

MAE Seminar SERIES

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Dr. Federico Rossi

Robotics Technologist
Robotics Section
Jet Propulsion Laboratory
California Institute of Technology

MULTI-ROBOT SYSTEMS FOR PLANETARY EXPLORATION: NASA'S COOPERATIVE AUTONOMOUS DISTRIBUTED ROBOTIC EXPLORERS

ABSTRACT

This talk will present the autonomy architecture of NASA's Cooperative Autonomous Distributed Robotic Explorers (CADRE) mission, a technology demonstration that will deliver a team of autonomous rovers to the Moon's Reiner Gamma region in 2024. Multi-robot systems hold great promise to address a number of key questions in planetary science. They can observe phenomena of interest from multiple, geographically-distributed locations at the same time; produced detailed three-dimensional images of the subsurface through seismic and RADAR surveys; and offer increased resilience compared to monolithic explorers, enabling bolder exploration. Autonomy is a key enabling technology for these multi-robot systems: it allows agents to operate together as a team, building on each other's abilities, with no humans in the loop, a critical capability when light-speed delays and low bandwidth make teleoperation infeasible or inefficient. But how do we design, build, test, and fly algorithms for a team of autonomous robots? How should the robots decide who (if any) should be in charge; when they should drive, and when they should recharge; how to explore an unknown region together; and how to collect measurements in formation? In this talk, we will walk through CADRE's autonomy stack, explore the trade-offs that inform the design of a multi-agent autonomy architecture, and end by speculating about the future of multi-robot systems for planetary exploration.

BIO SKETCH

Dr. Federico Rossi is a Robotics Technologist with the Maritime and Multi-Agent Autonomy Group within the Robotics section of NASA's Jet Propulsion Laboratory. He received a Ph.D. in Aeronautics and Astronautics at Stanford University under the guidance of Prof. Marco Pavone in 2018 with a thesis "On the Interaction between Autonomous Mobility-on-Demand Systems and the Built Environment: Models and Large Scale Coordination Algorithms". Prior to that, Federico received a dual M.Sc. in Space Engineering from Politecnico di Milano and Politecnico di Torino, Italy, in 2013. He is an alumni of the Alta Scuola Politecnica. Federico's research focuses on the design and development of algorithms that make teams of autonomous robots work effectively together. Applications of his work include planetary exploration with teams of autonomous robots and spacecraft, and coordination of fleets of self-driving cars for autonomous mobility-on-demand in urban environments. Federico is currently the Planning, Scheduling, and Execution lead for NASA's CADRE, a technology demonstration mission that is slated to demonstrate multi-robot exploration on the surface of the Moon with a team of four autonomous rovers in 2024.



University at Buffalo

Department of Mechanical
and Aerospace Engineering
School of Engineering and Applied Sciences