

ECGR4161/5196 – Lecture 6 – June 9, 2011

YouTube Videos:

- http://www.youtube.com/watch?v=7hag6Zgj78o&feature=player_embedded

Micro Robotics

[Worlds smallest robot - Version 1](#) - "[tank](#)"

[Worlds smallest robot - Version 2](#) - "[BristleBot](#)"

[Worlds smallest robot - Version 3](#) - "[picoBot](#)"



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Tutorials

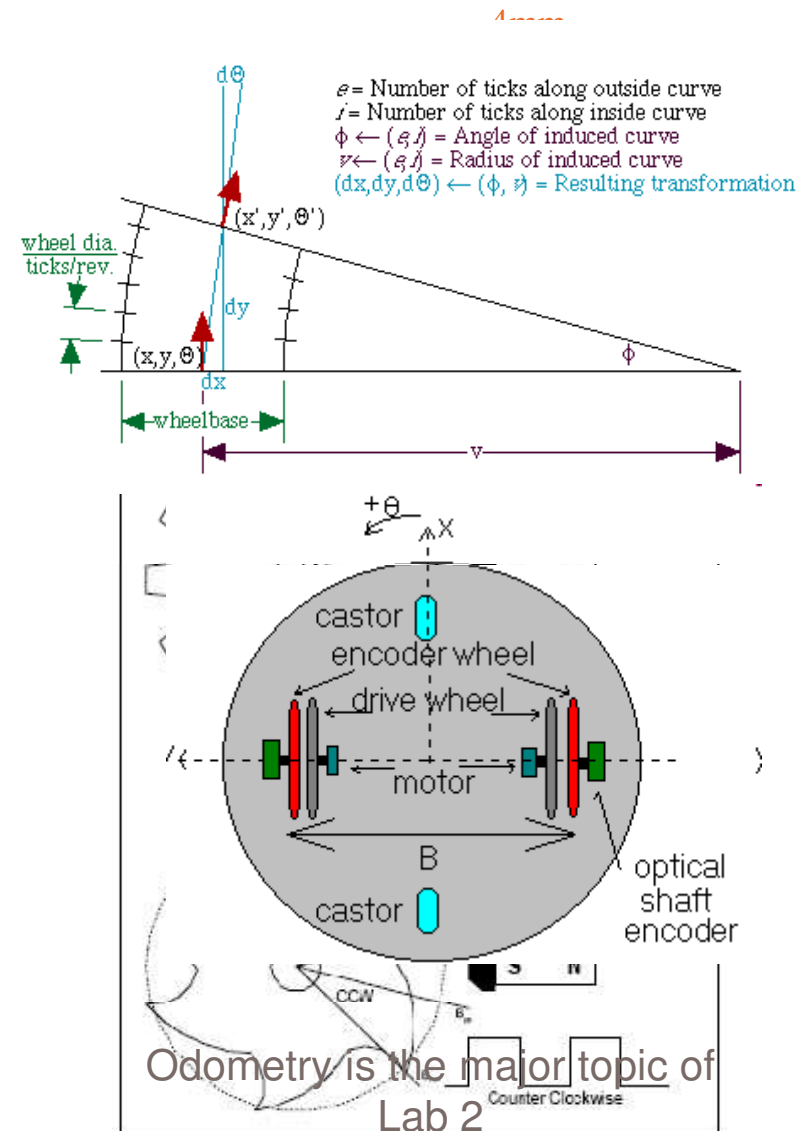
- <http://dkc1.digikey.com/us/en/tod/Microchip/StepperMotorControl/StepperMotorControl.html>
- <http://dkc1.digikey.com/us/en/tod/CUI/MotionControlKit/MotionControlKit.html>
- <http://dkc1.digikey.com/us/en/tod/STMicroelectronics/StepperFundamentals/StepperFundamentals.html>



