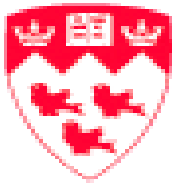


CS-417 INTRODUCTION TO ROBOTICS AND INTELLIGENT SYSTEMS

Midterm Review

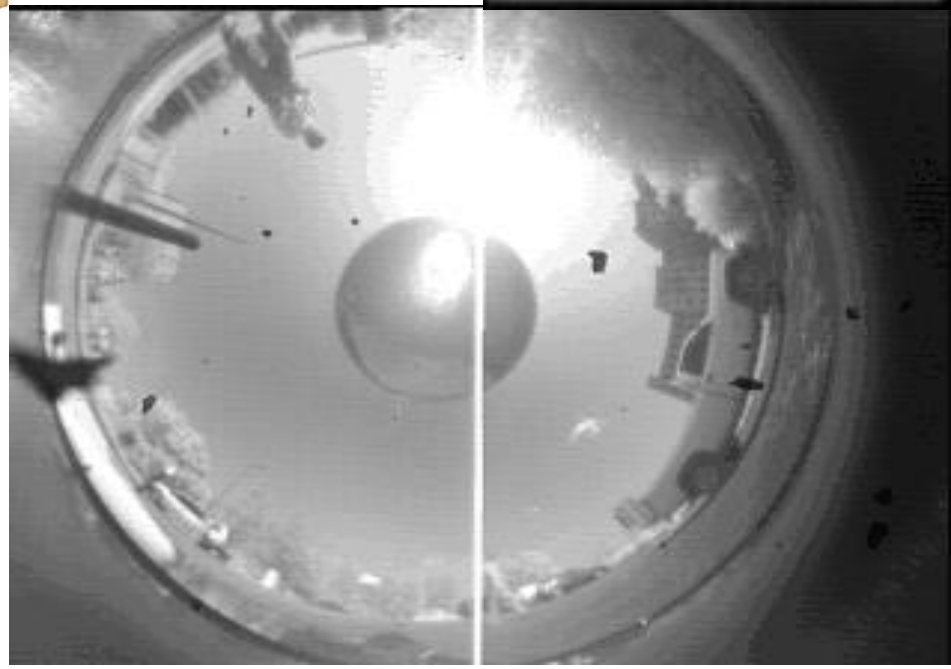
Ioannis Rekleits

Overview

- History
- Sensors
- Actuators
- Locomotion
- Mapping
  - Topological
  - Metric
  - Feature Based
  - Occupancy Grid
- Computer Vision
- Coverage
- Path-Planning
  - Visibility Graph
  - Bug (0, 1, 2, Tangent)
  - C-Space
  - Probabilistic Roadmaps
  - Potential Fields
  - RRT
  - Generalized Voronoi Graph (GVG)

Sensors

- **Proprioceptive Sensors**
  (monitor state of vehicle-propagate)
  - IMU (accels & gyros)
  - Wheel encoders
  - Doppler radar …
    - **Noise**
- **Exteroceptive Sensors**
  (monitor environment-update)
  - Cameras (single, stereo, omni, FLIR …)
  - Laser scanner
  - MW radar
  - Sonar
  - Tactile…
    - **Uncertainty**



Sensors

- Tactile
- Close-range proximity
- Angular position
- Infrared
- **Sonar**
- Laser (various types)
- RADAR
- Compasses, Gyroscopes, Accelerometers - IMU
- Force
- GPS
- Vision

Actuators

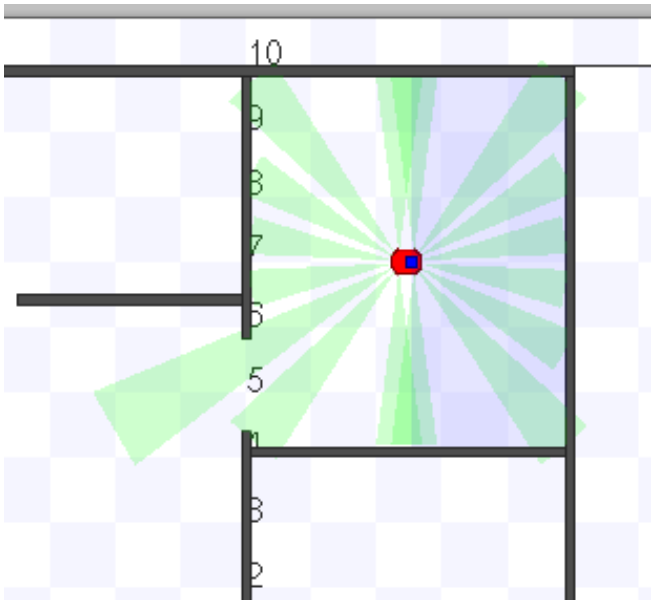
- Hydraulic Actuators
- Pneumatic Actuators
- Air Muscle
- Shape Memory Alloy Actuators
- Electric Actuators
- Stepper Motors

