CSCE 574 ROBOTICS

History

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Three Main Problems in Robotics

1. Where am I? (Localization)
2. What the world looks like? (Mapping)
   – Together 1 and 2 form the problem of *Simultaneous Localization and Mapping* (SLAM)
3. How do I go from A to B? (Path Planning)
   – More general: Which action should I pick next? (Planning)
Robot

Reason

Sense

Act
Talos (Τάλως/Τάλων) 400 BC

• A giant man of bronze who protected Europa in Crete, circling the island's shores three times daily while guarding it.
• Shore-length of Crete is 1.046 km.
• Average speed 130 Km/h
Automatons

Antikythera, 150–100 BC
Heron of Alexandria
(Ἡρων ὁ Ἀλεξανδρεύς)
10-70AD

One of the first sensors:
Odometer.
Heron of Alexandria
Automatons

“Canard Digérateur“, 1793

“The Turk“ 1770
Tea serving automaton

19th Century, Japan
Word “Robot”

Mobile Robots: 1950

• Walter’s *Tortoise*

Source: sciencemuseum.org.uk

https://www.youtube.com/watch?v=wQE82derooc
Shakey (1966 -1972)

- **Shakey** (Stanford Research Institute/SRI)
  - the first "autonomous" mobile robot to be operated using AI techniques
- **Simple tasks to solve:**
  - To recognize an object using vision, given a very restricted world
  - Find its way to the object
  - Perform some action on the object (for example, to push it over)
  - Perform compound actions and basic planning.
Stanford Cart

- 1973-1979
  - Stanford Cart developed by Hans Moravec
  - Use of stereo vision.
  - Took pictures from several different angles
  - The computer gauged the distance between the cart and obstacles in its path to do basic collision avoidance
  - About 15 min to think about each image, then drives 1 foot or so.
Industrial history: 1961

June 13, 1961
G. C. DEVOL, JR

PROGRAMMED ARTICLE TRANSFER

Filed Dec. 10, 1954

3 Sheets–Sheet 1

2,988,237

Magnetic Reader

Program Drum

Magnetic Code

Tracks

Gripper
Industrial history: Unimate
Industrial history: Puma 1978
Robot Vehicle (Late 80’s)

- \textit{VaMoRs}: Highway driving
- Tracking white lines with Kalman filtering (Dickmanns)
Mid 90’s: CMU’s Navlab 5

- Drove 2797/2849 miles (98.2%) on highways
- Throttle/Brake manually handled.
Exploring Mars

Sojourner 1997

Spirit and Opportunity 2003

Phoenix-2008

Mars Science Laboratory Curiosity (2012)
More Current Data

- **Curiosity**, Sol 2155 (Aug. 29, 2018), 19.6 Km
- **Opportunity**, Sol 5111 (Jun. 10, 2018), 45.16 Km
- **Spirit**, Sol 2210 (March 22, 2010), 7.7 km
Highlights: Mapping the Titanic

Highlights: DARPA Grand Challenge

• 2004: Mojave Desert USA, 240 km
  – CMU Sandstorm traveled the farthest distance, completing 11.78 km

• 2005: Mojave Desert USA, 240 km
  – Stanford’s Stanley, first place 6h54m
  – CMU’s Sandstorm, second place 7h05m
Highlights: DARPA Urban Challenge 2007

- George Air Force Base, California. 96 km urban area course

  CMU’s BOS, first place 4h10m

  Stanford’s Junior, second place 4h29m
1. Drive a utility vehicle at the site
2. Travel dismounted across rubble
3. Remove debris blocking an entryway
4. Open a door and enter a building
5. Climb an industrial ladder and traverse an industrial walkway
6. Use a tool to break through a concrete panel
7. Locate and close a valve near a leaking pipe
8. Replace a component such as a cooling pump
Highlights: DARPA Robotics Challenge

http://www.youtube.com/watch?v=hpeZGCzUmNY&feature=youtu.be
DARPA Challenge failures

https://www.youtube.com/watch?v=g0TaYhjpOfo
Driverless Car

• Safer
• More efficient
• Enable people

• The Nevada law went into effect on March 1, 2012, and the Nevada Department of Motor Vehicles issued the first license for a self-driven car in May 2012. The license was issued to a Toyota Prius modified with Google's experimental driverless technology.
• Google driverless car, with a test fleet of autonomous vehicles that as of Aug. 2018 has driven 12.8 million km.
Another trend
Mobile Manipulation

The robots have only interpreted the world, in various ways; the point is to change it.

http://pr.cs.cornell.edu/videos.php