

12.215 Modern Navigation

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Review of last class

- Basics of Handheld GPS
 - Run through typical screens that are available in handheld GPS
 - Navigation screens
 - Tips on using this type of GPS
- In Monday's class we used GPS outside to show how the system works in practice.

GPS Applications

- Look broadly at general application areas
 - Communication, Power grids, timing
 - Tracking and shipping
 - Personal navigation
 - Mining and engineering
 - Safety of life
- Precise GPS applications for geophysics
- Some useful links:
 - <http://gpshome.ssc.nasa.gov/>
 - <http://www.gpsworld.com/>

Overview

- General overview

Image removed due to copyright concerns.

<http://www.mitre.org/news/digest/archives/2000/gps.html>

Communication/Power Grids

- General applications in these areas are based on timing
- Coordination of power grids requires precise knowledge of time to keep the alternating power in phase.
- Communications: Often a billing issue but new regulations require 911 position information (first deadline already missed)

Tracking and Shipping

- Many applications are being in this area
- Knowledge of locations of vehicles
- Tracking information on packages
- Route information
- Maintenance infrastructure (i.e., change the oil every 3000 miles—GPS not only keeps track of number of miles covered but also average speed (actually complete history of speed)).
- Positional and motion information that can feed back into many areas.

Personal Navigation

- Saw an example of this is class excursion
- When linked to accurate maps and information (such as restaurants, hospitals etc) can be very effective in personal navigation
- Currently available in luxury cars (~\$2000 option typically) but will “trickle” down.
- Combined with cell phone communication of traffic conditions allows alternate routes. Possibility of vehicles communicating back.
- Possible congestion solution is to better use available roads.

Mining and Engineering

- Usually carrier phase application with few centimeter accuracy
- Control of bull dozer and grader for getting correct cut and fill surfaces. Automatic systems exist that allow operator to following precise depth profile
- In open-cut mining: Vehicle location and control of mined area (i.e., just mine to bottom of ore layer).
- Combined with GIS (Geographic Information System) allows yield to be monitored.

Safety of life

- Marine navigation in rescue (especially if the rescue's were using GPS)
- 911 service (especially in non-urban regions)
- Dispatcher information on vehicle locations and road and traffic conditions (Cambridge fire department uses such a system).
- Operator information on near by vehicles (police especially)

Aviation

- Wide-area-augmentation system (WAAS): few meter positioning in US. Not approved yet for aviation but signals are available
- 26-station tracking network in US provide input for average corrections to be transmitted from Geostationary satellite.
- On-runway/taxiway tracking of aircraft: Major problem at airports currently.
- Local -area-augmentation system (LAAS) still several years away but will allow landing in inclement weather.

Farming

- Major application area.
- Harvest yield by position
- Precise fertilizer application
- Boundary issue (farm all of land and not be stopped by fences).

Precise applications

- Meteorology: Monitoring atmospheric water vapor
- Space craft navigation (both coarse and accurate orbits). Shuttle has GPS receivers
- Attitude control and positioning digital aerial photography and laser scanning.
- Geophysical applications: We will spend some time in class looking at the California crustal motion model derived from the SCIGN array (www.scign.org)
- Use the Gamit/Globk Matlab tools
<http://bowie.mit.edu/~tah/GGMatlab>

End of class summary

- GPS is being used in increasingly many applications which require position and time information.
- It is being like the telecommunication industry: How long ago was it that people did not think they needed to be contact all the time? Soon it could be how long ago did people did not need to know where they were all the time?
- Combining communication with GPS positioning provides many new applications.
- Good luck on the final.