ECGR4161/5196 – Lecture 9 – July 10, 2012

Today:

- Presentations – Robots (recorded in two sessions, with a break in the middle).
- Lab questions/time (Sam)
- Quiz 6

Foster- Miller TALON

- most common robot in use by the military
- RF or Fiber-optic link from an Operator Control Unit
- travel through sand, water, snow, and up stairs
- color, b/w, infrared, and night vision cameras
- 8.5 hour; 2 lead, 1 Li-ion
- 4 versions: IED/OED, SOTAL, SWORDS, HAZMAT

- IED/EOD TALON
  - controllable arm
  - 100 pounds

- SWORDS TALON
  - guard/combat roles on the frontline
  - M16, M240, M249, 50-caliber, M202 –A1

IED/EOD TALON [1]

SWORDS TALON [1]

[1] http://www.qinetiq-na.com/products/unmanned-systems/talon/#!prettyPhoto[success1]/0/
[2] http://science.howstuffworks.com/military-robot2.htm

Adept AIV

- Autonomous indoor vehicle designed to deliver materials.
- 25 kg Payload
- Uses
  - lasers for distance measurements and object avoidance
  - sonar for object avoidance
  - Differential Drive System
  - Mapped paths taught by user

http://go.adept.com/autonomy

http://www.adept.com/products/mobile-robots/mobile-transporters/sph-2200/general

Image:http://www.globenewswire.com/newsroom/prs/?pkgid=13576

FANUC ArcMate 120i Robot (RobotWorx)

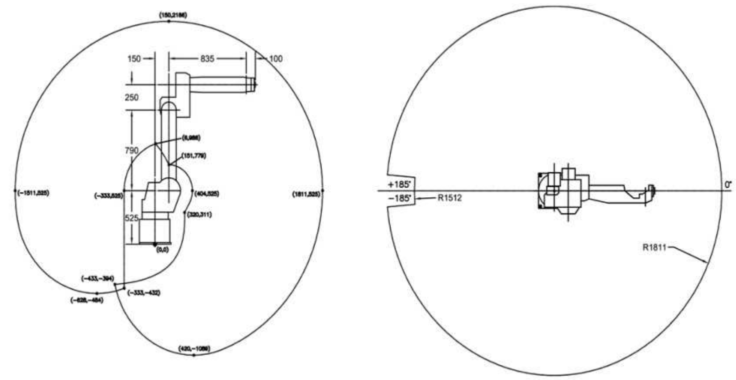
Advantages:

- Improve quality
- Conserve paint
- Safety
- Save Energy and Space

Features:

- Degrees of freedom: 6
  - Electric servo motors
- Horizontal reach: 1811mm
- Payload: 20Kg
- Mounting: F, C, W, A
- Integrated Controller

http://www.robots.com/blog/viewing/5-reasons-buy-a-robotic-spray-painting-arm/453

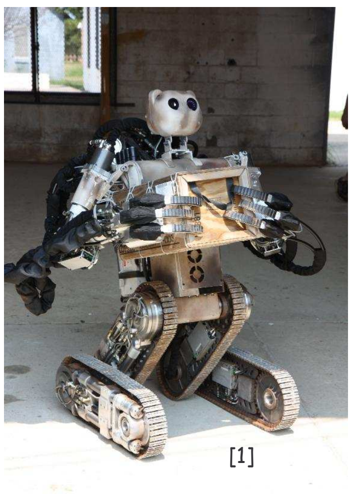


http://www.robots.com/fanuc/arcmate-120ic/657

“B.E.A.R” Robot

- The B.E.A.R is an acronym for **B**attlefield **E**xtraction-**A**ssist **R**obot
- Currently a semi-autonomous robot that can rendezvous at GPS locations or specific mapped out targets
- Unique form of locomotion that includes tracks and a biped design that work in unison to enable to Bear to traverse all terrain types

[3]


[1]

Current sensors on the bear include:
- Tactile sensors on fingers
- 360° IR and color situational awareness camera’s
- Newly developed Micro-Hydraulics used for precision handling

The Bear’s three fingered hands have 6 degrees of freedom

The Bear is suppose to have a “friendly” appearance… I will let you be the judge of that!


