Navigation

6 DoF

position

x, y, z

attitude

θ, ϕ, ψ

How?

dead reckoning

celestial

landmarks

radio

inertial
Inertial (INS)

gimbal vs. strapdown
"black box"

1. accelerometer
2. Coriolis
3. Periodic correction (orbit)

Measure acceleration

\[ X_i = \int \int x_i \, dt \, dt \]
INS Errors

- increase with time
- correct via GPS

Combined w/ Kalman Filter(s)
GPS 101

- 24 (28) satellites
- $L_1 \approx 1575.42$ MHz
- $L_2 \approx 1227.6$ MHz
- PRN codes
- Ephemeris & Almanac (sub)
GPS

$2-3\, m \Delta x, \Delta y\, \Delta 6-9\, m \approx$

Pole coverage less than optimal

Above 70kfeet, localities

Versions of DGPS...

Short & long baseline

WAAS other radio corrections
Sample integrated systems

- GPS (Motorola OEM board) + MEM accel.
  → race car on track, check apex

- GPS L2 + L1 + FOE accel.
  → aim < 1°, < 1 m GPS

- Us ?

Choices...
Navigation Issues

- Precision
- Rate (1pps)
- online vs. offline
- Commonality
A sample nav. system for ANITA

<psi> 1pps
<x,y> 1m
<z> 2m
<theta> 1/2
Telemetry

- ULDB data format & procedure
- do things = values?
- 50 kbps - should it be an issue
- on board reasoning
Flight Computer

- Pentium n (n=1, down to 10W)
- Conductive cooling
- 586/PC/104/vME/VXI/ePCI
- Linux - RT
- Serial lines
- Ethernet
- JDF (mod) \equiv NSBF