THE MONTHLY OPT-IN

AI4OPT Monthly Newsletter

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FROM THE DIRECTOR

AI and machine learning have been extremely successful in leveraging large amounts of data for computer vision, natural language processing, and playing games. Optimization approaches tend to focus on models rather than data but have been widely deployed in practice. The mission of AI4OPT is to revolutionize decision making at massive scales by fusing AI and optimization. mathematical Βv combining the power of AI and optimization, AI4OPT moves from optimization solutions to intelligent systems. It unifies the data-driven and model-driven approaches at the core of AI and optimization. An example of combining AI and optimization is the work of Yao Xie, who is featured in this month's newsletter. Xie is leveraging AI and optimization to better understand uncertainty and uses it to make better decisions. In fact, she was just awarded the prestigious Donald P. Gaver, Jr. Early Career Award for outstanding contributions at the interface of operations research, statistics, machine learning, and optimizations.



AI4OPT is leading the conversation on AI and optimization, and was well-represented at the **INFORMS** Annual Meeting, one of the largest conferences in optimization and decision making. AI4OPT organized six sessions and numerous talks on ethical AI, combinatorial learning, and end-to-end optimization, among many other topics. AI4OPT continues to push the boundaries of AI and optimization to create the next generation of optimization systems.

- Pascal Van Hentenryck

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MEMBER RESEARCH SPOTLIGHT

WORK AND CONTRIBUTIONS OF AI4OPT TEAM MEMBERS

The research of Yao Xie consists of developing predictive and detection algorithms with uncertainty quantification that can be robust, online/for streaming data, and deployed in the spatio-temporal setting and for graph data.



Uncertainty Quantification Using Conformal Inference and Neural Networks for Prediction

By Yao Xie

Uncertainty quantification (UQ) has proven to be increasingly valuable in prediction pipelines and is closely related to both AI4OPT's methodology and theory developments. My primary research area is in statistics, particularly change-point detection in sequential and spatio-temporal data, and hypothesis testing. These efforts under AI4OPT's decision-making and uncertainty thrust have a direct effect to energy use systems.

We want our spatio-temporal prediction (STP), which is used in data analysis when data is collected across both space and time, to be used for wind power generation prediction and solar power generation prediction. We are using novel methods based on conformal prediction, called CONFOR-MAL, which is a new type of distribution free methods for quantifying the uncertainty for general machine learning predictive methods.

The wind power generation data we have is from a wind farm in the Midwestern United States region. The challenge is that the data is timevarying. Winds not only changing in magnitude but also direction which can leave the prediction to become more complex when you take both time variations into account. We also need to do this, considering the spatial temporal correlations of the data and a lot of the predictions in the past have been one dimensional times series.

Now we're considering multidimensional and high dimensional time series where each dimension of the time series corresponds to one location, wind power generation and the different directions. We want to do the prediction for spatio-temporal setting because in these use cases such as wind power predictions, we need to consider prediction at the same time for different locations. So, the prediction is based on graphs in certain networks.

Harvesting neural network-based methods coupled with conformal inference to quantify the uncertainty of the prediction is also important for the next stage of optimization algorithms.

About Yao Xie

Yao Xie is an Associate Professor and Harold R. and Mary Anne Nash Early Career Professor at Georgia Institute of Technology in the H. Milton Stewart School of Industrial and Systems Engineering, and an Associate Director of the Machine Learning Center. She received her Ph.D. in Electrical Engineering (minor in Mathematics) from Stanford University and was a Research Scientist at Duke University. She received the National Science Foundation (NSF) CAREER Award in 2017, INFORMS Wagner Prize Finalist in 2021, and the INFORMS Gaver Early Career Award for Excellence in Operations Research in 2022. She is currently an Associate Editor for IEEE Transactions on Information Theory, IEEE Transactions on Signal Processing, Sequential Analysis: Design Methods and Applications, INFORMS Journal on Data Science, and serves on the Editorial Board of the Journal of Machine Learning Research, and an Area Chair of NeurIPS in 2021 and 2022.



ADDITONAL INFORMATION
To view Xie's website, click here.
To read Xie's publications, click here.

DEVELOPMENTS & ACCOMPLISHMENTS

WE TAKE PRIDE IN OUR WORK AND ACHIEVEMENTS

Fellowship Announcements

AI4OPT sends congratulations to Farzana Hussain, a participant in the first cohort of the AI4OPT Faculty Training Program, for receiving a fellowship from the AIM-AHEAD (Artificial Intelligence/Machine Learning Consortium to Advance Health Equity and Researcher Diversity) program, which is funded by the National



Institutes of Health. Hussain, an Associate Professor and Chair in the Department of Mathematics at Huston-Tillotson University, takes what she has learned from the faculty training program and applies it to the AIM-AHEAD Research Fellows Program, which aims to face disparities and inequities in health by ways of data science, machine learning, and artificial intelligence. What an honor, Farzana!



