CSCE274 Robotic Applications and Design Fall 2021 Navigation

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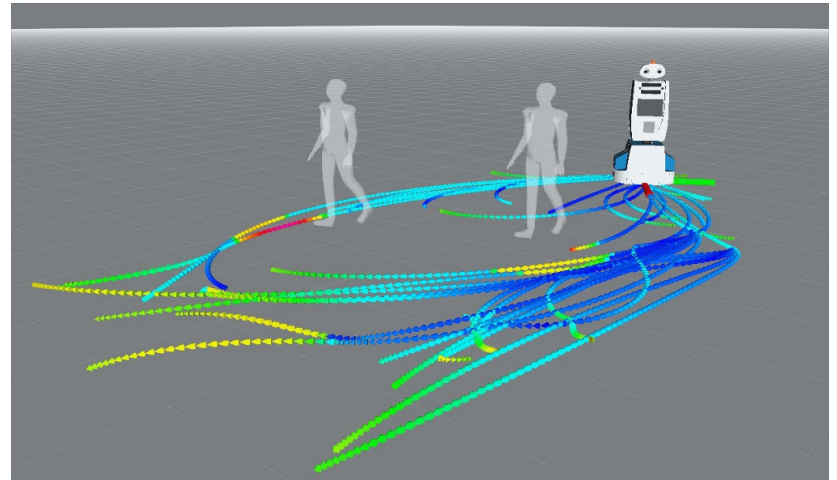
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Navigation

- *Navigation* refers to the way a robot find its way in the environment

- We saw last time state estimation, which is required for proper navigation
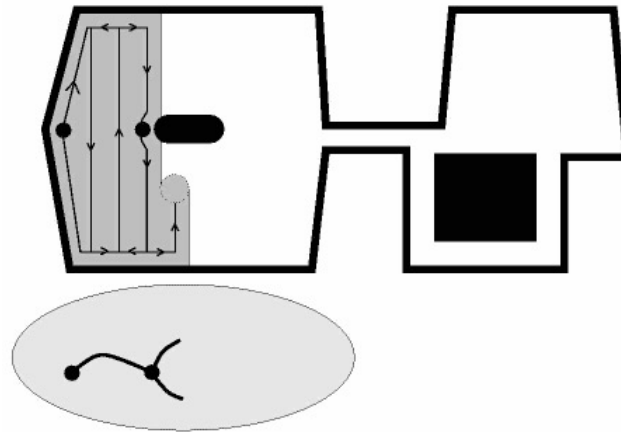
Path planning

- *How to go from A to B?*
- Additional challenges when environment is dynamic
- Several criteria can be used to decide the best path
  - Distance
  - Number of turns
  - Less risky
  - ...

Source: github.com/srl-freiburg/srl_global_planner
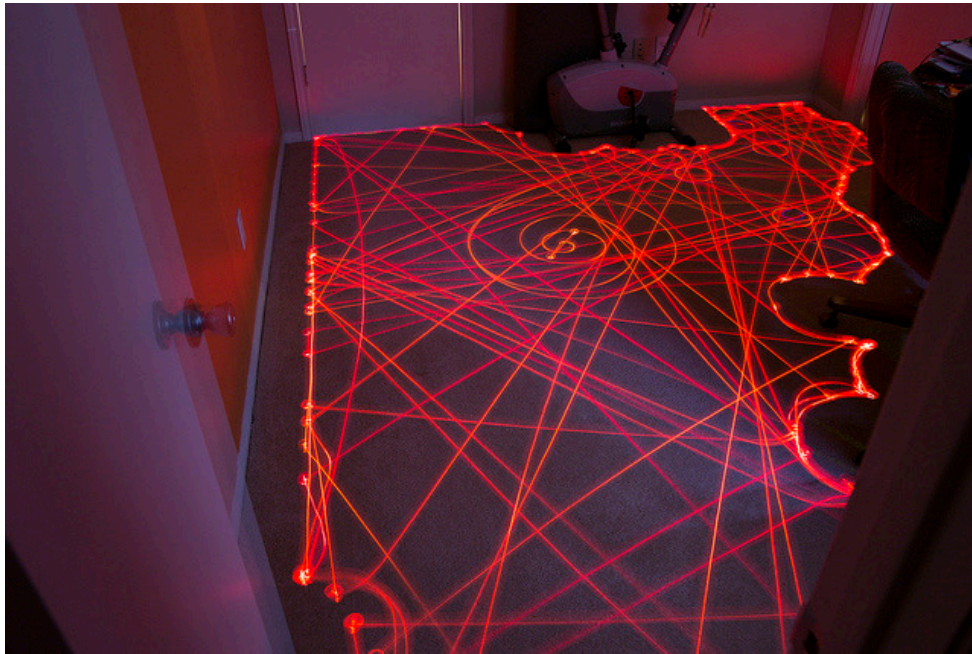
Coverage

