GPS Concepts

1. Elasped time - distance equals rate times interval of time.

- **Procedure is called pseudorange C/A code measurement.**
- **Satellite transmits code having particular pattern.**
- **Receiver generates same pattern and compares to signal from satellite. Difference (shift) is measure of transit time for signal from satellite to receiver (passive).**
- **Distance from satellite to antenna is the measured time interval times the speed of light.**
- **Antenna position is 3-dimensional distance/distance/distance intersection. Three satellites are needed to find three unknowns (lat/long/height).**
- **Due to imprecise clock, distances are not quite correct. With 4th satellite, local clock correction is found as part of the solution.**
- **Subject to satellite geometry (PDOP), "accurate" local position is found.**

2. Doppler shift - change in observed frequency due to movement.

- **Transit satellite system. Used for navigation 1964 to 199?.**
- **Satellite broadcasts very stable frequency.**
- **Frequency received is:**
  - **shorter if range is decreasing.**
  - **longer if range is increasing.**
  - **instantaneously identical for closest approach (time).**
- **If the two frequencies are subtracted, the result is an intermediate frequency called the "beat" frequency and used to compute position.**
- **Many satellite passes required to determine "accurate" position.**

3. Interferometry

- **Based upon interference of waves (light/radio)**
- **Very Long Baseline Interferometry (VLBI) & use of quasars**
- **Measure position on wave within 1% - development continues**
- **L1 frequency wavelength is 19 cm, ultimate resolution - 2 mm**
- **Question for surveyors is which wavelength - integer ambiguity**
- **Many techniques developed to find "the right integer" etc.**
  - **Knowing approximate location helps**
  - **Doppler data can help narrow the search**
  - **Count cycles while "locked" onto satellites**
  - **Differencing combinations between satellites & receivers**
  - **Dual frequency receivers help resolve atmospheric effects**
  - **Use many satellites and "best" geometry**

