WAYNE STATE UNIVERSITY

Faculty Impact

From the Provost:

Welcome to the first issue of Wayne State Faculty Impact, a new e-newsletter highlighting faculty research, teaching, and service accomplishments. Although some departments and units already share faculty accomplishments such as awards, key publications, or grants, there were no vehicles to share outstanding faculty contributions that unfold over time.

The aims of this newsletter are to showcase the good work of faculty with the wider university community, enhance interest in interdisciplinary collaborations by highlighting a particular theme, and provide students and junior faculty with models of scholars who are persistent and creative in their quest for knowledge.

The inaugural newsletter focuses on faculty who are doing "Big Data" work. I invite you to contact my office for ideas for themes for future issues. Enjoy!

Keith E. Whitfield, Ph.D
Provost and Sr. Vice President for Academic Affairs

Keith E. Whitfield, Provost and Senior Vice President for Academic Affairs

Wayne State Professor Uses Edge Computing to Shore Up Big Data

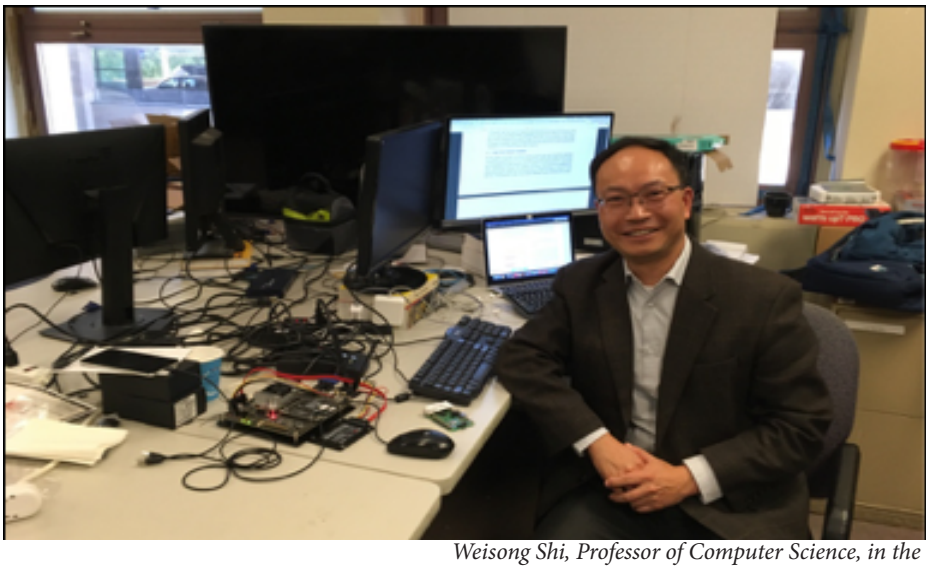
Big Data—that ubiquitous term used to describe the gathering and storage of large swaths of information for eventual analysis—and its utility are important considerations for Wayne State and the local community.

"I think the real challenge here is: How do you store the data? How do you transfer the data? And after you transfer the data, and then how do you process the data?" said Weisong Shi, Professor of Computer Science at Wayne State University.

A recent collaboration with an FBI agent in South Dakota illustrates Shi's point about processing large amounts of data that lie outside the computing capacity of traditional computer systems.

Shi and his team are currently working on a project related to live video analytics, which analyzes the live video data for automatic event detection. The question for Shi and his team: How to get the 100 terabytes of video from South Dakota to Detroit?

"You might think well [the] Internet is fast," Shi said. "But if you do a little math, you will find that if you're using a pure network [to] transfer this amount of data here, it might take several months to get the data here."



Weisong Shi, Professor of Computer Science, in the Connected and Autonomous dRiving (CAR) Laboratory, Wayne State University

The solution was more low-tech than you might think: Two of his students rented a car, purchased about 100 terabytes of disk space, and then drove to South Dakota to pick up the data. "…this is the fastest way to try to transfer this amount of data from South Dakota to here [Detroit]," said Shi.

One solution to Big Data challenges Shi proposes is edge computing, which differs from cloud computing. In cloud computing, data is collected and moved into the cloud, and then

processed in a centralized fashion. Edge computing, a new computing paradigm according to Shi, focuses on the large amount of data being generated at the edge of the network.

"So, basically, the idea of edge computing is in addition to the centralized processing in the data center, you have to do a lot of data processing at the edge of the network," Shi said.

His research aims to make computing resources (power, efficiency, and storage capacity) available at the edge of the Internet, i.e., close to mobile devices, sensors, and end users. The goal is to improve computer applications and systems computing power and efficiency.

