IMPROVING MISSION INTELLIGENCE WITHIN FLEETS OF ROBOTS

Posted by Amanda Stoneman | Apr 22, 2019 | Faculty

Above: Assistant Professor Stephanie Gil is one of 10 Ira A. Fulton Schools of Engineering faculty members to receive an National Science Foundation CAREER Award for 2018 to 2019. She will develop an algorithmic and mathematical framework to achieve better coordination and localization among fleets of robots.

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> *The National Science Foundation grants the Faculty Early Career Development Program (CAREER) Award to early-career faculty members who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization.*
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> ***Ten faculty members in the Ira A. Fulton Schools of Engineering have received NSF CAREER Awards between September 2018 and April 2019.***

A future filled with delivery drones, disaster-response robots and self-driving cars is upon us. These fleets of interacting intelligent agents are poised to have significant impacts by advancing the nation's capabilities in emergency response, search and rescue, space exploration, transportation safety and more.

For multi-agent cyber-physical systems to reach their full potential, the intelligent agents must understand their environment, know the state of other agents in the system and use this information to coordinate and complete mission-level goals across diverse platforms.

But there remain challenging technological barriers to enabling those intelligent agents to get the critical information necessary for them to fully coordinate their activities.

Stephanie Gil, an assistant professor of computer science and engineering in Arizona State University's Ira A. Fulton Schools of Engineering, will bridge robotics and communications to help multi-agent cyber-physical systems gain robust contextual awareness for better coordination and decision-making. The project is supported by a $500,000, five-year National Science Foundation Faculty Early Career Development Program (CAREER) Award.

"Normally in multi-agent cyber-physical systems, we think of communication as a way to relay information between agents," says Gil. "By looking at the problem from a communication-as-a-


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sensor perspective, there could be information already present within these systems, in the communication signals themselves, that can be exploited to improve agent capabilities in real-world environments."

For example, Gil and her colleagues have been able to protect multi-robot agreement algorithms, such as consensus, from a Sybil Attack by analyzing received wireless signals to reveal with high probability whether or not a message is coming from a unique sender.

Gil will derive an algorithmic and mathematical framework to utilize this new source of critical information to improve mission intelligence, coordination and localization among agents in cyber-physical systems.

"At the end of the day, information is only useful if you know how to use it," says Gil.

Gil's algorithms have the potential to make fleets of interacting intelligent agents more capable in situations where higher levels of contextual awareness are integral for achieving mission-focused tasks. Such situations include making driving safer for autonomous cars on the road, carrying critical medical supplies to accident sites as quickly as possible, or having robotic counterparts working with human emergency responders on search and rescue or reconnaissance missions in specific areas.

As part of the project, Gil will collaborate with the Arizona Department of Emergency and Military Affairs to develop technology for use in emergency management operations and coordination. Gil believes this collaboration is among the reasons the NSF selected her research proposal since cyber-physical systems can play an essential role in the effectiveness of future emergency response initiatives.

Receiving the NSF CAREER Award was "exciting" and "a big honor," says Gil. "I'm now able to push the envelope forward in terms of the coordination and control of multi-agent cyber-physical systems and pursue real impact in the next five years and beyond."

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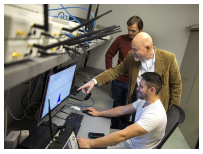

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ABOUT THE AUTHOR

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Amanda currently serves as a science writer in the Ira A. Fulton Schools of Engineering at Arizona State University. Prior to this role, she worked as a copywriter for five years in the College of Liberal Arts and Sciences and at G/O Digital (formerly GannettLocal). In 2013, Amanda earned a Bachelor of Arts in English (creative writing) at ASU. Now, she's pursuing a Master of Science in