in the Context of Phishing Emails

PI: Dr. William Kettinger, Business Information Technology, Fogelman College of Business and Economics

Co-PI: Dr. Jong Lee, Business Information Technology, Fogelman College of Business and Economics

Co-PI: Dr. Chen Zhang, Business Information Technology, Fogelman College of Business and Economics

Corporate Governance Effectiveness and Cyber Security Risk Assessment and Management

PI: Dr. Zabi Rezaee, School of Accountancy, Fogelman College of Business and Economics

Co-PI: Dr. Joseph Zhang, School of Accountancy, Fogelman College of Business and Economics

Senior Hospital Administrators' Challenges on Emerging Cyber Security in Healthcare: An Exploratory Study Using Q-Methodology

PI: Dr. Soumitra Bhuyan, Division of Health Systems, Management, and Policy, School of Public Health

Co-PIs: Dr. Marian Levy, Division of Social and Behavioral Sciences, School of Public Health

Co-PI: Dr. Dipankar Dasgupta, Computer Science, College of Arts and Sciences

Securing Online Review Platforms: An Anomaly Detection Framework Using Advanced Machine-Learning

PI: Dr. Naveen Kumar, Business Information Technology, Fogelman College of Business and Economics

Co-PI: Dr. Deepak Venugopal, Computer Science, College of Arts and Sciences

Biologistics Research Cluster

The Biologistics Research Cluster collaborates with the Memphis Intermodal Freight Transport Institute to research and develop better ways to safely transport and store high value, temperature-sensitive and time-critical biological materials, including tissue and blood samples, vaccines and pharmaceuticals.

Funded projects in 2016–2017 include:

Biologistics of Lung Cancer Screening and Management: Compact Table Top Instrumentation and Efficient Logistics

PI: Dr. Prabhakar Pradhan, Physics and Materials Science, College of Arts & Sciences

Assessment of Biologistics Research and Practices for the Purposes of Proposing a New Cutting-Edge Research Agenda: Phase 2

PI: Dr. Mehdi Amini, Marketing and Supply Chain Management, Fogelman College of Business & Economics

Co-PI: Dr. Mihalis Golias, Civil Engineering, Herff College of Engineering

Post-Disaster Management of Freight Transportation Networks: Phase 2

PI: Dr. Charles Camp, Civil Engineering, Herff College of Engineering

Co-PI: Dr. Shahram Pezeshk, Civil Engineering, Herff College of Engineering

Co-PI: Dr. Chris Cramer, Center for Earthquake and Research Information (CERI), Herff College of Engineering

Biologistics Security: Implications for Market Growth, Transportation and Logistics

PI: Dr. Haskel D. Harrison, Sparks Bureau of Business & Economic Research, Fogelman Collegeof Business & Economics

Advanced Aerogel Packaging Solutions for Cold-Chain Biologistics

PI: Dr. Firouzeh Sabri, Physics and Materials Science, College of Arts & Sciences

Co-PI: Dr. Jeffrey Marchetta, Mechanical Engineering, Herff College of Engineering

Remote End-To-End Temperature Tracking for Regulatory Compliance

PI: Dr. Firouzeh Sabri, Physics and Materials Science, College of Arts & Sciences

Nano-Enabled Energy Storage Device: Nanoengineering Approach

PI: Dr. Sanjay Mishra, Physics and Materials Science, College of Arts & Sciences

Drones, RObotics and Navigation Enabled Systems (DRONES)

The DRONES Research Cluster has been established to provide proactive leadership in the fast-emerging field of unmanned systems, including autonomous vehicles, robots and drones. Its goal is to bring new, practical applications of these technologies to commercial markets.