Melexis 90217 Hall-Effect Gear Tooth Sensor

- The main application for the Melexis 90217 is to act as an encoder or pulse generator for 'practical scale' ferrous gears or encoders
- This functionality can be exploited in a wide variety of applications such as:
 - Speed Encoding (bi-directional)
 - Position Encoding
 - Motor control (position/speed)
- The chief advantages of this sensor:
 - Low-cost (\$5-8)
 - Rugged and robust (non-contact)
 - Simple installation (any ferrous gear or vaned structure can become an encoder)
 - Built-in, self adjusting ADC

Applicability: Robot odometry, or manipulator feedback

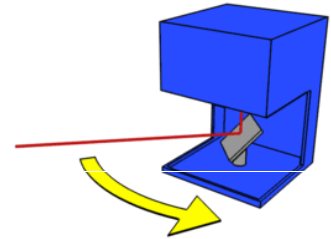


Microsoft Xbox Kinect



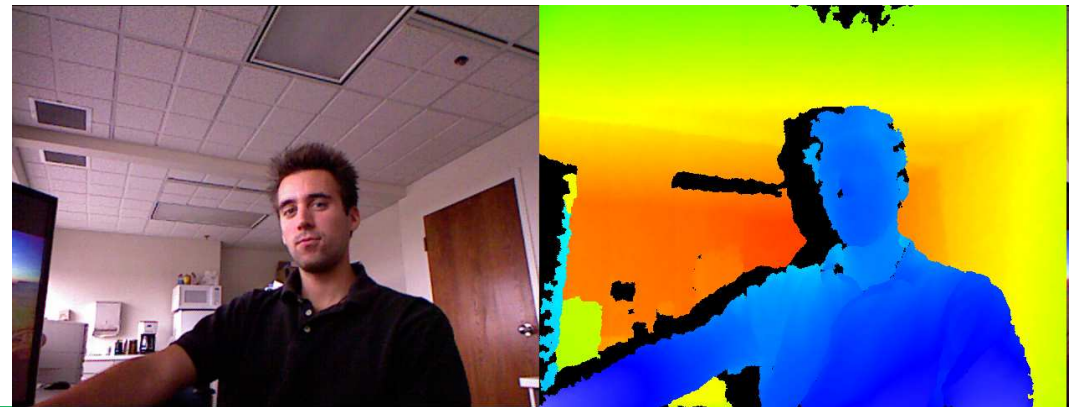
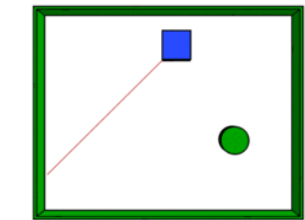
Traditional LIDARS

- Uses “time of flight”
- Long Range
- Limited FOV
- EXPENSIVE



Xbox Kinect

- Uses “displacement”
- Short Range
- same FOV as a camera
- \$150



GPS (global positioning system) Sensors

ROBOT GPS receivers are passive but exteroceptive sensors. They provide an estimate of the robot's location. GPS receiver does not work indoors, to avoid this obstacle new strategies were used with GPS sensors, the pseudo range and the Differential GPS (which make use of a static 2nd receiver at a known location)



Figure 1 GPS 15™ sensor from [1]

References:

1. <http://www.megagps.com/gps15xw.aspx>
2. Chapters 4 and 5 of the introduction to Autonomous Mobile Robots

