AGR 1515 Intro to GPS

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Syllabus Overview

Grades

- 2 exams – 50 pts each
- Weekly Quizzes – 10 pts each
- Assignments – 10-20 pts each
- Final Project – 30 pts

Policies

Canvas Overview

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https://farmingwithhorses.com/wp-content/uploads/2017/11/video_0.png

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https://www.siliconrepublic.com/wp-content/uploads/2022/01/john_deere2.jpeg

Why do we use GPS?

GPS in Agriculture

- Define Boundaries
- Reduce farmer fatigue
- Automate equipment
- Tie it to information (GIS)

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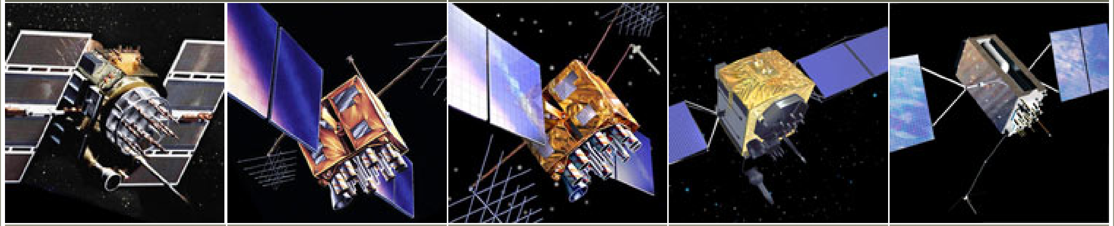
GPS

- 24 satellites
  - “The United States is committed to maintaining the availability of at least 24 operational GPS satellites, 95% of the time.” – GPS.gov
- Maintained by the department of defense
- Actually fly 31 GPS satellites to ensure min of 24 operational

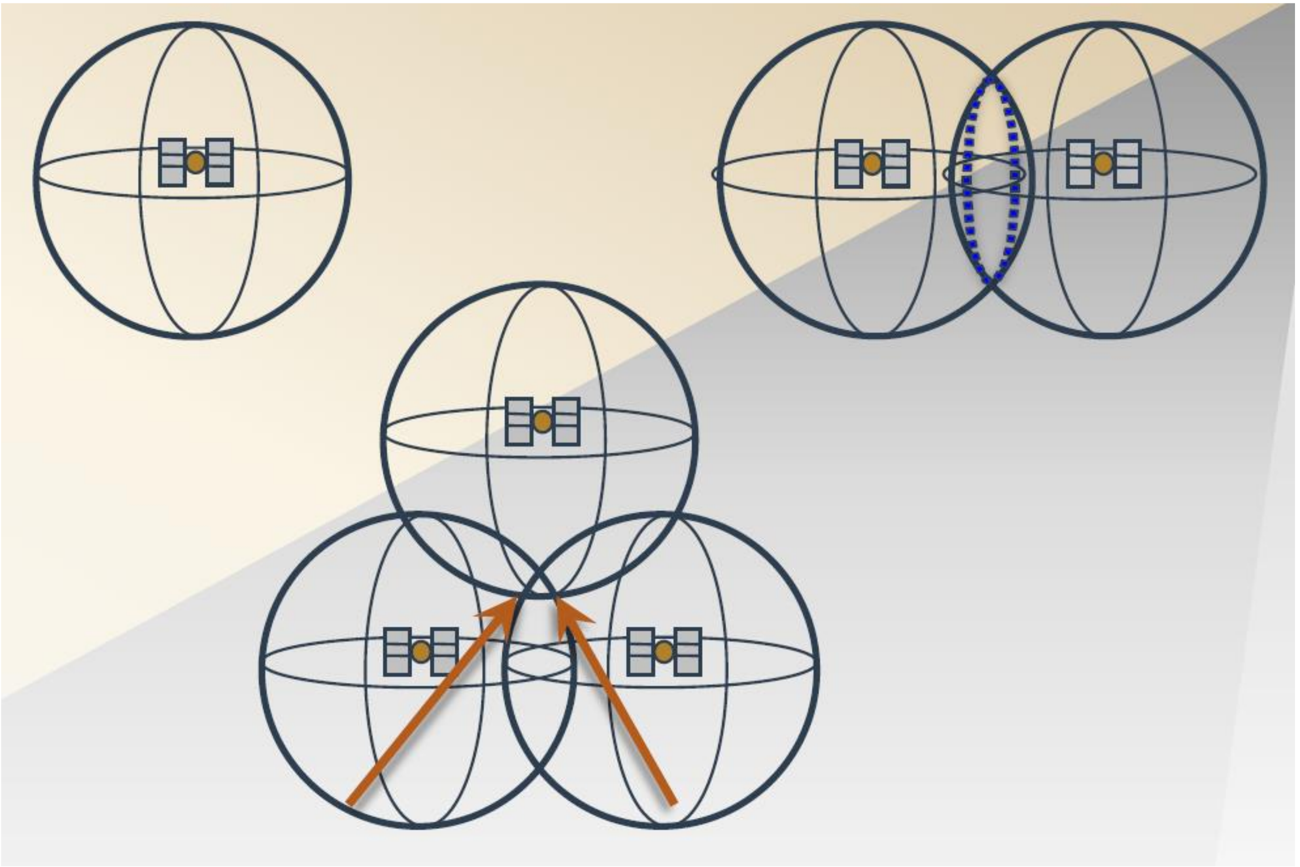
https://upload.wikimedia.org/wikipedia/commons/thumb/2/29/Seal_of_the_United_States_Space_Force.svg/1200px-Seal_of_the_United_States_Space_Force.svg.png

