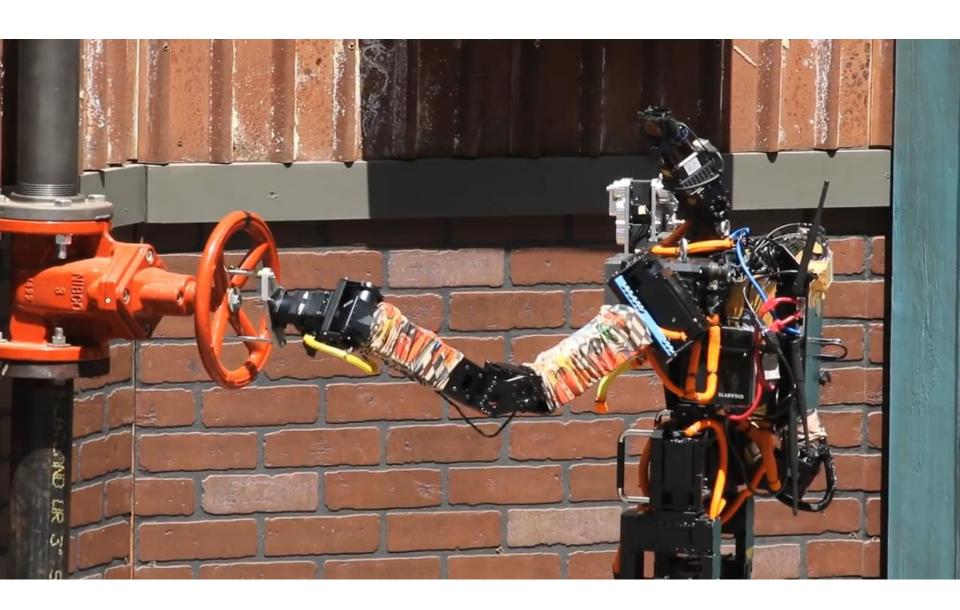
Robotics

Estimation and Learning with Dan Lee

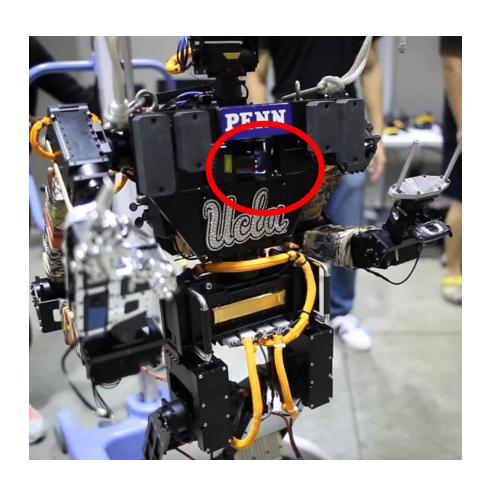
Week 3. Robotic Mapping

3.3 3D Mapping
3.3.1 3D Sensors and 3D Map Representation

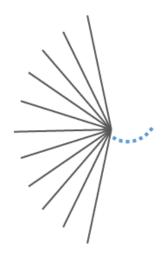




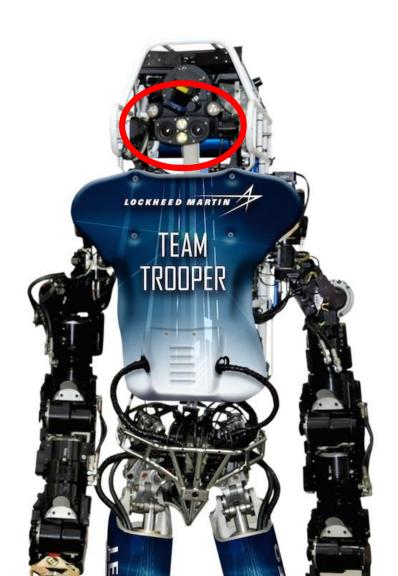
Sensors for 3D Mapping



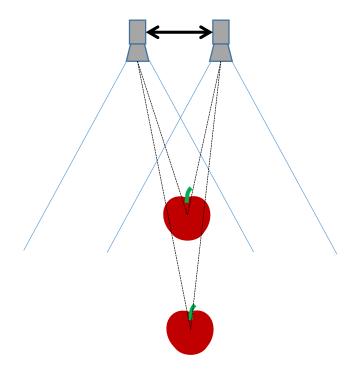
• 3D Range Sensor



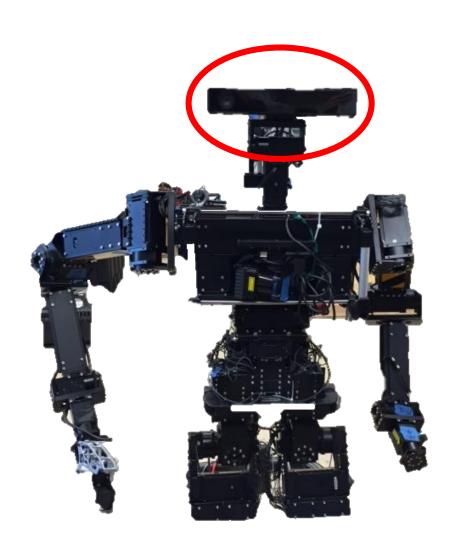
Sensors for 3D Mapping



Stereo Camera



Sensors for 3D Mapping

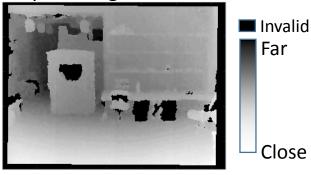


Depth Camera

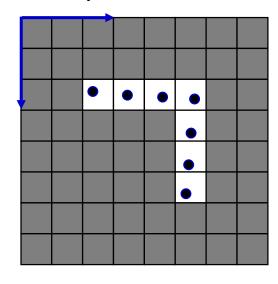
Scene



Depth Image



Grid Representation



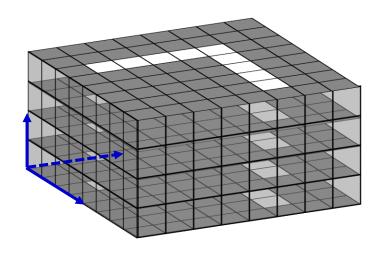


Immediate access to a cell



- Requires Large memory (map size) ~(map range)/(resolution)
- Lose information from discretization

Grid Representation



In 3D, most cells will be empty.

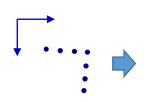


Immediate access to a cell