"Computing is a core of many disciplines in the modern age," Shi said.

One potential application of edge computing is in public safety where Shi and his team are working on the EdgeBox. EdgeBox technology would be a useful tool for Detroit's green light project, according to Shi.

In 2016, the Detroit Police Department partnered with eight gas stations to install real-time cameras connected to police headquarters as part of a partnership between local businesses, the City of Detroit, and Project Green Light Detroit.

The big data challenges Project Green Light faces include data storage, data transfer, and data sifting. The EdgeBox solution is an example of technology that would provide the Detroit Police Department the computing power and tools to perform all three functions, according to Shi.

Edge computing presents a myriad of applications in a variety of research areas, but Shi remains focused.

"Looking from the outside, it looks like a lot of things are going [on] here…but the core part here is…what's your contribution to your discipline," Shi said. "I would say that my contribution right now in this area…is edge computing."

Water Warrior By Kelsey Husnick

Professor of environmental engineering works to safeguard Michigan's waters and inform the public about water issues.

A Michigan native, Dr. Carol Miller has always been fascinated with the Great Lakes. Her interest in the state's natural water resources began when she would camp along the lakes as a child with her family and transformed into a research agenda focused on one unifying theme: a healthy environment, and more specifically, healthy urban water systems.
Miller, a professor in the Department of Civil and Environmental Engineering who's been teaching at Wayne State University for over 30 years and is a former chair of her department, gets her students hands-on experience working in those water systems, too. Her efforts have secured grants from the National Science Foundation to maintain three local field stations, where students and faculty research everything from aquatic organisms to water treatment to beach health and water contamination.
"Wayne State University over the last couple of years has been making a name for itself in terms of the involvement of faculty and students in safeguarding the drinking water for this region," said Miller. "The Detroit River is a drinking water source for 4 or 5 million people on both the Canadian and U.S. side of the river, so it's an extremely important resource in that sense."

Leading that cause is Miller, who is also the director of a collaborative research effort called Healthy Urban Waters. The interdisciplinary groups tackles issues related to environmental degradation along the Huron to Erie corridor and the larger Great Lakes watershed. One such project helps Michigan and Canadian citizens pinpoint the level of contaminants in their drinking water at the exact moment it's extracted from the Detroit River before it gets treated and pushed out to homes and businesses.

"We've [developed] a website that provides real time information about the quality of the water at the point at which utilities are pulling the water in for drinking water," Miller said. "So we can see how the quality of the water changes from Lake Huron all the way down to Lake Erie, because there are a variety of water plants, not only the Detroit plants, that pull water in."

Another website developed by Miller and her team uses big data from local energy producers to show consumers exactly where their energy is coming from at a specific point in time. The website, Home Emissions Read-Out (HERO) Wayne, allows consumers in seven different states to input their zip code and get a forecast for their area's energy. The project, funded by the Great Lakes Protection Fund, uses data sets pulled in from the power grid, the water grid, the EPA and a host of other sources and inputs the information into a predictive algorithm.
"So people could know what time of the day tomorrow is wind going to be providing my energy. Or at what time of the day is hydropower, or at what time of the day is the dirtiest coal-fired plant in the state actually

Dr. Carol Miller is pictured along the Detroit RiverFront with two of her graduate student researchers.

going to be providing the energy to my home," Miller explained. "If you can give people that information, it allows consumers to make a decision on when they want to use up energy. And so if someone is especially concerned about pollution from coal fired power plants, they can use this information and decide to forgo energy use during this period when the dirtiest plants are online providing your energy. And they can then shift their energy use to times when clean or renewable energy is on the margin."

The project is managed by Miller and a handful of Wayne State professors and graduate students whose biggest challenge after acquiring the data needed for the project was "to get the existing sources of data to talk to one another," Miller said. The final result needed to be a piece of information that everyone — no matter their level of scientific or environmental understanding — could easily digest and make use of. HERO is used by everyday homeowners, as well as sophisticated water utilities. It's gained enough national attention that, according to Miller, "it's been adopted by the American Water Works Association out of Colorado as a technique that water utilities can use to shift their energy use to times of cleaner power sources."

These types of pragmatic implications are important to Miller, and, as she partners with other faculty at Wayne State and outside organizations such as the Henry Ford Health System, touch all aspects of life in Detroit. While the both above-mentioned research projects focus more on energy use, Healthy Urban Waters also tackles issues related to sustainability, environmental justice, and public health. These new collaborations have transformed the way water issues have been traditionally studied, especially from the perspective of an engineer.