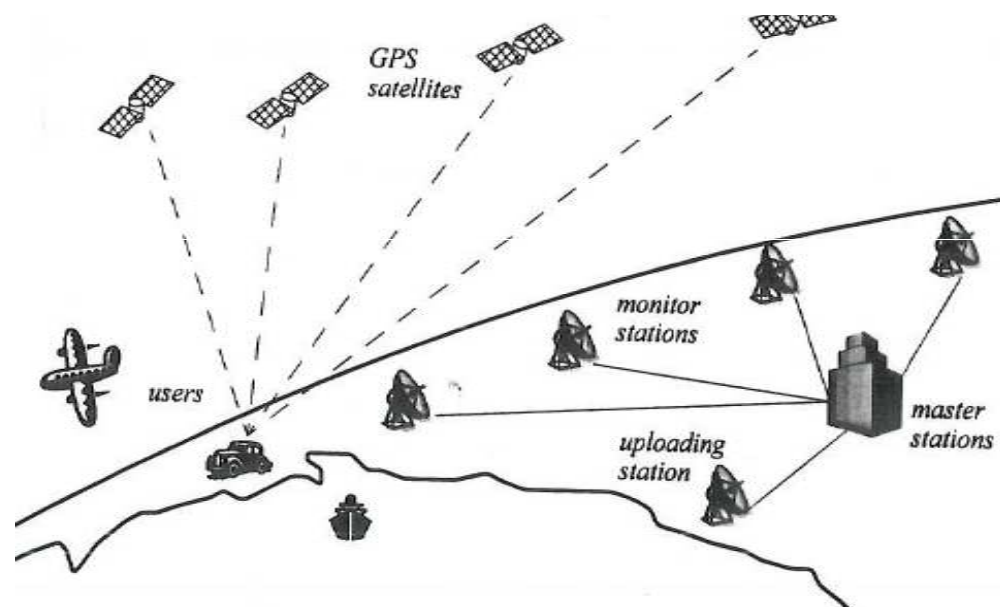


Figure 2 from [2]

Thermistor – Temp Sensor

Part Number - NCP15XW152J03RC

- Resistance varies with temperature
- Used in overcurrent protection circuits, overtemperature protection, and heat regulation circuitry
- 2 basic types – NTC, PTC

<u>Part Number Code</u>	<u>Specification</u>
NC	NTC Type
P	Plated Termination Series
15	1.00 x 0.50 mm (0402)
XW	Beta 3950 - 3999K
152	1.5 kOhm
J	5 % Tolerance
3	Standard Type
RC	2mm Pitch Packaging

References:

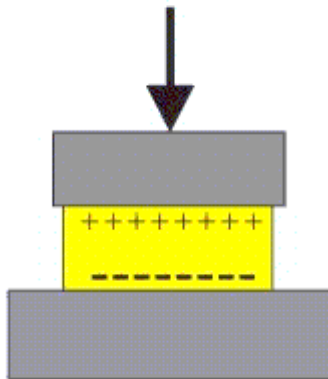
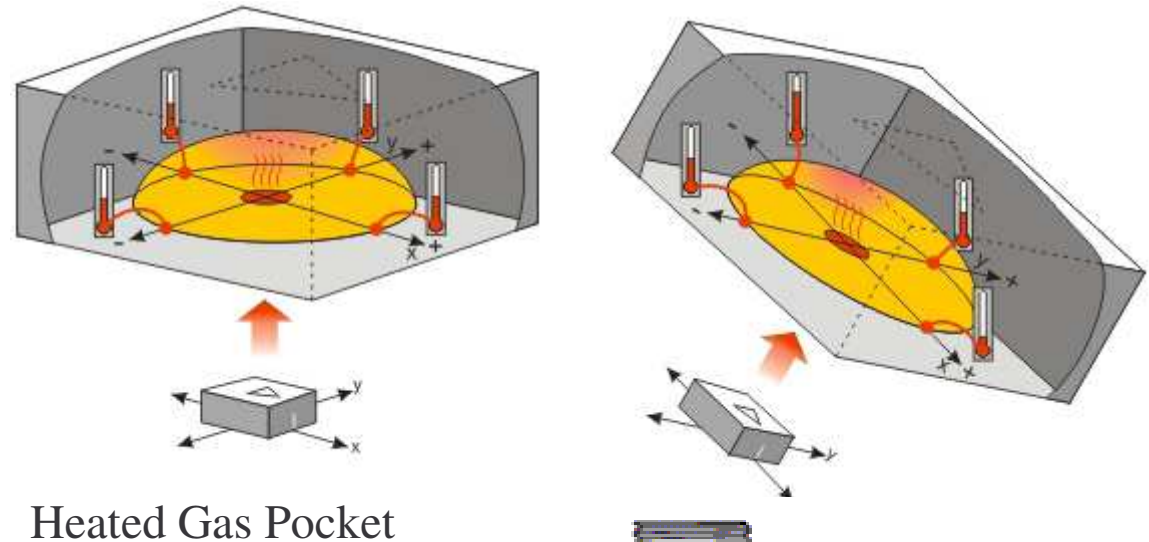
<http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=490-2421-1-ND>