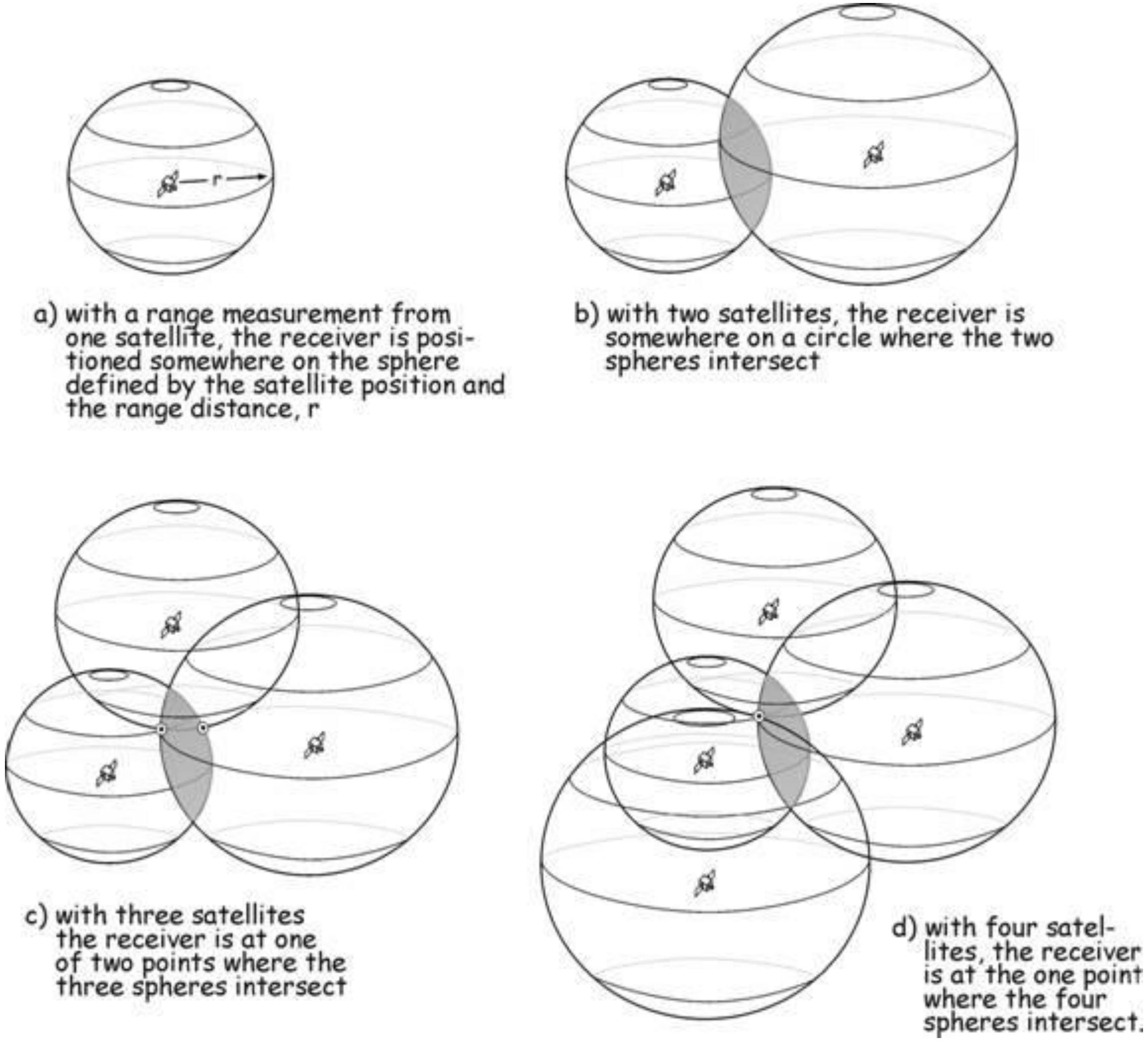


LEGACY SATELLITES		MODERNIZED SATELLITES		
BLOCK IIA	BLOCK IIR	BLOCK IIR-M	BLOCK IIF	GPS III/IIIF
0 operational	7 operational	7 operational	12 operational	5 operational
▪ Coarse Acquisition (C/A) code on L1 frequency for civil users ▪ Precise P(Y) code on L1 & L2 frequencies for military users ▪ 7.5-year design lifespan ▪ Launched in 1990-1997 ▪ Last one decommissioned in 2019	▪ C/A code on L1 ▪ P(Y) code on L1 & L2 ▪ On-board clock monitoring ▪ 7.5-year design lifespan ▪ Launched in 1997-2004	▪ All legacy signals ▪ 2nd civil signal on L2 (L2C) *LEARN MORE* ▪ New military M code signals for enhanced jam resistance ▪ Flexible power levels for military signals ▪ 7.5-year design lifespan ▪ Launched in 2005-2009	▪ All Block IIR-M signals ▪ 3rd civil signal on L5 frequency (L5) *LEARN MORE* ▪ Advanced atomic clocks ▪ Improved accuracy, signal strength, and quality ▪ 12-year design lifespan ▪ Launched in 2010-2016	