- *Coverage problems* require the robot to visit every location in the environment

- It can be systematic

Source: biorobotics.ri.cmu.edu/research/complete.php

Coverage

- Coverage can be also randomized

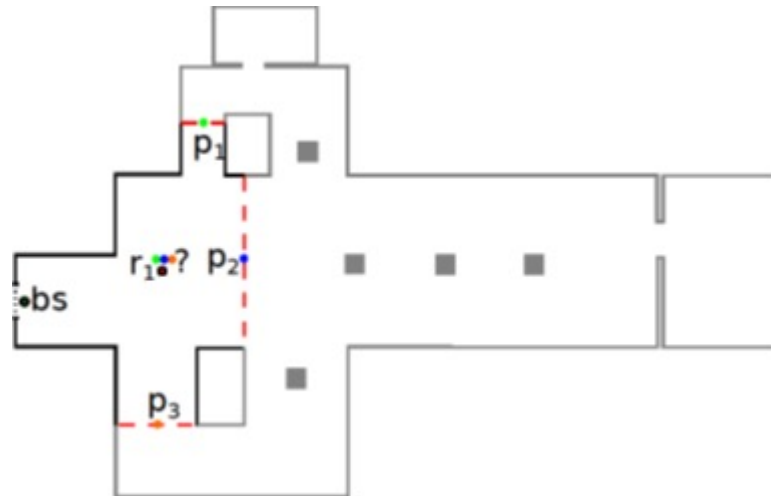Source: flickr.com/photos/joejungmann/14505181338/in/pool-roomba/

Exploration

- *Exploration problems* require the robot to build the map of an unknown environment
- One way to address this is called *frontier-based exploration,* where robots move to the boundary between known and unknown portion of the environment
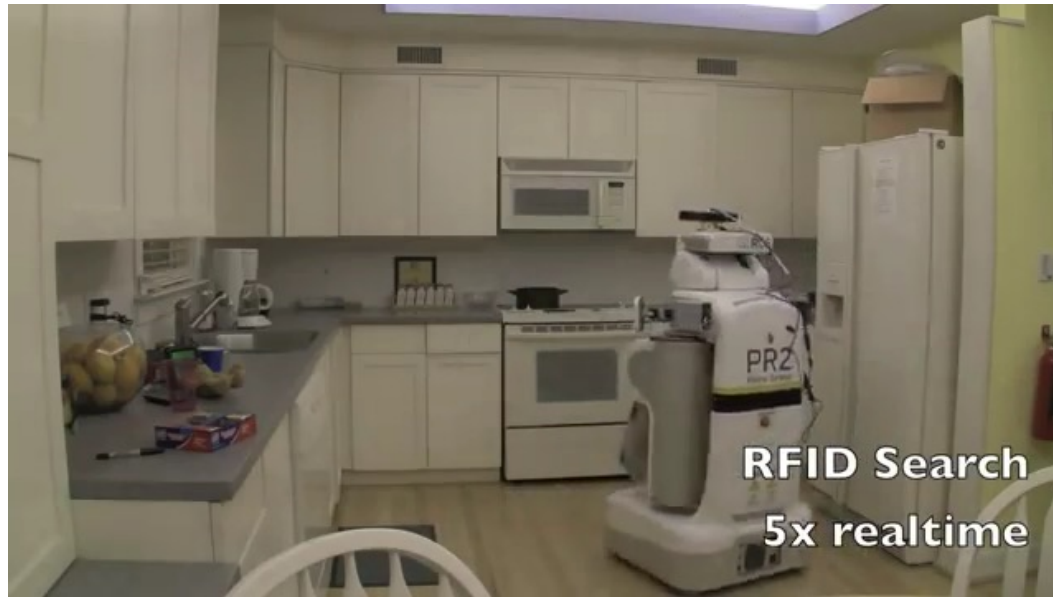
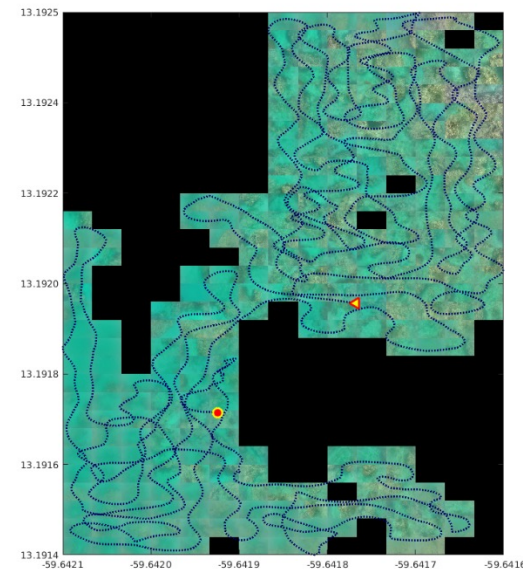Source: mobilerobots.com
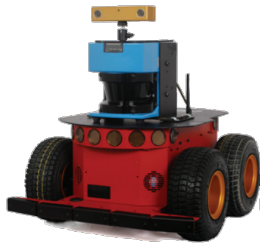
Pioneer 3-AT