[4]

- Currently under proof-of-concept phase of development
- Next Phase is BEAR 8.0 due to debut in late 2012

VECNA ROBOTICS
BETTER TECHNOLOGY. BETTER WORLD.®

[2]

[Demo Video]

References:
[1] (2010). *Andrew Allen of the Bear Robot Program is Interviewed by Sander Olson*(2011). [Web Photo]. Retrieved from http://nextbigfuture.com/2010/09/andrew-allen-of-bear-robot-program-is.html
[2] (2012). *The Bear™ Vecna Robotics LOGO.* . (2012). [Web Photo]. Retrieved from http://www.vecna.com/robotics/solutions/bear/index.shtml
[3] (2012). *New Robots Navigate by “Guessing” What’s Ahead before Seeing* (2007). [Web Photo]. Retrieved from http://news.softpedia.com/newsImage/New-Robots-Navigate-by-Guessing-What-039-s-Ahead-before-Seeing-2.jpg/
[4] (2012). *Bear Robot Designed to Save Lives, Looks Like It Will Kiss Us All* (2010). [Web Photo]. Retrieved from http://technabob.com/blog/2010/09/05/vecna-bear-robot/

HAUV (Hovering Autonomous Underwater Vehicle)

Program: autonomous survey operation uploaded via "intuitive mission planning tool" software that enables dives, data retrieval, and reporting to occur automatically

Applications: ship hull and infrastructure inspection, unexploded ordnance, scientific research, mine countermeasures, security

Energy: 1.5kWh Lithium-Polymer battery pack

Propulsion: 5 thrusters for stability and control

Sensors:

- **IMU (Inertial Measuring Unit)** - velocity, orientation, gravitational forces
- **DVL (Doppler Velocity Log)** – navigation "underwater GPS", under water current tracking
- **Depth Sensor**
- **DIDSON 1.8MHz (Dual frequency Identification Sonar)** – uses sound waves to map and create an image of the ocean floor or the hull of a ship

Figure1

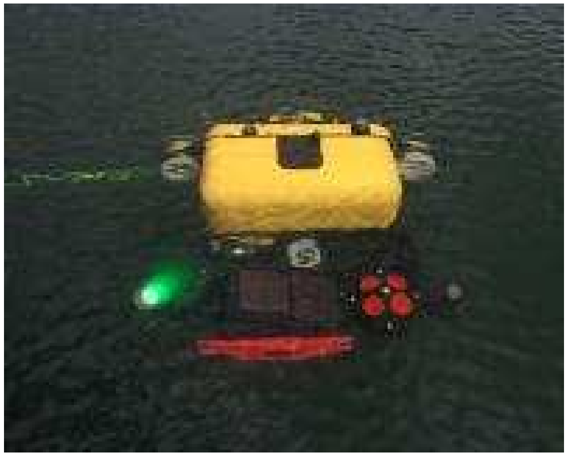


Figure 2

Works Cited:

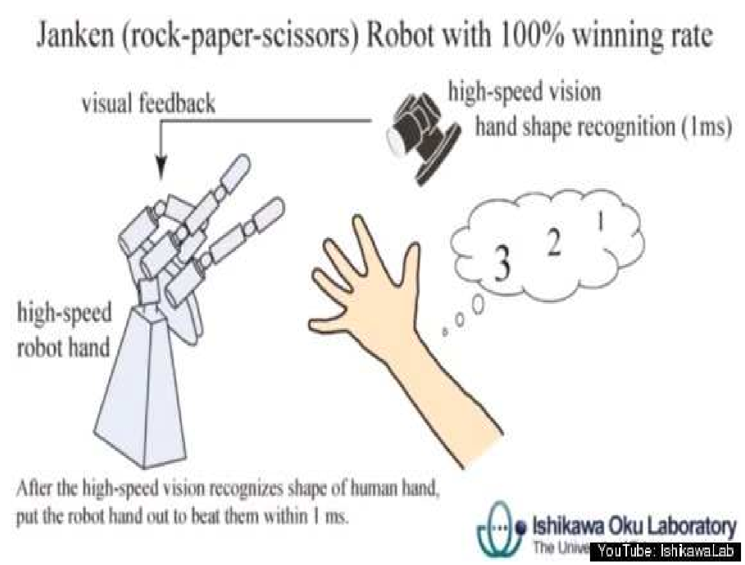
[1] http://www.bluefinrobotics.com/products/hauv/

