COMPUTER SCIENCE SEMINAR

Bio-inspired Swarm Robotics: Natural algorithms to monitor nature

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Abstract: Natural systems have evolved decentralized, collective behaviors that are much more adaptive, flexible, and robust than anything built by humans. For example, right now trillions of T cells are crawling through your tissues, without a blueprint of your body or centralized instructions, protecting you from viruses and tumors. Uncountable numbers of ants crawl across forest canopies, desert sands and perhaps your kitchen counter, and each species uses its own decentralized strategy that tailors a small repertoire of sensing, navigation, and communication behaviors to forage effectively in its environment. Yet it remains a formidable challenge to engineer flexible and cooperative robotic systems that can function in the real world. We emulate natural search behaviors in robotic swarms that sense, navigate and communicate to search effectively in unmapped environments. We show that provably efficient search algorithms that work well in theory are not necessarily the best algorithms in practice, and that bio-inspired designs can effectively scale to thousands of robots. We implement search algorithms in ground robots designed for NASA to explore for resources and support human settlements on other planets and in UAVs designed to monitor gases emitted from volcanos. ¡br¿¡br¿ Bio: Melanie Moses is a Professor of Computer Science with a secondary appointment in Biology at the University of New Mexico (UNM) and an external faculty member of the Santa Fe Institute (SFI). Her current research includes the VolCAN project to develop a swarm of autonomous adaptive robots to predict volcanic eruptions, and SIMCoV, a spatial model of COVID-19 lung infection and immune response. She is a co-PI on two AI research institutes, one to rethink the foundations of intelligence at SFI, and the Proteus Institute at the University of Vermont. She is a member of the UNM/SFI Interdisciplinary Working Group on Algorithmic Justice and the CRA Computing Community Consortium. She recently led the NASA Swarmathon and NM CSforAll educational programs for thousands of high school and undergraduate students.

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