Funded projects in 2016-2017 include:

Bridging the Gap Between Virtual Reality and Real World Automated Navigation

PI: Dr. Aaron L. Robinson, Electrical and Computer Engineering, Herff College of Engineering

Co-PI: Ernest McCracken, Department of Computer Science, College of Arts & Sciences

Developing a Modular Unmanned Aerial Vehicle (UAV) Platform for Air Pollution Profiling and Emergency Monitoring

PI: Dr. Chunrong Jia, Division of Epidemiology, Biostatistics and Environmental Health, School of Public Health

Drone Assisted Cavity Ringdown Sensor for Real-Time Environmental Methane Gas Monitoring

PI: Dr. Prabhakar Pradhan, Physics and Material Sciences, Herff College of Engineering

Drone Imaging of Active Sand and Gravel Quarries to Optimize Exploration and Mining

PI: Dr. Roy Van Arsdale, Earth Sciences, College of Arts and Sciences

Co-PI: Dr. David Lumsden, Earth Sciences, College of Arts and Sciences

Co-PI: Dr. Randel Cox, Earth Sciences, College of Arts and Sciences

Co-PI: Dr. Youngsang Kwon, Earth Sciences, College of Arts and Sciences

Co-PI: Dr. Andrew Mickelson, Archaeology, College of Arts and Sciences

Engineering Materials for Battery: Nanowhiskered Oxide Electrodes

PI: Dr. Sanjay Mishra, Physics and Material Science, College of Arts and Sciences

Gravitational Effects on Rapid Solidification of Metal Powders for On/Off-Earth Additive Manufacturing

PI: Dr. Ebrahim Asadi, Mechanical Engineering, Herff College of Engineering

Light Weight Low Power Multi-Sensing Technology for Extreme Conditions

PI: Dr. Firouzeh Sabri, Department of Physics and Materials Science

Multi-Layer Aerosol Deposition for Converting a UAV's Body Into a Solar Panel

PI: Dr. Ranganathan Gopalakrishnan, Mechanical Engineering, Herff College of Engineering

Co-PI: Dr. Jingbiao Cui, Physics and Material Science, College of Arts and Sciences

Multi-Sensory UAV Approach to Stream Assessments Center for Applied Earth Science and Engineering Research

PI: Dr. Brian Waldron, Civil Engineering, Herff College of Engineering

Co-PI: Scott Schoefernacker, Center for Applied Earth Science and Engineering Research

Robust and Anonymous Information Sharing Among Autonomous Vehicles

PI: Dr. Lan Wang, Computer Science, College of Arts and Sciences

Mobile Sensor Data to Knowledge (MD2K)

MD2K is one of 11 national Big Data Centers of Excellence awarded by the National Institutes of Health (NIH) as part of its Big Data-to-Knowledge initiative. It continues its research and development of innovative tools that make it easier to gather, analyze and interpret health data generated by mobile and wearable sensors. The goal is to reliably quantify physical, biological, behavioral, social and environmental factors that contribute to health and disease risk.

LATEST ADVANCEMENTS:

mCerebrum and Cerebral Cortex.
Helping researchers process information from multiple field studies simultaneously.

MD2K has released an end-to-end software infrastructure for sensors, smartphones and cloud called mCerebrum. This platform was designed from the ground up and consists of more than 23 apps to create an entire data ecosystem that enables MD2K to concurrently run field studies at more than 10 sites, processing and storing an expected 106,608 person-days or 4.7 trillion data points. All of this processing is done on the phone to support real-time biomarker-triggered notifications and interventions.

Helping to process all this information is the Cerebral Cortex, the big data companion to mCerebrum. It receives data from thousands of concurrent mCerebrum instances running on participant phones. In addition to facilitating remote monitoring of data collection by participants, it is designed to support population-scale data analysis, visualization, model development, and intervention design.

Making a Mark in Biomarkers and Pattern Mining

A biomarker is a measurable substance in an organism that indicates a particular phenomenon, such as disease, infection or environmental exposure. Biomarkers, then, are vital to early detection and accurate prediction of the biological changes these phenomena will have over time. MD2K, which already has developed biomarkers for stress and smoking, identified new biomarkers for tobacco craving, fatigue, eating and TV viewing (detecting exposures to alcohol ads via smart eyeglasses).