Rock, Paper, Scissors Robot

- Developed by researchers at Sensor Fusion Lab in Tokyo, Japan
- 100% success rate against humans
- Uses a robotic actuator that represents a human hand (with three fingers and a movable wrist joint)
- The wrist angle of the robot will mock the humans during the initial counting. (1,2,3, shoot)
- Implements a high-speed camera that is programed to recognize hand shapes.
- The response time of the actuator is within 1ms after the hand shape recognition has determined the shape of the humans hand
- As a result, it is undetectable by the human eye that the robots hand shape is formed after the humans.

- **Why is this relevant?**

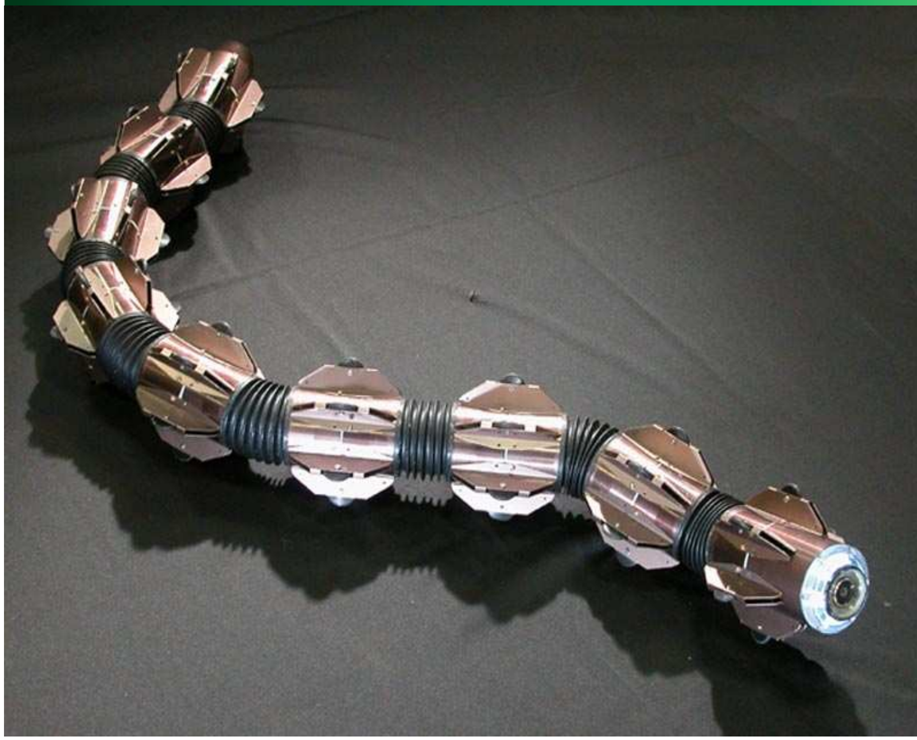
- This project is an excellent example of robotic and human interaction that has a very small time-delay
- Therefore with this technology, robots are able to react to human motions in real time.



http://www.huffingtonpost.com/2012/06/27/rock-paper-scissors-robot-video_n_1631359.html

