Researchers developing solutions for smart city infrastructures, autonomous vehicles

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Credit: Florida International University

FIU researchers are working to solve the problems of tomorrow. Specifically, the future of smart city infrastructures and autonomous vehicles, vehicles that can drive themselves.

Two researchers from the College of Engineering & Computing—M. Hadi Amini, an assistant professor in the School of Computing & Information Sciences, and Alireza Rahimi, a doctoral candidate in the Department of Civil and Environmental Engineering—are working on ways to revolutionize urban infrastructures, transportation networks and

how cities work.

Amini and his research group are currently developing distributed machine learning algorithms, as well as distributed intelligence and optimization methods, capable of dealing with real-time decision-making problems in interdependent networks, including energy networks, transportation networks and healthcare applications.

The HADI (Holistic Agent-based Distributed algorithm for IoT-based interdependent networks) is capable of solving large-scale decision-making problems in smart city infrastructures. Smart city infrastructure involves an evolved way of living and working, connecting energy systems, buildings and industries together with smart technology. Amini's recent research journal article published on *Patterns* provides a vision of data science problems in the context of interdependent networks and smart city infrastructures.

Part of Amini's research absorbs the fact that, while communication is necessary between autonomous technologies like drones and smart cars, having too much of an interconnected, interdependent network can lead to problems such as lack of privacy. That's why Amini focuses on algorithms for individualized learning and decision-making within the larger infrastructure.

His recent paper on distributed sensing platforms for distributed machine learning, co-authored by Ph.D. student Ahmed Imteaj received the best paper award at the 2019 IEEE Conference on Computational Science & Computational Intelligence (CSCI 2019).

This decentralization and working in distributed ways can also lead to increased safety. One example Amini used is pacemakers and the potential dangers of having thousands on one, interconnected, hackable network.

Amini looks at decision making—who's making the decisions, the vehicle or the driver? – and optimizing drone air traffic to prevent congestion.

"How can we develop intelligent decision-making frameworks for autonomous agents within the interdependent critical infrastructure? For example, when an electric vehicle is running low on charge, who chooses where and when to charge? How is the best decision made? Is it the driver or the vehicle that best understands these answers?" asks Amini.

These are some of the questions Amini and his team at FIU's Sustainability, Optimization & Learning for InterDependent Networks (solid) lab are working to answer.

Meanwhile, Rahimi believes autonomous vehicles may be the solution to many of today's problems.

"Autonomous vehicles would bring a great opportunity to increase the mobility options for different groups of people like seniors, disabled individuals and those who can't drive," said Rahimi.

Rahimi's research centers around autonomous vehicles and solving problems that may arise as their use becomes more prevalent—namely, traffic congestion. Traffic congestion could increase by approximately 20 percent in the United States once autonomous vehicles hit the roads.

Sponsored by the Florida Department of Transportation and the U.S. Department of Transportation University Transportation Center, Rahimi is working on projects having to do with a potential solution to this problem: shared autonomous vehicles.

"A solution to this issue is shared mobility. We are investigating travelers' behavior to develop plans and strategies to promote shared

autonomous vehicles," said Rahimi.

This solution doesn't come without its own challenges. Rahimi says, "Our studies showed that travelers' perception and attitude toward shared AVs play a pivotal role in their decision to adopt this technology. If we want people to use shared AVs, we need to address their concerns."

These concerns include the safety of sharing a vehicle with a stranger and the privacy involved with giving large companies the ability to track them.

Amini is the founding director of the Sustainability, Optimization and Learning for InterDependent networks laboratory (SOLID lab) at FIU, focusing on interdisciplinary topics at the intersection of optimization and learning theory, interdependent networks and sustainability. He is an awarded researcher with one best journal paper award, one best conference award and five outstanding reviewer awards from IEEE Transactions. He has more than 80 research publications, including five authored/edited books. He recently served as the editor of a new book published by Springer Nature entitled Optimization, Learning, and Control for Interdependent Complex Networks.

Rahimi has been a student at FIU since 2018, winning several prestigious awards including the Charles E. Perry Graduate Scholarship. He currently works as a graduate research assistant at the Lehman Center for Transportation Research.

More information: M. Hadi Amini et al. Interdependent Networks: A Data Science Perspective, *Patterns* (2020). DOI: 10.1016/j.patter.2020.100003