New DAPI Laboratory Develops Methods for Data Processing and Efficiency Analysis

According to the Harvard Business Review, data scientist is the “sexiest job of the 21st century.” Industrial and systems engineers have always used data analysis for prediction, decision making, and insight as a key part of their work. However, with massive amounts of ‘big data’ generated and captured every day, the quantity of data available to researchers has dramatically increased along with the challenges to fully realize the value of data. Industrial and systems engineers are eager to meet those challenges.

Today, an expanding range of information sources and sensor signals are used to assess the quality of products and processes in many industries, including automotive, electronics and semiconductor manufacturing, and stamping and chemical processing, as well as service industries such as healthcare and education. This creates a tremendous capability for engineers to access valuable information from various enterprise entities to improve their designs and operations.

The Department of Industrial and Systems Engineering at Rutgers University is at the forefront of data analytics. Professors Myong K. Jeong, Weihong (Grace) Guo, and Susan Albin are launching the new Data Analytics and Process Insights Laboratory. The mission of DAPI is to develop new methods for efficiently and effectively using massive data to obtain insights on different kinds of processes.

Developing new data mining and machine learning algorithms, promoting interactions between academia and industry, and increasing student participation are just three of DAPI’s goals. As an interdisciplinary group that connects ISE faculty members with different organizations, DAPI also aims to facilitate

Continued on p. 3
Message from the chair

Industrial and systems engineers are in continuous demand as businesses around the world see an increasing need for data analytics, process optimization, automation, and the decision-making skills only engineers can provide. These engineers help companies develop novel production methods, allowing them to stay competitive in rapidly growing markets.

The Department of Industrial and Systems Engineering at Rutgers University has seen several major successes over the past year, building on our previous work and promising further advances in the future. Our students especially have honed their skills, proving themselves ready for life as professional engineers after Rutgers.

ISE students continue to distinguish themselves through their efforts to be part of a national community of engineers and engineering students, organizing conferences and presenting work to national meetings. They are taught by our faculty to apply their lessons to solve engineering problems, analyze the greater impact solutions may have unrelated to the problem, and determine methods for applying these solutions.

Our faculty members partner with national and international research institutions to produce groundbreaking research in advanced manufacturing, quality and reliability engineering, data mining and machine learning, model predictive control, imaging and 3-D computational modeling, and large scale optimization, as well as help students create innovative solutions to growing global issues like climate change, clean energy, smart cities, transportation safety and mobility, and healthcare manufacturing. With new opportunities appearing in advanced manufacturing, smart cities, intelligent transportation, smart grid and cybersecurity, I know we are all excited about being part of an expanding field that is impacting the future.

Mohsen A. Jafari, Ph.D.
Chair, Department of Industrial and Systems Engineering

Lights, Camera, Action!

Do you look around and wonder how to make things better? Are you challenged to solve the problems others can’t see? A new video from the Department of Industrial and Systems Engineering poses these questions and captures the excitement of IE at Rutgers through interviews with students, faculty, and alumni. Check it out at: ise.rutgers.edu/wonder

Faculty Awards and News

Professor Tuğrul Özel is the lead editor of the new book Biomedical Devices: Design, Prototyping and Manufacturing, John Wiley & Sons. Other editors are Paolo Jorge Bártolo, Elisabetta Ceretti, Joaquim De Ciurana Gay, Ciro Angel Rodriguez, and Jorge Vicente Lopes Da Silva.

Assistant Professor Weihong ‘Grace’ Guo received funding from Ford Motor Company to lead a joint Rutgers-Ford team to explore big data values in improving product testing and vehicle manufacturing. This project aims to develop association rule mining algorithms and multi-task classification methods to discover insightful patterns and knowledge from data and diagnostic information collected from manufacturing testing and repair processes. Guo was also recently appointed president of the Process Industries Division of the Institute of Industrial and Systems Engineers.

RAPID PROTOTYPING, DESIGN, FABRICATION, DURABILITY TESTING, QUALITY AND RELIABILITY TESTING, PROCESS OPTIMIZATION, MANUFACTURING AUTOMATION, AND INNOVATIVE TECHNOLOGIES ARE DESIGNED TO OPTIMIZE NEW PRODUCTION METHODS.

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Yada Zhu: Innovation

Yada Zhu is a research staff member in the Department of Solutions and Mathematical Sciences, IBM Thomas J. Watson Research Center. Her current research interests include methodological research for survival analysis and time series analysis, statistical machine learning, and data mining and its applications to a wide range of industry problems and big data. Dr. Zhu has served as a technical lead in many business analytics projects and gained extensive experiences for developing innovative solutions for e-commerce, online advertising, air cargo business pricing, monitoring and control of advanced manufacturing processes, and maintaining utility and energy systems. She has eight granted patents and nine pending patent disclosures. Her work has been acknowledged with many IBM innovation awards and IBM research accomplishment awards.