Amphibious Snake

By Alex Moster



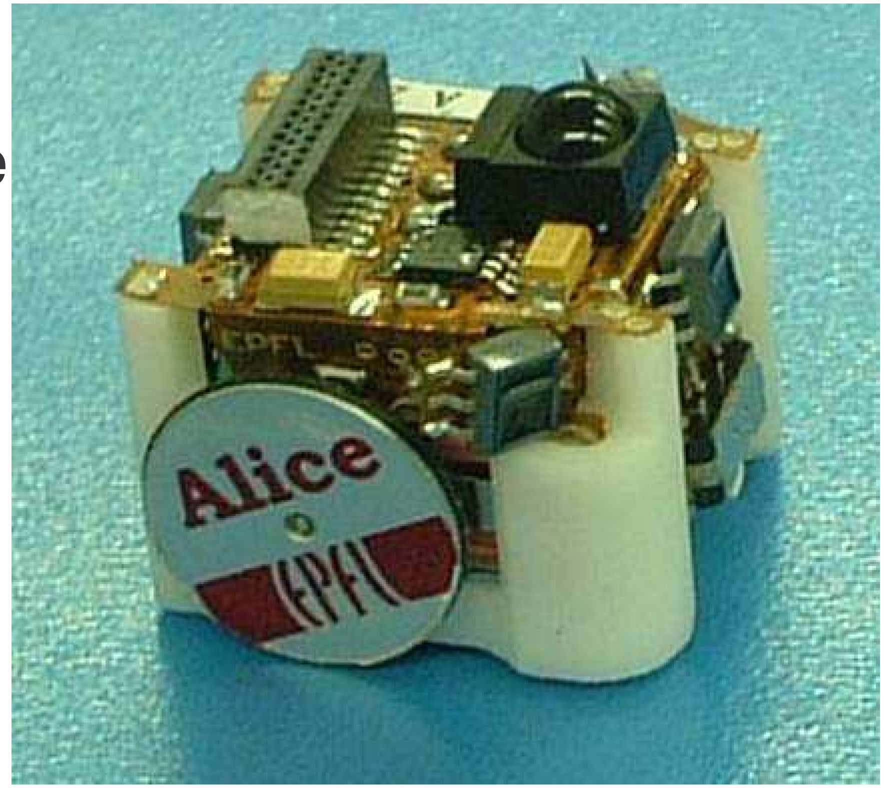
- Uses snake like movements to move over land or through water
- Though it has what looks like wheels, they are not motorized
- Each of the joints on the robot has a CPU, battery, and motors
- Each joint can move independently and communicate with the rest
- It is not remote controlled but rather moves freely on its own

http://www.youtube.com/watch?v=LZJslSbsLOU

All images from: http://www-robot.mes.titech.ac.jp/robot/snake/acm-r5/acm-r5_e.html

ALICE Micro Robot

- Very small (2x2x2cm)
- Up to 10 hours of autonomous life
- 2 motors to power each wheel individually
- Goal of this robot was to:
  - Design an intelligent robot as cheap and small as possible
  - Provide a hardware platform for further research
  - Study how they react with one another in a massive quantity



On-board Modules: Linear Camera, Radio Communication, Tactile Sensors

http://www.hizook.com/projects/alice

http://www.hizook.com/files/users/3/Alice_Micro_Robot.jpg

KUKA KR 1000 TITAN

Heavy Duty 6-axis Industrial Robotic Arm

- Withstands static torque: 60,000 N-m (44,253.7 lb-ft)
- Payload: 1000 kilos(2,204.6 lbs)
- Weight : 4700 kilos (10,361.7 lbs)
- Reach : 3.2 meters (10.5 ft)
- 9 motors = power of a car
  - axes 1 & 3 = two motors feed into a single gear
  - axis 2 = powered by two large motors w/ own gear
- PC based control platform

Arm in action:
http://www.youtube.com/watch?v=aZRT1MpTkQk&feature=related

Stickybot III

- Features
  - Uses Directional dry adhesion
  - 4 DoF
  - 16 Servo motors
  - Climbs at 5 cm/sec
- Sensors

  Hall Effect
- Youtube Videos

  http://www.youtube.com/watch?v=odAifbpDbhs

  http://www.youtube.com/watch?v=0y2MVuSyQlg&

- Reference

  http://bdml.stanford.edu/twiki/bin/view/Rise/StickyBotIII.html

  R.J. Full and M.R. Cutkosky, "From Bio-Inspiration to Robotic Implementation," joint presentation at IEEE ICRA07 Workshop [SF-1] on Biomimetic Robotics. Saturday, 14 April, 2007, Rome, Italy.