Miller uses the flooding of homes, which has been a pervasive problem in Detroit, as an example: "In the past I think engineers have looked at those problems as simply infrastructure problems. Is the pipe not big enough, or is the pipe breaking, or how to fix the pumps, you know? Whereas now the issue is more, well how is this flooding impacting people? What happens when sewer backs up into someone's home? What are the health implication with that? How does mold develop in the home following flooding, and how can we remediate this?"

She hopes this type of growth will continue into other interdisciplinary directions, such as economics and public policy.

Want More Information?

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Have a story to share?

Contact
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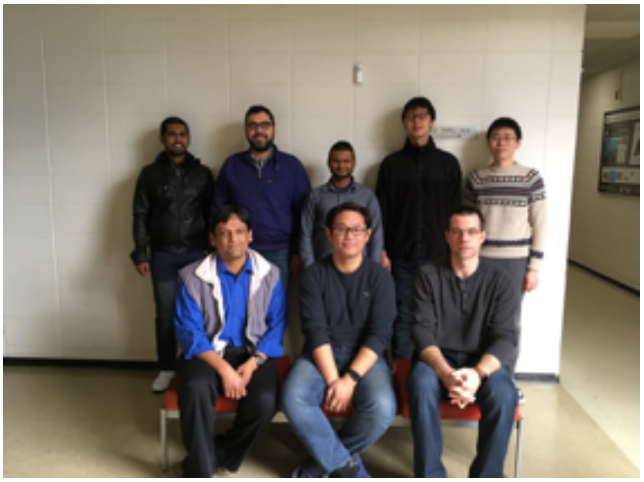
Wayne State leading the way in heavy-ion collision research By Keena Neal



Professor Abhijit Majumder (sitting from the left)and the JETSCAPE Collaboration Team

Scientists in the Department of Physics and Astronomy are developing the next generation of software to simulate the physics of ultra-relativistic heavy-ion collisions.

At the helm of the research project is Abhijit Majumder, associate professor and the lead principle investigator (PI) for JETSCAPE Collaboration, a multi-institutional, multi-disciplinary collaboration funded by a four-year, $4 million grant from the National Science Foundation.

"So, I think before I came along, there wasn't a person who was really working on this particular topic at Wayne," Majumder said.

Scientists use heavy-ion collisions to produce a hot, dense liquid known as Quark-Gluon Plasma, thus recreating the conditions that made up the beginnings of the universe.

"Microseconds after the Big Bang—we believe…the entire universe was just a plasma of quarks and gluons," Majumder said.

The Quark-Gluon Plasma exists only at and above 2 trillion Kelvin. As the universe expanded, the plasma cooled and condensed into protons and neutrons. Today scientists use heavy-ion collisions to produce this liquid.

"In these collisions—most of the times you get this hot plasma. But every once in a while, you get this extremely high energy jet that comes out. It usually starts out as one quark or one gluon that has an energy that is a lot higher than anything else around it," Majumder explained. "My theoretical specialty is looking at and studying jets and how these are changed by plasma."

Wayne State is leading the way in jet quenching research and Majumder is the university's leading scientist in this discipline. Jets are useful tools Majumder said jets are useful tools to study the internal structure of the quark-gluon plasma.

Theorizing is a critical part of Majumder's research in physics; his doctoral and post-doctoral training is in theoretical physics. In order to test theories, scientists require sophisticated methodological tools. Majumder is no exception.

"And if you want to compare with extensive experimental measurements, what you need is to have an elaborate simulator. That's ultimately how we do everything we do, we simulate it," Majumder said.

The challenge is developing a simulator that has the computing power and speed to test the various parameter combinations associated with multiple theories. JETSCAPE's interdisciplinary team of physicists, computer scientists and statisticians are working toward developing software that will carry out the simulations.

The JETSCAPE Collaboration includes computer scientists at Wayne State and statisticians at Duke (along with other physicists at Berkeley, Duke, Lawrence Livermore National Lab., MIT, Ohio State, Texas A&M, and Tennessee) to develop the software. Wayne State, as the leading institution, receives half of the grant funding, approximately $2.2 million.

The JETSCAPE team has two years left on the NSF grant to complete the project. Majumder said the software will be rolled out in stages.

"And about six months ago, we put our first product on-line, so people could start using it," he said.

Next year, Majumder and his team will develop an even bigger version of the simulator. In the final years, JETSCAPE will develop two versions of the simulator: one to run on regular CPU machines and one that will run on GPU machines. Once finished, Majumder said the software will be available to scientists throughout the world.

"We are the leading institution and that I think is…basically a testament to the amount of strength that we have in this field at Wayne State," Majumder said.