(Pictured: Farhana Hasan, HerWill Founder and CEO) Photo by: Takmila Faiza Farid

AI4OPT would also like to congratulate Farhana Hasan, Founder and CEO of HerWILL, for receiving a fellowship during the International Women's Forum (IWF). The 2022-2023 Leadership Fellows class is the largest in program history.

Hasan and her team work closely with the AI4OPT Institute in order to spur innovation and expand STEM and data research opportunities for underserved students and academic communities. Well done, Farhana!

Big Win at INFORMS 2022

Yao Xie, a member of AI4OPT, took home the Donald P. Gaver, Jr. Early Career Award for Excellence in Operations Research. One recipient receives the prestigious award each year and is selected out of the entire INFORMS society.



(Pictured: Xie following acceptance speech during ceremony.)

Xie successfully applied her research talent to applications of societal importance; and for her contributions to the education and mentoring of students at all levels.



(Pictured: Xie with her students.)

INFORMS, the largest association for the decision and data sciences, named 12 outstanding members as Fellows. The 2022 INFORMS Fellows were inducted during the INFORMS Annual Meeting in October.

STUDENT HIGHLIGHT/EVENTS GET TO KNOW OUR STUDENTS!

Meet Rachel Harris, a 2nd-year Ph.D. student in ECE at Georgia Tech, who is working to distribute optimization algorithms for power systems. She currently focuses on making distributed optimal power flow (OPF) more robust to cyberattacks and communication errors. While these distributed algorithms rely on communication



between local computing agents, she uses neural network approximations to find OPF subproblems to replace missing or corrupted shared data.

Harris joined AI4OPT this year and during these past few months, her interest peaked in using machine learning to detect and mitigate such attacks. Her adviser, Professor Daniel Molzahn, the co-lead for the "Energy Systems" end use case team, directed her toward AI4OPT, where she now collaborates with others interested in using artificial intelligence to enhance distributed optimization.

Q: What sparked your interest in Artificial Intelligence (AI) and optimization?

A: I want my research to contribute to the global effort to supply reliable power while reducing carbon emissions to protect our planet! Advances in AI and optimization will help us solve complex problems regulating huge numbers of distributed energy resources (electric vehicles, battery storage systems, wind and solar units, etc.) for cost-efficient, low-carbon energy.

Q: What's something unique about you?

A: I am really into hiking mountains. I did my undergrad in Utah where I lived in the Foothills of the Wasatch Mountain Range and could walk from my apartment to the trailhead in 10 minutes. Now, I have to travel farther for a great hike, but I've found some new favorites in Georgia (Brasstown Bald, Blood Mountain, and Cloudland Canyon are all great, and Kennesaw Mountain is only 30 minutes from Atlanta and offers decent elevation gain). I also visit family in Colorado regularly, where there are some of the best mountains in the country.



Q: What do you do when you're not studying? A: I spend lots of my free time at Piedmont Park! I go there for morning runs, evening walks, or just to sit and read a book on the bench by the lake. It's an awesome green space in the city.

AI4OPT's Student Leadership Council Gears up to Launch The Student Leadership Council (SLC) will consists of students who take on a leadership position within the Institute. The SLC will serve as a voice for the students of AI4OPT and as a vehicle for student led programs and activities.



NEWS & PUBLICATIONS

CURATED COVERAGE OF OUR RESEARCH AND EVENT APPEARANCES

AI4OPT Members Attend INFORMS 2022

Al4OPT hosted a cluster of sessions during the Institute for Operations Research and the Management Sciences (INFORMS) 2022 Annual Meeting in Indianapolis, last month. Beyond the planned sessions were smiles among our team members in addition to the thousands of presentations and network opportunities for operational research (OR) and analytics professionals and students



informs annual meeting

2022



Three papers by Al4OPT researchers are featured in the November edition of the <u>Electric Power Systems Research</u> journal. The papers assess how corrupted data may negatively impact optimal power flow algorithms, discuss how to create realistic synthetic data to enable modern research, and introduce AI methods to speed up distributed optimization algorithms.