Robot Fish (University of Essex)

- Autonomous, battery-powered robot
- 5-foot-long
- Fins constructed using oscillating servomotors
- Proximity sensors
- Depth and pitch sensors
- Chemical sensors
- Wireless internet signal transmission
- monitor oxygen levels in the water, detect oil slicks spilled from ships or contaminants pumped into the water from underground pipes

http://news.nationalgeographic.com/news/2005/10/1007_051007_robot_fish.html

http://news.bbc.co.uk/2/hi/sci/tech/4313266.stm

- Video Link: http://www.metacafe.com/watch/1424021/robot_fish/

Google's Driverless Car (Stanley)

- Car that drives to a location by itself.
- Utilizes Google Maps and sensors on the car.
- Sensors:
  - Video cameras
  - LIDAR
  - GPS
  - Radar sensors

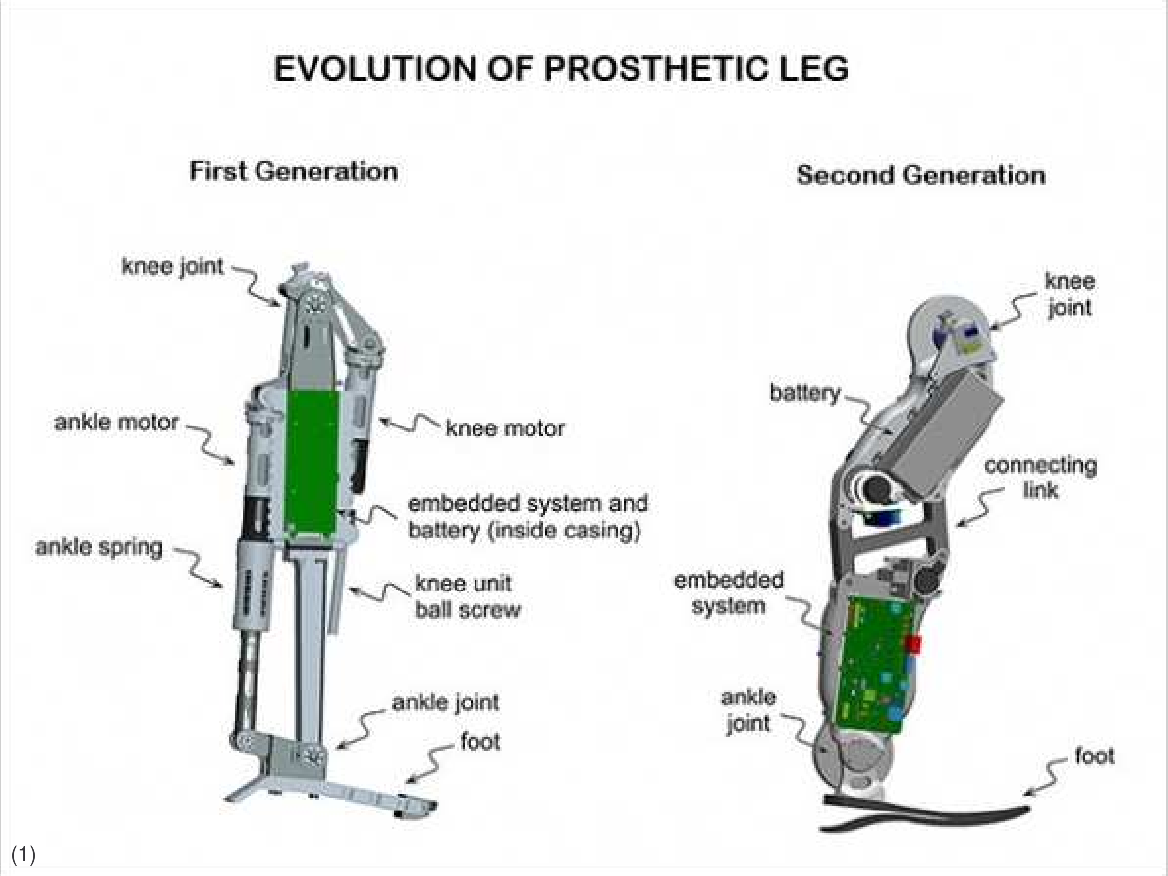
http://www.bbc.co.uk/news/technology-17989553

- Movement:
  - Uses motor, tires, brakes, steering, etc. already in car.
  - Has been implemented on Toyota Prius, Audi TT, and Lexus RX450h.
- Uses:
  - Decrease amount of traffic accidents and deaths.
  - Increase efficiency on the roadway.