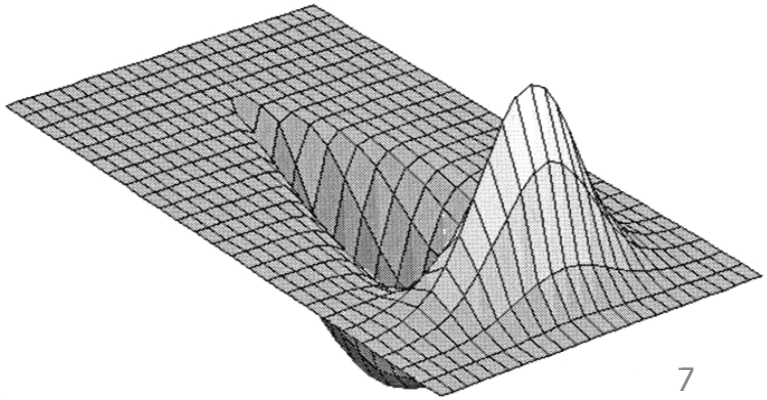
Locomotion

- Differential drive
- Synchronous drive
- Ackerman drive
- Legged Locomotion
  - Quadrupeds
  - Hexapod
  - Biped

Mapping

- Occupancy Grids
- Sonar model





Path Planning

World

- Indoor/Outdoor
- 2D/2.5D/3D
- Static/Dynamic
- Known/Unknown
- Abstract (web)

Robot

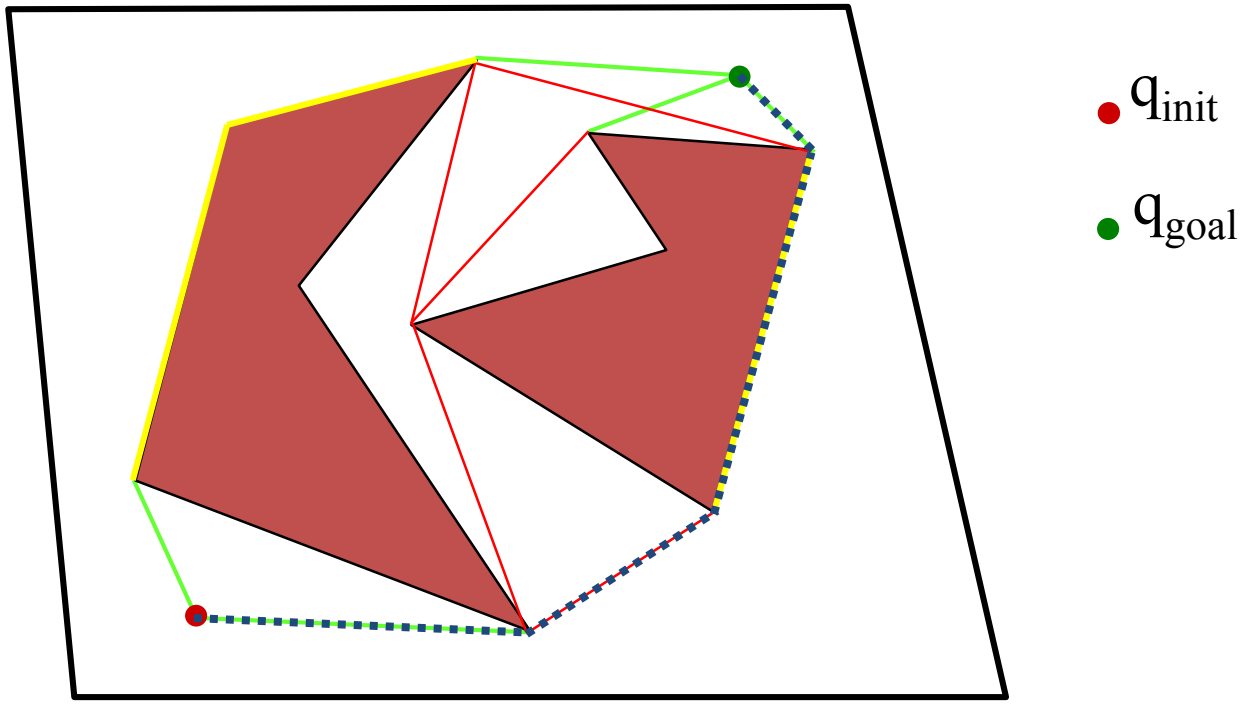
- Mobile
  - Indoor/Outdoor
  - Walking/Flying/Swimming
- Manipulator
- Humanoid
- Abstract