<http://en.wikipedia.org/wiki/Thermistor>

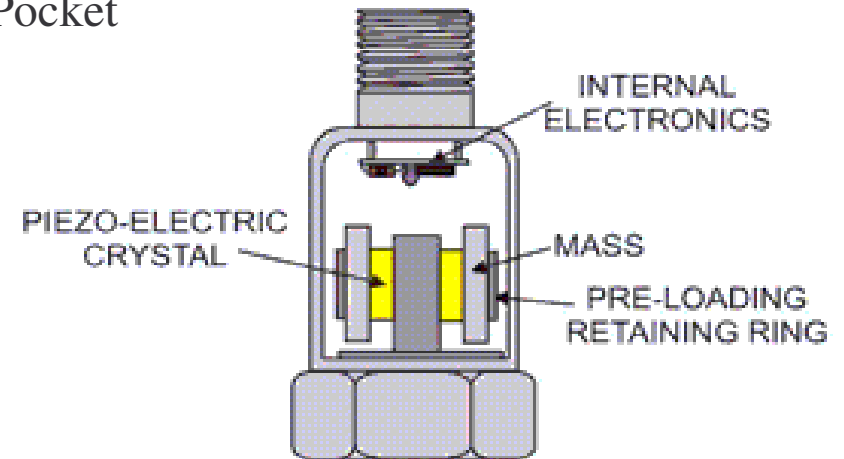


Accelerometer – Heated Gas Pocket, Piezoelectric

Acceleration
Tilt and tilt angle
Incline
Rotation
Vibration
Collision
Gravity



Compression Piezoelectric accelerometer



Shear type piezo-electric accelerometer

<http://www.mastec.co.nz/Dataforth/PDFs/How%20does%20a%20piezo%20accel%20work.pdf>

<http://www.parallax.com/dl/docs/prod/compshop/SICMemsicTut.pdf>

Broadband Seismometer (BBVS-60)

Seismometers are instruments that measure motions of the ground, including those of seismic waves generated by earthquakes, volcanic eruptions, and other seismic source

- Built-in 3 Components
- Electronic feedback
- Dynamic range: 140 dB
- Broadband: 50Hz ~ 120s
- Measure Range : $\pm 4g$
- Remote mass monitoring\
- Remote mass centering
- Low power consumption
- Low noise

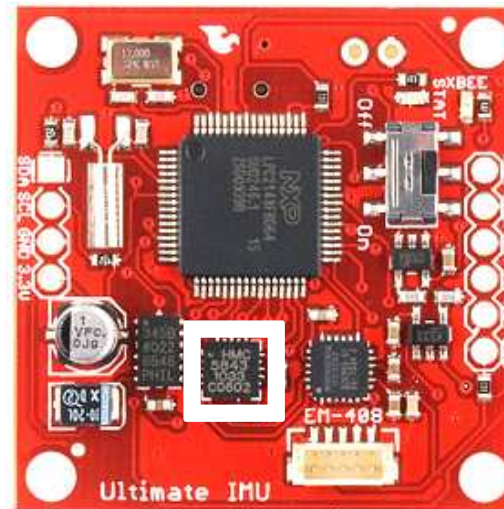
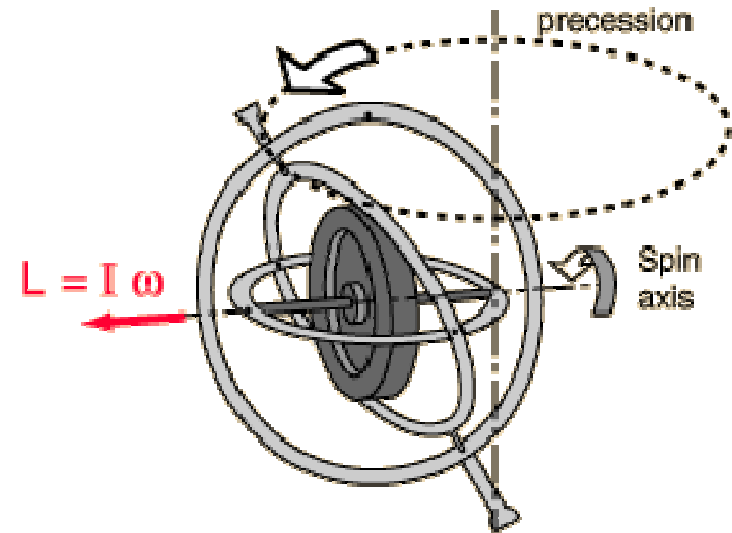