Search

- *Search problems* are problems involving looking for objects or people in an environment
- If no a priori information is available, this corresponds to exploration

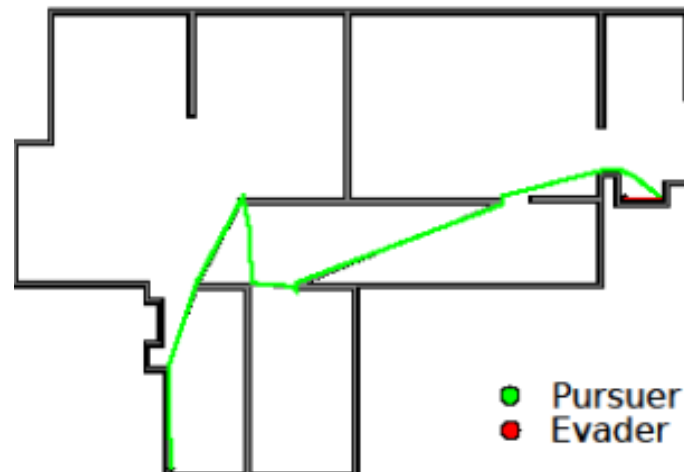Source: [Deyle et al., 2014, IROS]

Information gathering

- *Information gathering* is the problem of sending robot to collect data of a phenomenon of interest
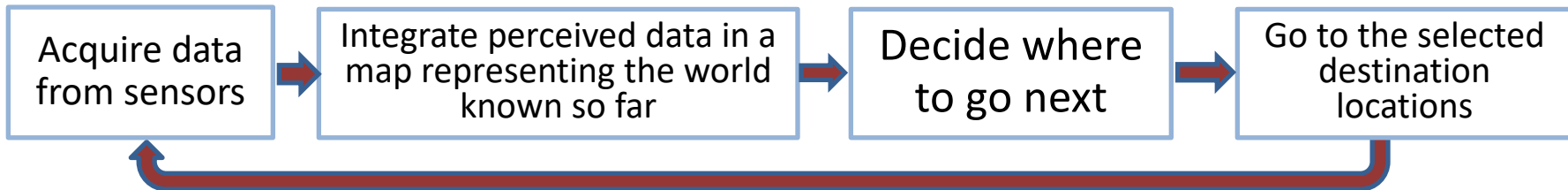

Source: [Manjanna et al., 2016, CRV]

Pursuit-evasion

- *Pursuit-evasion* is the problem of finding a strategy that allows the pursuer to capture an evader

- Usually theoretical analysis on the worst case

○ Pursuer
● Evader

Abstract robot behavior

- From high-level perspective, the robot behavior that should accomplish a task can be simplified as follows

Acquire data from sensors	→	Integrate perceived data in a map representing the world known so far	→	Decide where to go next	→	Go to the selected destination locations

A (tentative) framework

- Dimensions that *influence* the *design* and the *evaluation* of the strategies
  - Robot's capability

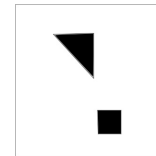 - Multiple robots

  - Environment

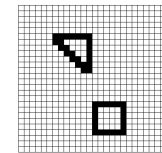 - Knowledge

  - Mission

Source: mobilerobots.com   Source: sick.com

Source: bettstetter.com

Source: robocup.org   Source: irobot.com

F. Amigoni, N. Basilico, A. QUATTRINI LI
"Moving from 'how to go there?' to 'where to go?': Towards increased autonomy of mobile robots"
In A. Rodic, D. Pisla, H. Bleuler (editors); New Trends in Medical and Service Robots, Mechanisms and Machine Science 20, Springer, 2014, p. 345–356.