Research by MD2K on the discovery of mHealth predictors resulted in a new pattern mining approach for identifying significant stress episodes at the minute level. This and other developments are helping researchers model patterns in mobile health event data and predict the risk of adverse events over a variety of future time intervals.

Big Data Advances

MD2K's work in big-data computing resulted in new capabilities that enable researchers to greatly reduce the time it takes to develop graph-based and data mining algorithms, more effectively debug their programs, and more easily determine the root causes of errors or delays in data processing. All of these capabilities are helping to speed the work of MD2K.

Patient Studies

In March 2017, MD2K began a pilot study on 20 congestive heart failure patients. Analysis of the data led to revisions in the EasySense sensor to improve its robustness for the field study and enhance the ability to estimate lung fluid levels.

A new wrist sensor was developed for a smoking cessation field study that was started in February 2017. This is the first study to include collection of raw sensor data from chest and wrist sensors, real-time analysis of the sensor data to infer stress episodes, and a microrandomized trial design to determine the optimal timing to deliver a just-in-time stress intervention.

Institute for Intelligent Systems

The Institute for Intelligent Systems (IIS) is dedicated to advancing the state of knowledge and capabilities of intelligent systems, using an interdisciplinary approach that brings together researchers from many different research areas in the cognitive sciences, including biology, communication sciences and disorders, computer science, education, engineering, linguistics, philosophy, physics and psychology. Its work is divided into three areas—learning, language and artificial intelligence—and has garnered more than $30 million in external funding.

LATEST ADVANCEMENTS:

Over the past year, the IIS has been focused on finding ways to enhance the capabilities of a powerful, comprehensive tutoring system called the Personal Assistant for Lifelong Learning or PAL3. Here are two important projects.

Careers: Helping Sailors Chart the Right Course

Working with the Institute for Creative Technologies at the University of Southern California and the Office of Naval Research, the IIS is giving sailors new insight into their own future. The goal is to incorporate a career module into the PAL3 that will give sailors career guidance based on their career goals, skill levels, mastery of subject matter, and other information that is collected by the PAL3 as it helps them to learn. The module will be dialogue-based, using a question-and-answer format to help the sailors discover compatible career paths.

Combining Forces to Strengthen Learning

The IIS is also helping the Army, working to integrate software components and standards of the Generalized Intelligent Framework for Tutoring (GIFT) with PAL3, ElectronicTutor and other learning systems. This integration will improve conversation-based learning and promote reading literacy and math comprehension. For this work, the IIS is leading a team that includes the University of Southern California's Institute of Creative Technologies, the Worcester Polytechnic Institute, and the U.S. Army Research Laboratory. The group's goal is to achieve standardization and scalability by specifying GIFT-based metadata for learner modeling, a lifelong learning record, recommender systems and learning management systems so that new courses and technologies can be incorporated under the umbrella of PAL3.

Research Centers

In addition to the Research Innovation Clusters, the Institute supported several other research centers in 2016-2017, including

- Center for Translational Informatics
- Systems Testing Excellence Program (STEP)
- SENSORIUM
- Center for Smart Biomaterials
- Center for Technologies and Research in Alzheimer's Care
- Center for Information Assurance
- Center for Applied Earth Science and Engineering Research (CAESER)

BE A PART OF THE SMART FUTURE

The FedEx Institute of Technology is always looking for new alliances in both the academic and business communities. Whether you want to support us, need help with a new research project or a new product, or simply want more information about all of the work we do, we encourage you to visit us online or give us a call. Together, we can make exciting new discoveries and help Memphis and the region continue to be a driving force for innovation.