broadband, wide dynamic range, low noise, high sensitivity seismometer. It's transmission function is very stable and suitable for broadband seismic observations.

Gyroscope

The effect of all this is that, once you spin a gyroscope, its axle wants to keep pointing in the same direction. If you mount the gyroscope in a set of **gimbals** so that it can continue pointing in the same direction, it will. This is the basis of the **gyro-compass**.^[2]

If several gyroscopes are mounted within a platform and then mounted within a set of gimbals this can be known as an inertial navigation system(INS)



- 1) "Gyroscope." *Test Page for Apache Installation*. Web. 09 June 2011. <<http://hyperphysics.phy-astr.gsu.edu/hbase/gyr.html>>.
- 2) "HowStuffWorks "How Gyroscopes Work"" *HowStuffWorks "Science"* Web. 09 June 2011. <http://science.howstuffworks.com/gyroscope3.htm>
- 3) "SFE Ultimate IMU Triple Axis Accelerometer, Gyro and Magnetometer - RobotShop." *RobotShop | Robot Store | Robots | Robot Parts | Robot Kits | Robot Toys*. Web. 09 June 2011. <<http://www.robotshop.com/ca/sfe-ultimate-imu-triple-axis-accelerometer-gyro-magnetometer.html>>

The Reed Switch

The basic reed switch contains two ferrous conductors encapsulated in glass and sometimes plastic with one conductor held over the other by a very small distance.

When a magnetic field is applied, the conductors (reeds) are pulled together and close the switch. This is an excellent non-contact switch that can be used in any application requiring non-contact momentary switching.

Some common uses are speedometers and door/window alarms

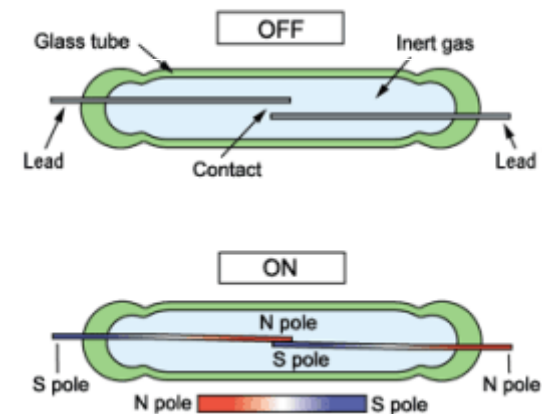
An example product is the (RS-01C) manufactured by Soway and found at SparkFun.com <http://www.sparkfun.com/products/10601>

This is a plastic insulated Reed Switch that is capable of handling loads of up to 1A @ 180VDC or 130VAC