Vanderbilt University - Bionic Leg

Major Features

- **Computer**
  - Performs several tasks simultaneously
  - Technology based off of microcontrollers in smart phones
- **Sensor**
  - Stair ascent
  - Anti-stumble routine
- **Electric Motor**
  - Knee joint
  - Ankle joint
- **Battery**
  - Operates for approximately 3 days of normal activity or 13 to 14 kilometers of continuous walking
- **Other**
  - Currently working on noise reduction
  - About 9lbs.



(1)

"A passive leg is always a step behind me. The Vanderbilt leg is only a split-second behind."
-Craig Hutto

Mechanical Engineer
Michael Goldfarb
(2)

References
1. http://news.vanderbilt.edu/2011/08/bionic-leg/
2. http://nanopatentsandinnovations.blogspot.com/2012/01/bionic-man-amputee-faster-on-his-feet.html

Automatic Guided Vehicle - Forklift

- ***Mechanical***: Vehicle chassis made of steel plate at the base of the vehicle. Low center of gravity for stability
- ***Drive Unit:*** Combination drive/steer wheel includes drive motor, steer motor, potentiometer, encoder (measures the movement of the lift), fail-safe brake
- ***Lift Unit*** includes a ball screw driven by an electric motor, fail-safe brake and encoder to measure lifting movements
- ***Control:***
  - Automatic: wire guided and laser
  - Manual: Hand held controller, display panel
  - Handle complex navigation with multiple AGVs
- ***Communications:*** WiFi 802.11(b) or wireless spread spectrum
- ***Software:*** De'Carte – Vehicle offboard control system based on Windows 2000 or XP and MS Visual Studio.net
- ***Power/Electrical System:***
  - Motor – 48 VDC
  - Control – 24 VDC, +/- 12 VDC, 5 VDC
  - Batteries last for 16-24 hours

http://www.amerden.com/AmerdenWeb/Documents/AGVSpecs/FLA.pdf

Twendy-One

- PHYSICAL DIMENSIONS
  - Total of 47 degrees of freedom.
  - It measures 1.46m (4.8 feet) high and 73.4cm (2 feet) wide.
  - Weights 250lb
  - soft silicone skins and force sensors that detect physical contact with a person on any part of its body. This is a key component of a “passive impedance mechanism” that enables the robot to adapt to unexpected external forces on the fly.

- MOBILITY
  - omni-directional wheel-based mechanism for mobility that allows the robot to move around efficiently even if the robot is in a narrow space.
  - twelve ultrasonic sensors and a six-axis force sensor to detect objects and humans near the robot and avoid collisions.

1

ABB FRIDA, PICK AND PLACE ROBOT J. Scot Collins

- **F**riendly **R**obot for **I**ndustrial **D**ual-arm **A**ssembly
- Designed to work with humans, safety is a major priority.
- Equipped with 2 arms, each with 7 axis and a servo controlled gripper lined with vacuum controlled suction cups.
- Has the control system in torso, powered by single phase power.
- Lightweight, portable and easily placed (clamped to a workbench) in a space of small size human worker.
- Can be connected to vision cameras for optical awareness.
- Limited power motor drives and software collision detection reduces danger to humans.
- Ideal for small electronic assembly line production.

Video: http://youtu.be/9iYg9Vhg3OQ
Information And Images: http://www.abb.com

‘Gumby’ Robot

‘Gumby’ robot was built by Harvard scientists. It’s the cutting edge robot technology. The length of this robot is only 5” include 4 legs. This device has no hard materials and all the stiffness are coming from air pumping in from the tube. The possibilities for this device could be ENDLESS.

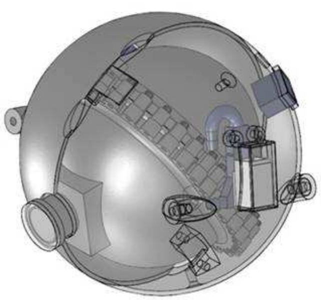
- First rubberized robot
- Built by silicon with mini chambers
- Currently using remote control
- Flexible
- No sensors
- Purposes:
    - Crawl in tight space
        - Clamp things
        - Explore and etc.