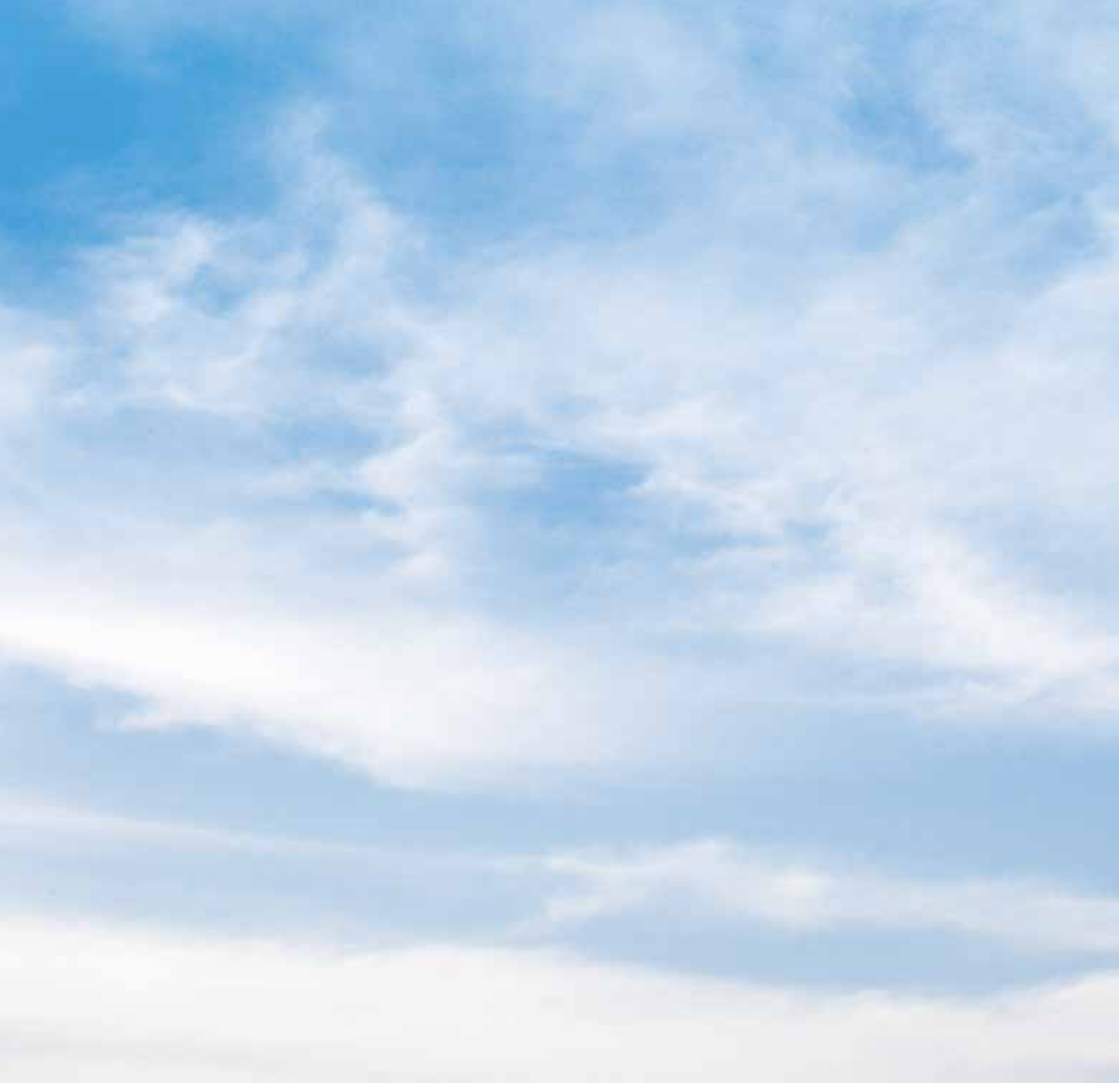
FedEx Institute of Technology
365 Innovation Drive
Memphis, Tennessee 38152

901.678.5105

fedex@memphis.edu

www.memphis.edu/fedex


FedEx
INSTITUTE OF
TECHNOLOGY
THE UNIVERSITY OF
MEMPHIS



FedEx Institute of Technology

The University of Memphis