

# The Field Robotics Center

## Seminar Series

**Thurs, May 9**

**NSH 1507**

**2:30-3:30pm**



Food and Drinks will be served

**James Lee**  
**MS Candidate**  
**Carnegie Mellon University**

### Graphical Methods for Mapping Underground Environments

**Abstract:** Robots are the perfect matches for the dull, dangerous, and dirty job of mining. Recent advances in robotics have enabled machines to operate independently from human operators and venture deeper into mines, map larger spaces, and more accurately relay scene and safety information back to base to remote users.

To do this, robots operating in underground spaces must accurately track their location and create maps. This chicken-and-egg problem of inferring robot pose and scene structure from one another is known within the robotics community as Simultaneous Localization and Mapping (SLAM) and many groups have successfully applied SLAM techniques to map underground spaces.

However, new developments in computing hardware and sparse linear algebra libraries have caused a renaissance of graphical approaches to optimization problems such as SLAM. These new approaches revolutionized large-scale above ground mapping but applying them to underground spaces has largely been left unexplored. These graphical methods can intuitively represent a wide range of problems as simple as back-propagating corrections along a series of robot poses to complex optimizations that jointly estimate pose and meld surface scans together using robot locomotion and surface smoothness priors.

The contribution of this thesis is a complete mapping and localization system optimized for operation in underground spaces. It combines state-of-the-art graph optimization routines, scan matching techniques, and error estimation theory into a holistic mapping solution. The algorithm is demonstrated on several robotic platforms in both active and abandoned mines across the globe.

**Speaker Bio:** James Lee is a Masters student at the Robotics Institute developing algorithms to map subterranean spaces. He received his Bachelors in Electrical and Computer Engineering at Carnegie Mellon University in 2011.



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