Map

- Topological
- Metric
- Feature Based
- 1D,2D,2.5D,3D

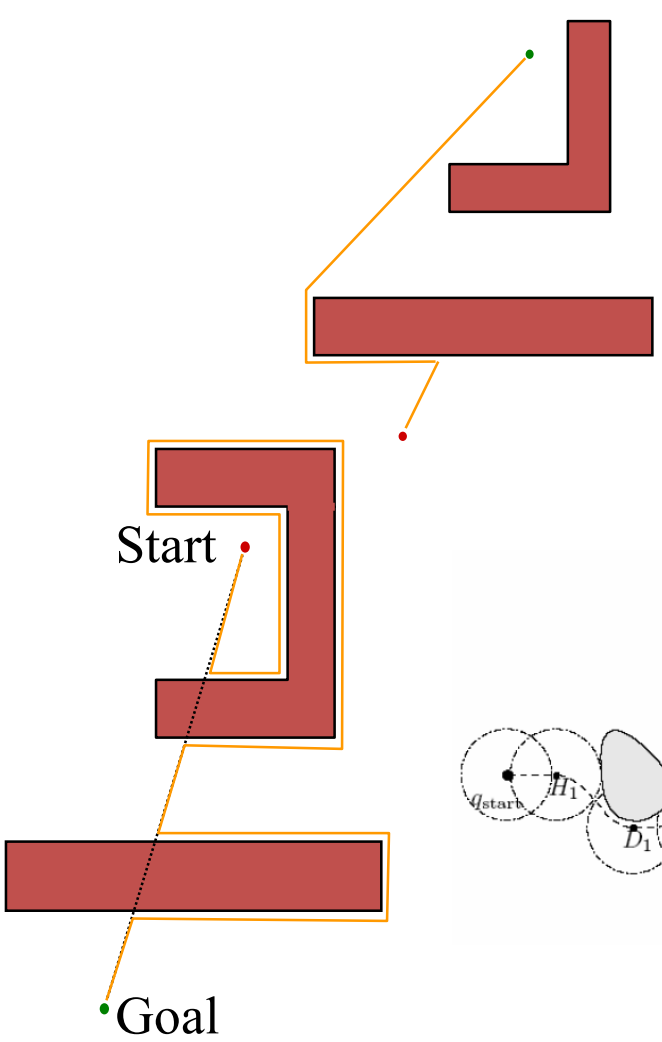
Path Planning

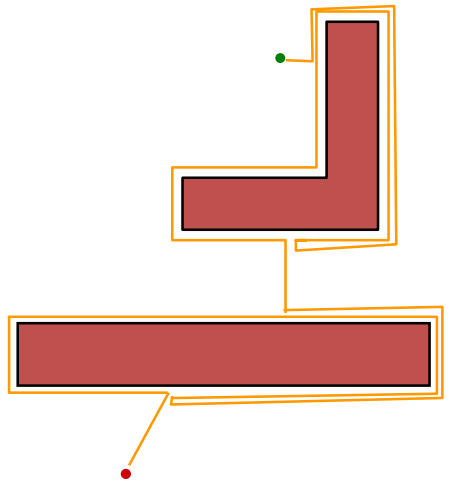
- Visibility Graph

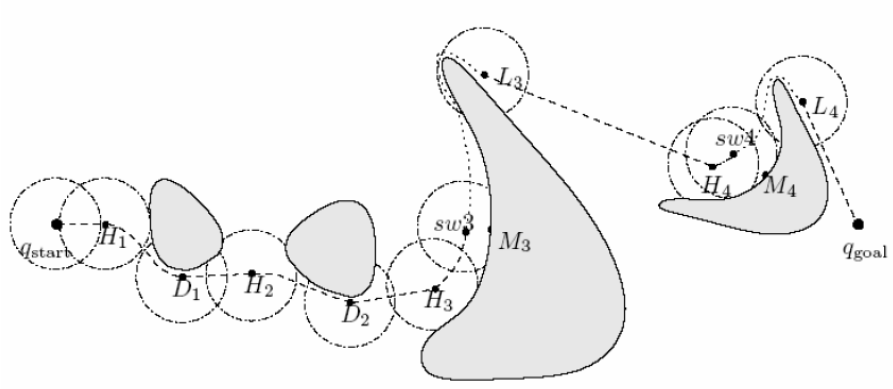


Bugs

- Bug0
- Bug1
- Bug2
- Tangent Bug

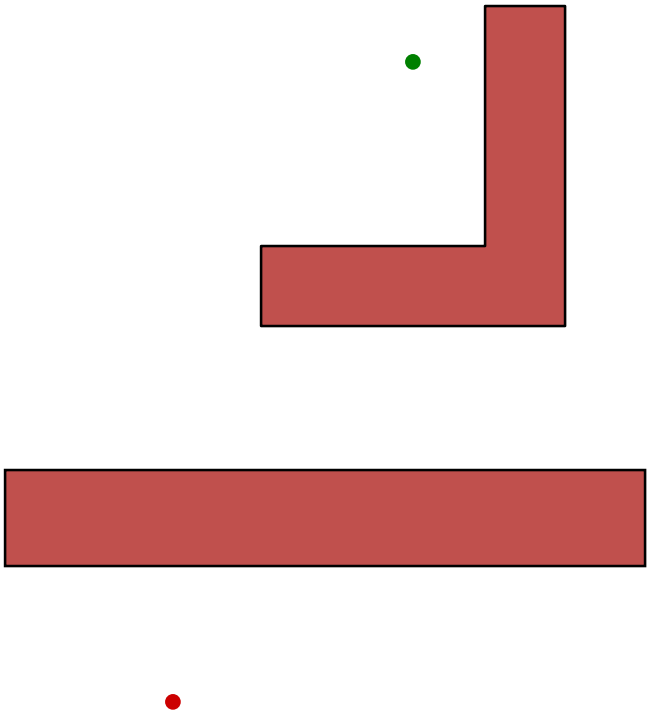




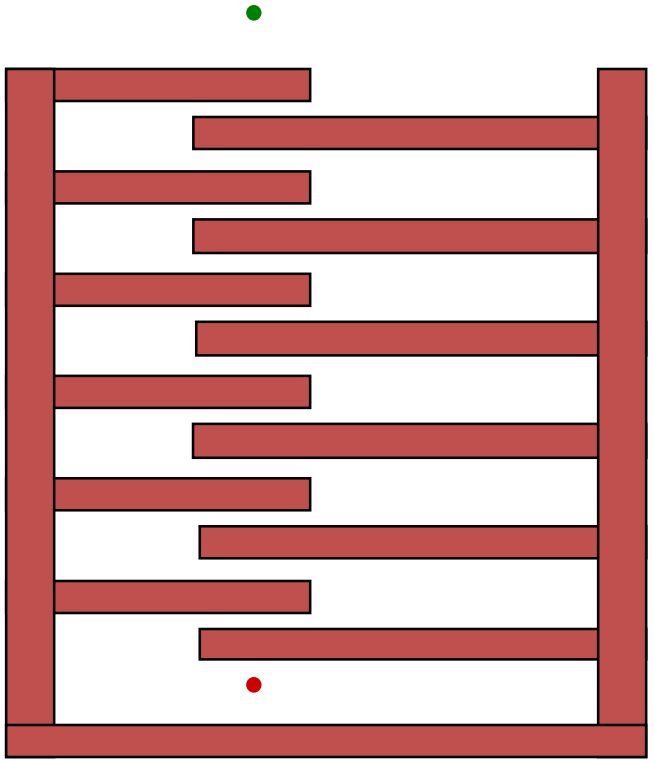


