National Institute for Occupational Safety and Health
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Swarm Robotics and its Potential for Complex Real-World Problems

Dr. Kiju Lee

Texas A&M University

Abstract: A swarm robotic system is distinguished by several key characteristics: distributed autonomy at both individual robot and swarm levels; 2) localized sensing and communication; 3) decentralized control; and 4) cooperative action for task performance. These qualities uniquely equip robotic swarms to efficiently tackle specific tasks, such as rapid large-area coverage, operations in dynamic environments, scalability within tasks, and ensuring redundancy to prevent critical failures. However, despite their potential, real-world applications of robotic swarms face technical challenges. Challenges include establishing reliable robot-to-robot communication, mobility limitations in smaller robots, and the lack of generalized algorithms for diverse task scenarios. To address these hurdles, our research group is undertaking several initiatives. These include 1) developing a scalable swarm simulator, 2) crafting universal algorithms for consensus-based decision-making and task allocation, 3) exploring hybrid strategies for dependable wireless communication, and 4) designing innovative robotic platforms with advanced locomotion capabilities. Our current focus is on enabling configurable and adaptive swarm-enabled automation solutions tailored for smart and collaborative agriculture – a pivotal step towards realizing the practical utility of robotic swarm technologies.

Bio: Kiju Lee joined Texas A&M University in Fall 2019, as an Associate Professor jointly affiliated with the Department of Engineering Technology and Industrial Distribution and the Department of Mechanical Engineering. She directs the Adaptive Robotics and Technology (ART) Lab, which facilitates interdisciplinary research and hands-on educational activities for both graduate and undergraduate students. Before joining Texas A&M University, Prof. Lee was with the Department of Mechanical and Aerospace Engineering at Case Western Reserve University, Cleveland, Ohio. Prof. Lee earned her MS and PhD in Mechanical Engineering from Johns Hopkins University, Baltimore, Maryland, and her BSE in Electrical and Electronics Engineering from Chung-Ang University, Seoul, Korea. Her current research program is funded by DARPA, USDA, are NSF.