Can be mounted directly to a PCB



Soway RS-01C Reed Switch
<http://www.sparkfun.com/products/10601>



Reed Switch Operation

<http://www.hy1688.com.tw/SWITCH/REED%20SWITCH/SWITCH/O-OKI.htm>

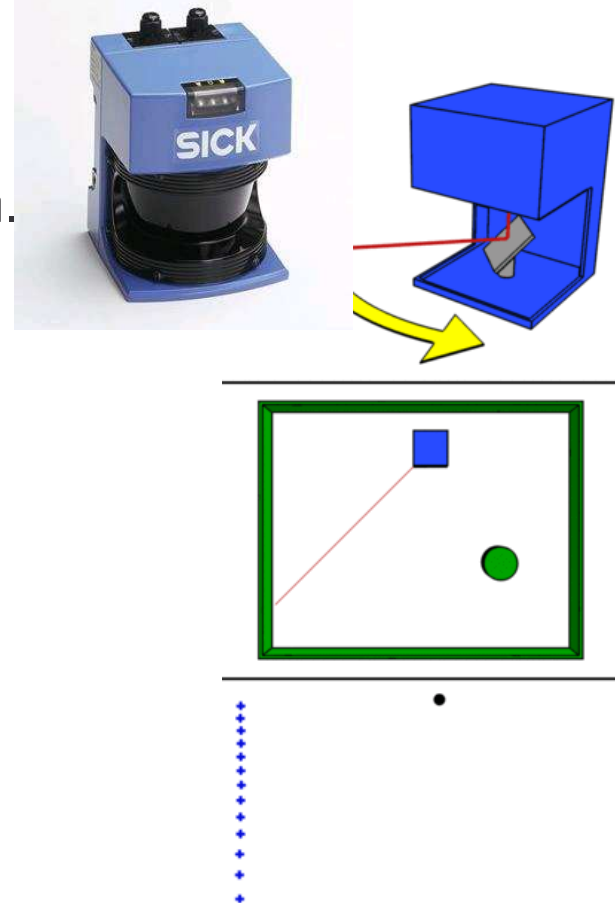
Sources:

SparkFun - <http://www.sparkfun.com/products/10601>

Hamlin Sensors - <http://www.hamlin.com/technical-detail-reed-switch.cfm>

LIDAR (Light Detection and Ranging)

- Uses optical remote sensing technology to measure the distance to an object by illuminating it with light (often pulses from a laser)
- Used ultraviolet, near infrared light.
- Measures distance, speed, rotation, chemical composition and concentration.
- Major components: Laser, scanner, photo detector and receiver electronics, position and navigation systems.



<http://www.pages.drexel.edu/~kws23/tutorials/sick/sick.html>

<http://www.lidar.com/>

<http://en.wikipedia.org/wiki/LIDAR>

Echoscope 3D Sonar

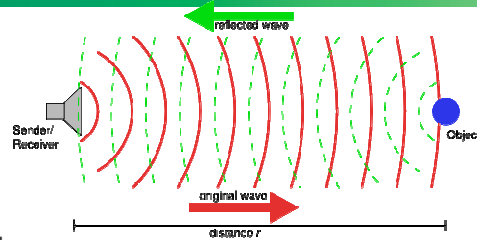
Information

Produces 16000 beams simultaneously, producing 3D Images of stationary or moving objects.
Data density 100x greater than traditional echo sounders
Capability of viewing the same data from multiple angles.