Dr. Zhu earned both her Ph.D. degree in industrial and systems engineering and master’s degree in statistics from Rutgers University. Under the direction of her doctoral advisor, Prof. E. A. Elsayed, her research work towards her thesis was featured in IE magazine. She is also the first recipient of the Best Graduate Student award from the Department of Industrial and Systems Engineering.

How long have you worked at IBM?
I joined IBM in 2010. I have been working at IBM Research for six years.

What is most compelling to you about your research?
The real world impact – the end to end innovative solution that we provided to our client integrates and automates business processes. The solution is immediately tested in real world applications and directly measured by dollar saving.

How do you see data mining or business analytics informing innovation?
Recent years have witnessed data explosion in every business sector due to advances in instrumentation and storage techniques. Analyzing large data sets to extract information needed to make important decisions has become a key basis of running a successful business and underpinning innovative growth.

How did Rutgers impact your career?
I studied computer-aided design as an undergraduate. Rutgers opened the door for me to learn statistics and explore statistical machine learning, and inspired my interests to develop a career in the area of business analytics.

Manufacturing processes can be improved through data analytics by identifying relevant variables within unique processes with a goal of reducing the time needed to create products and reduce waste. Defect monitoring during manufacturing helps to reduce the number of products requiring manual inspection.

Utilizing the power of data analytics in healthcare allows for more efficiency related to patient care and well-being. Advanced smart systems will allow for learning from previous successes and failures, developing consistencies in determining the best outcome for the patient every time.

Intelligent traffic and transportation systems on the nation’s largest roads will contribute to vital advances in infrastructure design and technology. At present these systems are inefficient and difficult to implement. Improved systems using sensors in specific locations and developed algorithms will contribute to benefits in congestion relief, increased travel efficiency, automotive advances, and safety.

The lab is conducting research into cutting-edge technologies which can improve day-to-day life. DAPI researchers plan to provide solutions to emerging process problems in industry and conduct period meetings with member companies to discuss research issues. As they do so, they will develop their new data analytics algorithms and deliver leading-edge tools and technology.

Visit: ise.rutgers.edu/dapi-lab

Yada Zhu: Innovation

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DAPI (continued)

working relationships with both government agencies and industrial partners. Faculty members in DAPI have had research funded through government agencies, industrial partners, and foundations, including the Robert Wood Johnson Medical School, the National Science Foundation, Samsung Electronics, General Motors, Corning, and Ford Motor Company.

The laboratory’s research encompasses a wide array of fields, ranging from healthcare and traffic analysis to manufacturing improvements in glass formation and batteries. The systems being developed employ modeling, data collection and analysis, monitoring, and process control. Initial research areas include manufacturing, healthcare, and intelligent transportation systems.
Industrial and Systems Engineering graduates from the past five decades enjoyed an evening with Dean Thomas Farris and department chair Mohsen Jafari at the first annual ISE Alumni Networking Event in May. Meant as an opportunity for graduates to meet one another in an informal atmosphere, the event was hosted at the Battello restaurant in Jersey City, just across the Hudson River from New York City.

Some of the alumni present graduated as far back as 1968, while others left Rutgers more recently.

Paul Lomelo (ENG’96, GSNB’02) was recognized for earning the first Rutgers ISE Outstanding Contribution Award. Sofia Hernandez (ENG’16) was also lauded for being the first Rutgers student to earn the German Center for Research and Innovation Foundation Engineering Prize in 2016.

The networking event’s success has inspired similar alumni programs, which will occur throughout the academic year. The ISE Industry Day will take place this semester, and will allow students and faculty to network with alumni and their employers. The next alumni networking event will take place in May 4, 2017.
What if playing cops and robbers could inform how defense strategies are built for response to real attacks? That’s the thinking behind the GRIST project that is being developed at Rutgers School of Engineering’s Department of Industrial and Systems Engineering.

“Using game theory, the study of mathematical models of conflict and cooperation between intelligent decision makers, we can build a game where we would divide the decision makers as attackers and defenders, then use the game to better understand which infrastructures an attacker would go for,” said Melike Baykal-Gürsoy, director of the Laboratory for Stochastic Systems and the lead researcher on the project.

Along with ISE doctoral candidates Abdolmajeed Yolmeh and Zhifan Xu, computer science students Mudassar Zaidi, Jennifer Borucki, Andrew Choliy, and the director of the Virtual Worlds, Rick Anderson, Baykal-Gürsoy is creating a playable game for humans to compete against each other. Attackers simulate attacks on certain targets, while defenders figure out how to block them.