▪ All Block IIF signals ▪ 4th civil signal on L1 (L1C) *LEARN MORE* ▪ Enhanced signal reliability, accuracy, and integrity ▪ No Selective Availability *LEARN MORE* ▪ 15-year design lifespan ▪ IIIF: laser reflectors; search & rescue payload ▪ First launch in 2018

https://www.gps.gov/systems/gps/space/

Triangulation



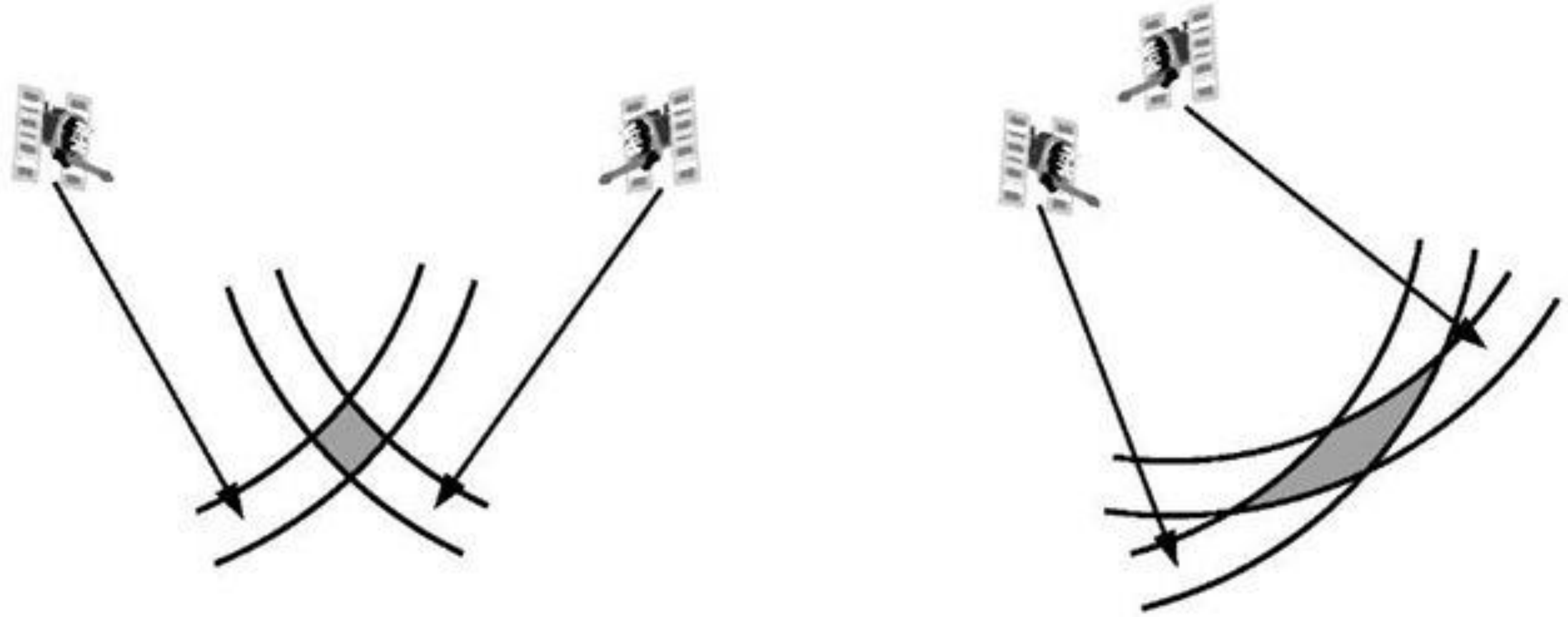


https://gis.depaul.edu/shwang/teaching/geog258/GPS.htm

Sources of Error

- Atmospheric delay
- Signal multi-path (reflection of signal)
- Receiver clock errors
- Orbital errors (satellite position error)
- Number of satellites visible
- Satellite geometry

Satellite Geometry



(a) (b)

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Distance

- Radio signals travel at the speed of light
- Let’s put some numbers on it
  - Altitude = 12,500mi.
  - Speed of light = 186,000 mi/sec
  - Transmission Time = 0.067 sec
- What happens if we are off a little?
  - 0.001 sec * 186,000 mi/sec = 186 mi