Specifications

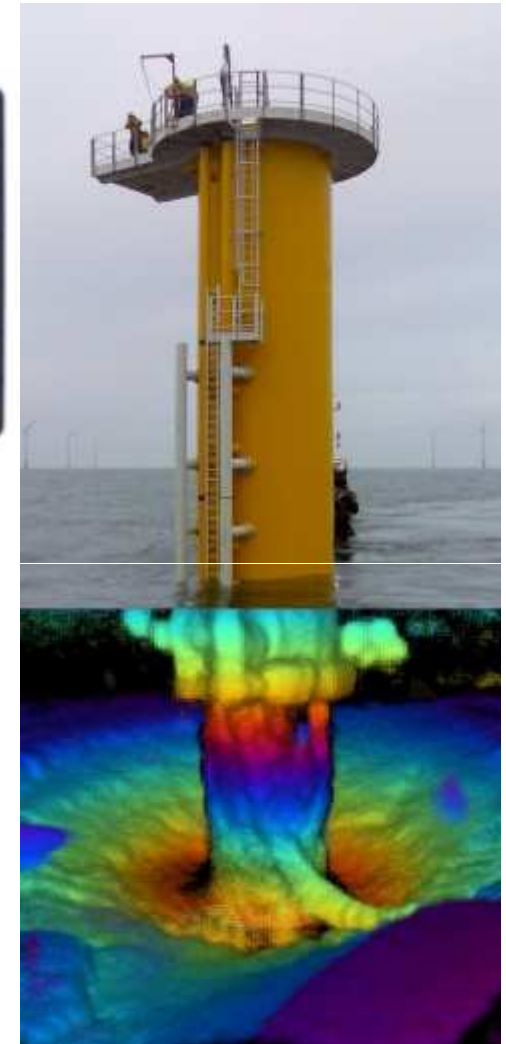
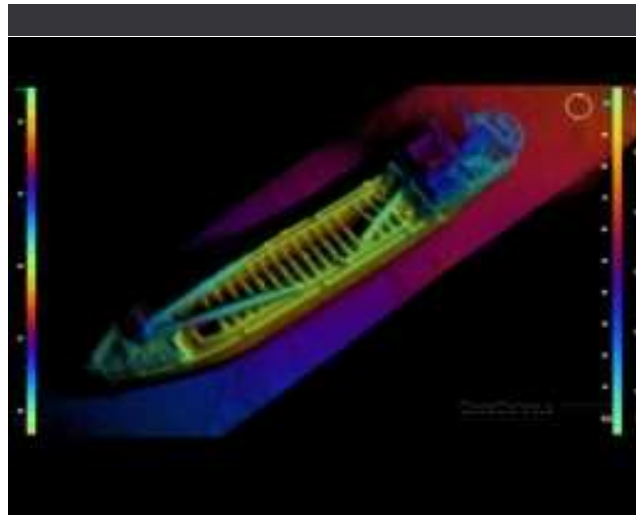
Max Range: 150 feet
Min Range: 3 feet
Frequency: 375 kHz
Range Resolution : 3cm

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Applications

Underwater Construction
Bridge and Dam Inspection
Search and Recovery
Obstacle Avoidance

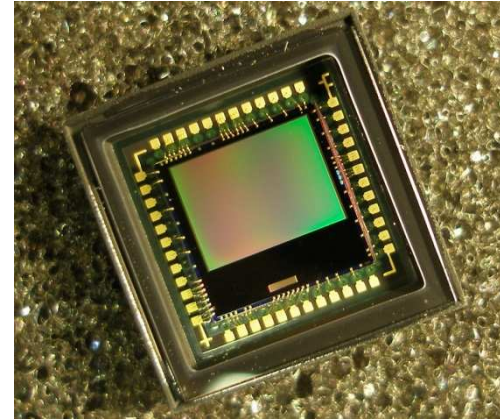


<http://www.codaoctopus.com/echoscope-3d-sonar/>
<http://en.wikipedia.org/wiki/Sonar>

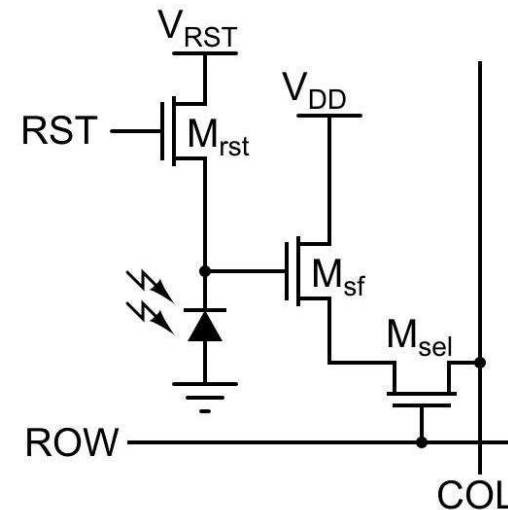
<http://www.youtube.com/watch?v=LUx9r2wSuIE>

CMOS Active Pixel Sensor

- Increasingly used in robotics
 - Environmental analysis
 - Navigation
 - Object ID/Tracking



- Pixels built from transistors and a photodiode
 - One to reset image after each acquisition
 - One to amplify the signal
 - One to select the row of pixels



"Robotics Fundamentals Series: CCDs and CMOS Image Sensors - Developer Zone - National Instruments."
NI Developer Zone. National Instruments Corp. Web. 09 June 2011.
<<http://zone.ni.com/devzone/cda/tut/p/id/8178>>.