The project, which has received support from the National Science Foundation, creates an immersive virtual world that intelligently tracks how players behave and can learn from the activities performed by them. From this data, researchers can simulate how actual terrorists might behave in a given situation, helping law enforcement predict and plan responses for attacks. In addition to the game itself, Baykal-Gürsoy’s team intends to collect data by analyzing specific targets like transit facilities, banks, and other public areas.

“This project is related to seeing some of the news about attacks. I noticed that crowds are important for some attackers, and you want to limit those attacks,” she said.

The team has already built a simplified version of the game on their website, which they use to collect data and demonstrate their concept. This current game is two-dimensional, but the more complete game will be three-dimensional.

“We demonstrated the 2-D game at Rutgers Day and the School of Engineering’s open house and collected the data,” Baykal-Gürsoy said. “We are now building a 3-D game, which will be more informative.”

The project has several distinct areas of focus unified under the central theme of using security game play data to gain insight into attacker models. One focus emphasizes what policies an attacker must follow to inflict the most damage and what policies a defender should have to limit the attackers success. Player behaviors are studied to analyze how actual attackers and defenders might react to different situations.

Another focus is on member behavior, but allows for differences in what each attacker or defender might know. Known as “private information,” this research assumes that the unique ideas and knowledge of different participants will form the basis for their attack or defense strategies, similar to real-world situations. The focus considers variable parameters as a factor, and will help defenders optimize their work while assuming they do not have all the available information. Still another looks at how players allocate technical resources to alter detection capabilities in addition to the defend-attack game.

Combining these different areas of research can result in a comprehensive game while simplifying the development process for each researcher involved. Along with undergraduate students from the Aresty Research Program, the doctoral candidates working under Baykal-Gürsoy will determine the most efficient and successful methods for creating a game that can simulate an attack. Data from the game can then be used to help model actual attacks from terrorists.

Preliminary results show that attackers are more likely to attack the first possible target, while defenders focus on high-value locations rather than all possible targets.

“Oh these in mind, we were able to come up with an algorithm that can improve the probability of the attacker being captured,” Baykal-Gürsoy said.

She hopes that her work will help law enforcement and other groups identify new strategies to deal with public safety and security.

“There are different types of attackers who operate differently,” she said. “We want to know, can you learn from the attackers?”
If one of the defining distinctions of the Rutgers School of Engineering program is to prepare students academically and make them career-ready, industrial engineering students demonstrated their capable skills during the recent Institute of Industrial and System Engineers Northeast Regional Conference. Hosted and fully-organized by Rutgers IE students, under the direction of Professor Jim Luxhoj, the three-day conference included presentations across a variety of industries, networking sessions, and workshops. More than 120 students from throughout the northeast attended.

The event brought together more than 10 industrial engineering professionals as speakers, representative of the diverse fields where IEs are employed, said Natalia Soler, an ISE senior and chair of the conference.

“Rutgers industrial engineering alumni work within so many more distinct areas than some of the other schools participating in the conference,” said Soler. “Participants were impressed by our speaker roster that included ISE alumni working at top firms in distribution, operations, finance, transportation, and consulting.”

Presentations during the conference included representatives from companies, including Accenture, Deloitte, Lockheed Martin, Johnson & Johnson subsidiary Ethicon, Anderson Windows, St. Onge, and Tiffany & Co. Topics included business technology, IE applications for the defense industry, global supply chain challenges, and project management roles in healthcare and finance.

“We had amazing connections to presenters which provided students an awesome opportunity to learn firsthand how industrial engineers impact the success of the companies they work for,” Soler said.

School of Engineering alumni, including Jeffrey Metzler from Ethicon, Jeffrey Larson from Tiffany & Co., Josue Jolibois, and keynote speaker Ray Attiyah joined the speakers in discussing their post-Rutgers careers, providing advice for the attendees.

Guests came from different institutions in the tri-state and surrounding areas, including the New Jersey Institute of Technology, Northeastern University, and Worcester Polytechnic University.

“The opportunity was there to provide students with the perfect networking chances,” said Vidita Gawade, one of the conference planners. “I believe people should attend conferences for the new things you get to learn and the new experiences you gain.”

To honor the memory and legacy of industrial and systems engineering professor, Tayfur Altiok, the Department of Industrial and Systems Engineering and the Altiok family established the Tayfur Altiok Scholarship Fund, following his death in 2012. The scholarship supports outstanding graduate students pursuing research in the areas of queueing theory, simulation modeling, and risk analysis. Altiok’s many research contributions included homeland security, marine port logistics, supply chain management, production optimization, and performance analysis.

The 2016 scholarship was awarded to doctoral student Sangahn Kim who is studying the relationship between two queueing systems and the application of those systems in modeling and analyzing real life conditions.