http://phys.org/news/2011-11-gumby-like-flexible-robot-tight-spaces.html

Nuclear Reactor Inspection Robotics

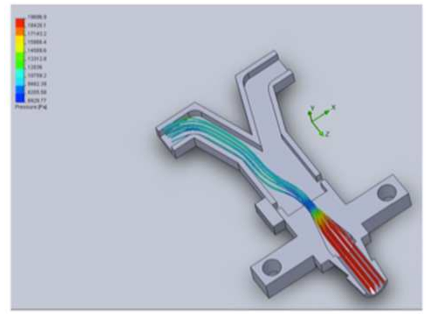
d'Arbeloff Laboratory

- Harry Asada

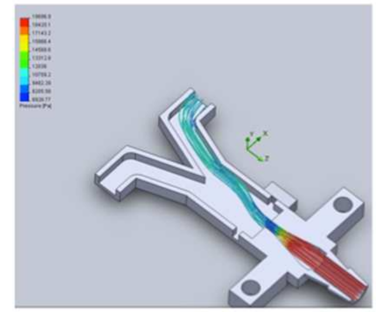


http://www.futureoftech.msnbc.msn.com/technology/futureoftech/robot-may-monitor-nuke-plants-121504

Coanda Jet Actuators

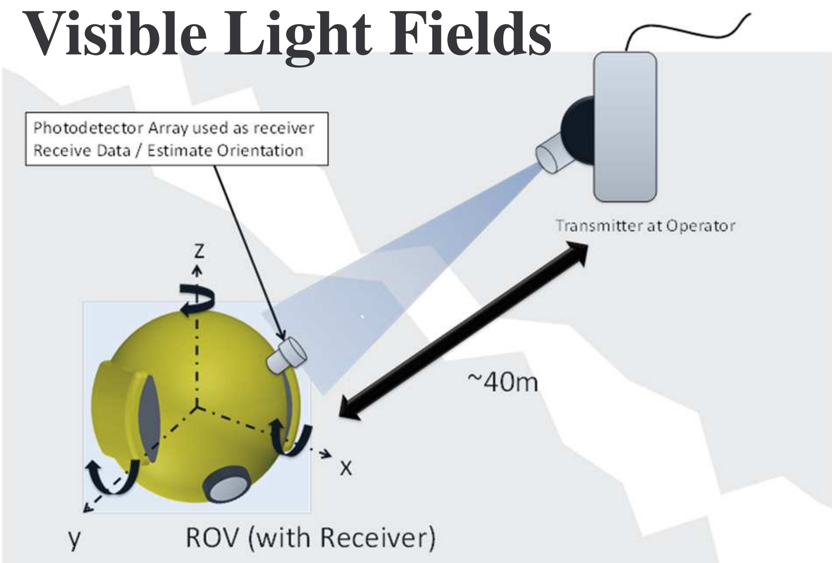


Directing Flow Left

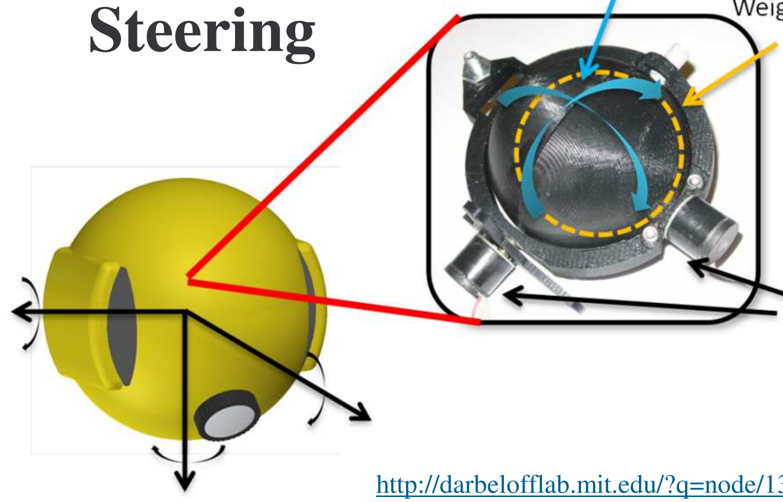


Directing Flow Right

Localization Using Visible Light Fields



Eccentric Mass Steering



http://darbelofflab.mit.edu/?q=node/13