Head-to-Head Comparison

- Bug 2 beats Bug 1

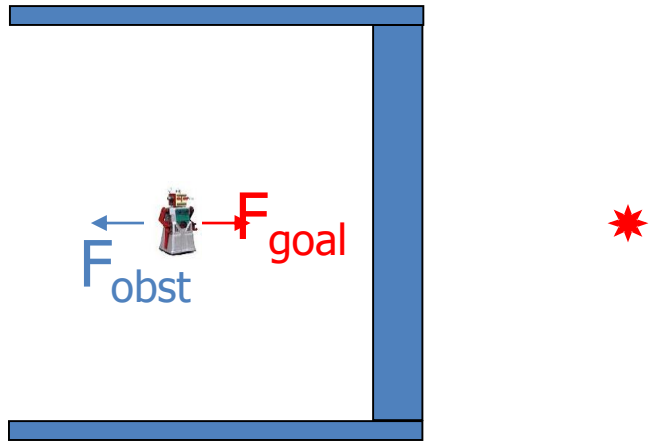


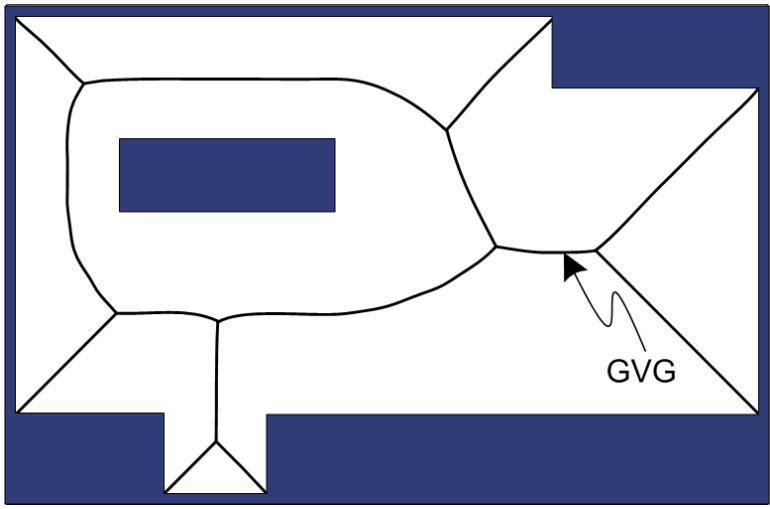
- Bug 1 beats Bug 2



Path Planning

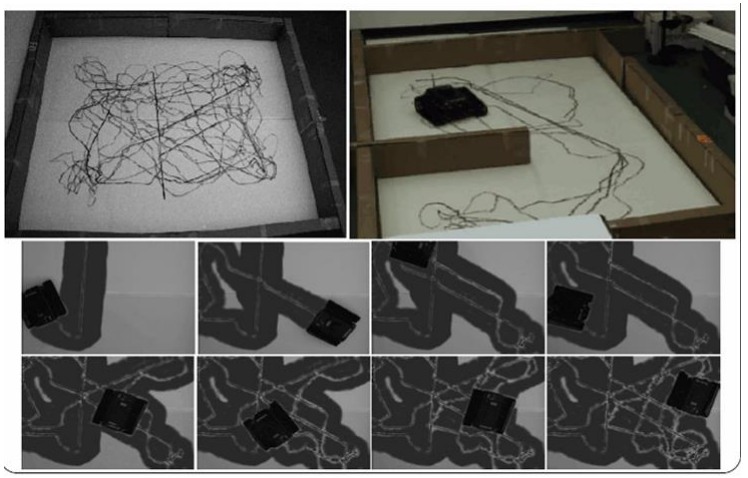
- Potential Field Path Planning
- Generalized Voronoi Graph
- Wavefront Planner
- Configuration Space
- Probabilistic Roadmaps
- Rapidly Exploring Random Trees (RRT)





Coverage

- Complete?
- Deterministic?
- Optimality
- Applications
- Boustrophedon
- Multi-Robot Coverage



Computer Vision

- Camera Geometry (Perspective Transformation)
- Ill Posed Problem
- Correspondence Problem
- Gaussian Blur
- Fiducial Markers
- Stereo Vision
- Optical Flow