- Requires Large memory (map size) ~(map range)/(resolution)
- Lose information from discretization

List Representation



2.3,	2.3
2.5,	3.4
2.6,	4.6
2.7,	5.7
3.8,	5.5
4.8,	5.4
5.8.	5.2

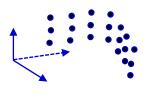


Takes long to search (O(N))



- Requires less memory (map size) ~(# Occupied Points=N)
- No discretization

List Representation



2.3, 2.3, 1.0
2.5, 3.4, 1.1
2.6, 4.6, 1.0
2.7, 5.7, 1.1
3.8, 5.5, 1.2
4.8, 5.4, 1.0
5.8, 5.2, 1.1
•••



Takes long to search (O(N))



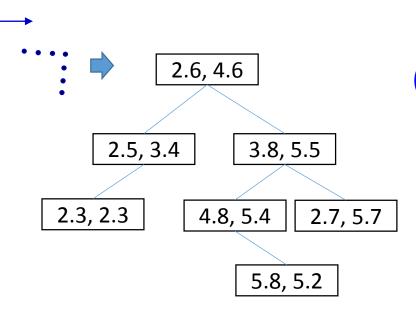
- Requires less memory (map size) ~(# Occupied Points=N)
- No discretization

In 3D, N is usually very large.

Tree Representation



Reasonable search time (O(logN))

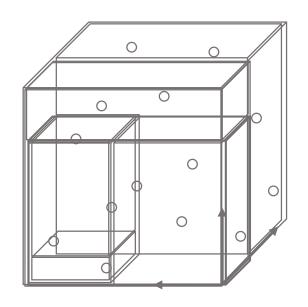


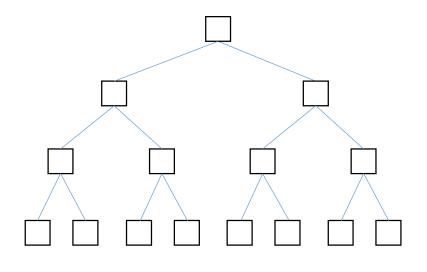


- Requires less memory (map size) ~(# Points)
- No discretization

 Requires organized data structure for efficient maintenance of the map

• Example (1) kd-tree





Example (2) Octree