- Mohannad Alkhraijah, Carlos Menendez, and Daniel K. Molzahn. Assessing the Impacts of Nonideal Communications on Distributed Optimal Power Flow Algorithms. Electric Power Systems Research, 212:108297, 2022. doi: 10.1016/j.epsr.2022.108297
- Minas Chatzos, Mathieu Tanneau, and Pascal Van Hentenryck. Data-Driven Time Series Reconstruction for Modern Power Systems Research. Electric Power Systems Research, 212:108589, 2022. doi: 10.1016/j.epsr.2022.108589
- Sihan Zeng, Alyssa Kody, Youngdae Kim, Kibaek Kim, and Daniel K. Molzahn. A Reinforcement Learning Approach to Parameter Selection for Distributed Optimization in Power Systems. Electric Power Systems Research, 212:108546, 2022. doi: 10.1016/j.epsr.2022.108546

AI4OPT Participates in First HerWILL Community Meeting To Help Lessen STEM Education Gap for Underrepresented Youth

Al4OPT joined the nonprofit, Women Inspired in Life and Leadership (HerWILL), for the launch of the HerWILL community meeting. More than 25 participants gathered for the virtual meeting that talked about STEM career paths, particularly in data science and AI, to underrepresented youth from around the world.





Kevin Dalmeijer, who oversees operations as the director managing of AI4OPT was among the of presenters. group Dalmeijer discussed the long-term partnership between the two organization along with HerWILL founder and CEO, Farhana Hasan.

(IAC)

FACES OF OUR NEW COMMITTEE AND MANAGEMENT TEAM

NDUSTRY ADVISORY COMMITTEE



Tim Vanderham NCR Corporation



Tongxin Zheng ISO New England Inc.



Debra Lam Georgia Tech



Jonathan Owen General Motors



Amy Wheelus AT&T



Michael Plasencia Ryder System, Inc.



Mark Hess Comcast



Scott King Amazon

DeStefano

Quality Contro Board Leader



Jon Orwant Google AI



Anne Robinson Kinaxis



Mike Downey UPS



Russell Bent Los Alamos National Laboratory



AI4OPT held its first Industry

meeting at Georgia Tech, last

month. The main purpose of

Advisory Committee

committee and discussed how to select industry projects, how to balance short-term and longterm goals, and how to develop master agreements for collaborations.



Brian Moore Kahua



Craig Lawton Sandia National Laboratory

AI4OPT MANAGEMENT TEAM UNDER PASCAL VAN HENTENRYCK



evin Dalmeijer

Managing

Director







Berkley Site Director





Cami Douglass

Executive



Breon Martin



Charles Pierre







Raluca Scarlat

Stephanie Sigler

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MARK YOUR CALENDAR!

UPCOMING AI4OPT EVENTS

• AI4OPT Seminar Series

• Yinyu Ye (Nov 11)

To watch past seminars, click here.

Tutorial Sessions (Nov 14 - 18)

 Subhabrata Sen, an assistant professor in the Department of Statistics at Harvard University, will deliver a week-long multipart tutorial at Georgia Tech, which will be featured on the <u>AI4OPT YouTube channel</u>.

FULL EVENT LIST

AI4OPT PRESENTS TECHFEST



Join us and hear from Georgia Tech President, Ángel Cabrera, Executive Vice President for Research (EVPR), Chaouki Abdallah, members of AI4OPT, and presentations from the Institutes core industrial partners.

When: Wednesday, November 16, 2022 Time: 8:30 a.m. to 5 p.m. Where: Georgia Tech Dalney Building (926 Dalney St. NW, Atlanta, GA 30318)

BE SURE TO **<u>RSVP</u>** BY NOVEMBER 9.

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OUTREACH

WE'RE HIRING PH.D. STUDENTS AND POSTDOCS AND LOOKING TO EXPAND OUR PARTNERSHIPS!

WE'RE HIRING!

Collaborate, learn, and plan your career alongside current and future academic and industry experts in operations research, analytics, data science & more at AI4OPT!

Click here, for more information and how to apply:

- Post-Doctoral Fellows at Georgia Tech
- Post-Doctoral Researcher at USC
- Ph.D. students at Georgia Tech

PARTNER WITH US!

At AI4OPT, we are expanding our team of collaborators. We seek to work with industry leaders and companies who share our purpose and want to create an impact through AI and optimization.

Our current and long-term Industrial Partners include:

- Argonne National Laboratory
- Google
- Intel
- ISO New England
- Kahua
- Kinaxis
- Los Alamos National Laboratory
- Ryder System, Inc.

AI4OPT is funded by the <u>National Science Foundation</u>. 🏌



CONNECT WITH US!

We aim to broaden community contribution through the development of an AI and mathematical optimizationbased system to address societal challenges in energy, logistics and supply chains, resilience, and sustainability and circuit design and control.

Subscribe and follow us to learn more about our latest projects and research and upcoming community events. If you are interested in media relations or AI4OPT's research, education and partnership initiatives email and call us by clicking here.

Email, subscribe, and follow us to learn more!