To honor the research he valued, please consider a gift to the Altiok Scholarship Fund. Checks made out to “Rutgers University Foundation,” with “Tayfur Altiok Scholarship” in the memo line or in a note accompanying the check, may be mailed to: Rutgers Engineering, Annie Nienaber, Office of Development - Room B103, 98 Brett Road, Piscataway, NJ 08854.
Meet Industrial and Systems Engineering Alumnus Joel Reiss ENG’92

What do you do at TransDigm?
TransDigm is a leading global designer, producer, and supplier of highly engineered aircraft components, systems, and subsystems for use on nearly all commercial and military aircraft in service today. I oversee four operating units: Adams Rite Aerospace, Hartwell Corporation, Airborne Systems North American and Airborne Systems Europe.

What’s unique about these divisions?
Our engineered components are custom designed for a particular function. The array of products that I oversee includes aircraft exterior latches, faucets, cockpit doors, guided parachute systems for troops and equipment, as well as parachutes for space capsules.

Why did you study industrial engineering?
I came in wanting to study electrical engineering, but on the second day of classes I realized it wasn’t the field for me. I’m more people oriented and when I saw the IE presentation during the introduction to engineering course I knew that was for me.

Do you have any favorite Rutgers memories?
I really enjoyed my graduating class, everybody was really collaborative. We figured things out together and gelled really well. Dr. Luxhoj was a great teacher. I was president of the IIE student chapter for two years and he was the faculty advisor so I got to spend a lot of time with him. He was an engaging professor, he made the topic interesting and you wanted to do well for him.

How would you describe your leadership style?
Give trust and earn respect is the hallmark of great leadership. I prefer to ask questions rather than give people solutions. I also think it’s important that the leader creates a collective sense of purpose for the team – this way each individual understands why we are working on a project and what we are trying to do.

What project are you most proud of?
After 9/11, our company Adams Rite Aerospace was selected to develop and manufacture the systems to lock the cockpit door on all Airbus aircraft. Our challenge was to first keep the door secure – that is to withstand a terrorist breach. At the same time, we needed to be able to open the cockpit door in less than 5 milliseconds in the event of a rapid decompression event in the flight deck. Our solution to the combined challenge of strength and speed was what enabled us to win the program over about 100 competitors.

This was a once in a life time project to be part of. What we accomplished as a company was unbelievable in terms of the challenges we had to overcome and the importance and urgency of our mission. It’s something I am proud to have been part of.

Read the complete interview online at ise.rutgers.edu/reiss

You can’t teach passion, you can just help it bloom.

student news

The Rutgers University chapter of the Institute of Industrial and Systems Engineers (IISE) was named a Gold Award chapter, which was earned under the leadership of student chapter president Natalia Soler and faculty advisor and industrial and systems engineering professor Jim Luxhoj.

The Materials Handling Society of New Jersey recently awarded scholarships totaling $3,000 to seniors Eric Carvajal, Aldi DiNoshi, Mike Kovacs, and Madhav Sharma, for successfully creating a machine that automatically separates balls of different materials, densities, colors, and magnetic properties. This was the first design that performed the separation perfectly in many years of competition on this problem.

Nine ISE undergraduates attended the IISE annual meeting in Anaheim this past summer. During the meeting, William Joyce ENG’xx presented a paper on “Safety Risk Modeling of a UAS for Monitoring Beach Erosion,” which previously won the 2016 ISERC Best Paper Award in Systems Engineering and Design.
Taking the Lead in Energy Planning

Rutgers University’s School of Engineering and the Department of Industrial and Systems Engineering convene leadership forum to address energy distribution issues.

In an effort to address the leading issues impacting the energy distribution industry, the Rutgers School of Engineering recently convened a select group of leaders, representing major utilities, government agencies, independent service operators, and energy consulting companies, for a high-level day of discussions and strategy sessions. The Utility of the Future and Energy Innovation workshop, held on September 16, addressed a broad range of topics, including energy storage and grid integration, energy security and grid vulnerability, financial implications and techno-economic impact, and training the next-generation workforce.

The event, which is expected to be an annual gathering, drew more than fifty participants from California Public Utilities Commission, Quanta Technology, PSE&G, DNV GL Energy, Lawrence Berkeley National Lab, Exelon Corporation, Con Edison, and the New York State Department of Public Service, among others.

“It has become eminently clear to both providers and consumers of energy that we must find a better way to design and generate energy,” said Mohsen Jafari, professor and department chair of industrial and systems engineering at Rutgers University-New Brunswick. “By bringing together representative influencers for open and wide-ranging discussions on an annual basis, we hope to shape the conversation and drive innovation.”

The event was presented with participation from the Rutgers School of Engineering’s Department of Industrial and Systems Engineering, Laboratory for Energy Smart Systems (LESS) and Center for Advanced Infrastructure and Transportation (CAIT).

Visit ise.rutgers.edu/energyworkshop for participants list and presentations.