

# The Field Robotics Center

## Seminar Series

Thursday, 24<sup>th</sup> May

NSH 3305 1:00 – 2:00 PM



Lunch will be served

**Alberto Candela Garza**

PhD Student

Robotics Institute

Carnegie Mellon University

### Generative Models of Orbital and In Situ Data for Autonomous Science

**Abstract:** The mapping and characterization of planetary bodies relies on the analysis of data collected by spacecraft and orbiters. For example, the instruments carried by the Mars Reconnaissance Orbiter have been crucial in the mapping of landforms, stratigraphy, minerals, and ice of Mars. These instruments provide extensive contextual information, but factors such as sparsity, resolution, and noise leave uncertainty in the orbital analysis. Hence the need to send robotic explorers - such as Curiosity and ExoMars - to refine these models through the collection of definitive, in situ measurements. Given the many operational challenges and constraints that are faced during space exploration, finding underlying patterns between orbital and in situ data can reveal sampling locations that optimize information value, leading to increased efficiency during exploration

This talk first proposes two generative models relating remote and in situ data: one based on a variational autoencoder, and another based on Gaussian mixture models. It then describes tools from information theory for optimal experimental design and measurement planning. These methods are applied to spectroscopic observations of the Cuprite Hills in Nevada. The results indicate that the proposed methods are capable of inferring high resolution features from low resolution data, and that they also identify effective in situ sampling locations.

**Speaker Bio:** Alberto Candela is a PhD student in the Robotics Institute advised by David Wettergreen. He holds a B.S. degree in Mechatronics Engineering and a B.S. degree in Industrial Engineering from Mexico Autonomous Institute of Technology, as well as a M.S. degree in Robotics from Carnegie Mellon. His research uses artificial intelligence and machine learning for space exploration. During his graduate studies, he has spent time working at NASA's Jet Propulsion Laboratory. He is recipient of the Fulbright Scholarship.



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