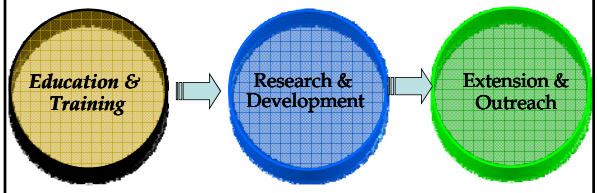
The GeoTREE Center

GPS-ArcPad

What is GeoTREE?

- GeoTREE: GeoInformatics Training, Research, Education and Extension Center
- The primary goal of this center is to transfer NASA related geoInformatics technology to the individuals from federal, state, local, and tribal (FSLT) governmental bodies in Iowa.

GeoTREE Approach: Components



Education: Workshops

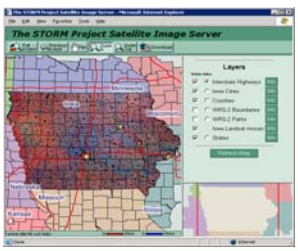
- Organized more than 10 workshops in the past three years.
- Over 200 people from FSLT agencies have attended.
- This summer we are organizing three workshops (GPS & LiDAR - Full) for more than 75 people from FLST agencies.

GeoTREE Research Activities

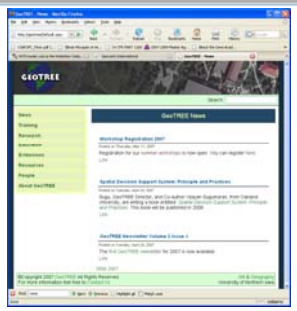
- Selected completed and ongoing projects with FSLT agencies include:
- Water quality and watershed monitoring using RS and GIS (NASA NRCS-SWCD & DNR)
- Alternate routing for emergency planning (INRCOG)
- Iowa Wetlands Project (BHC)
- West Nile Virus habitat analyses (NASA & Iowa Public Health)
- Hog Confinement Analysis (BHC & DNR)
- Land evaluation for corn suitability (BHC & NRCS)
- Invasive species identification (County and US Fish and Wildlife)
- Winter maintenance system for Iowa (MTC & IDOT)

3. Extension and Outreach

- NOAA-UNI (Earth Science and Geography)
- Goal: To disseminate remotely-sensed imagery via the Internet to public



More Information



www.geotree.uni.edu

GPS Overview

- What is GPS? Other navigation systems
- GPS Project
  - Field Reconnaissance
  - Project Planning (Mission)
  - Data Collection/Data Update
  - Data Processing

What is GPS?

- The Global Positioning Systems (GPS) allows users to determine their location on land, sea, and in the air around the Earth.
- GPS is a worldwide radio navigation system that allows users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world.
- The Global Positioning System (GPS) is a satellite-based system that can be used to locate positions anywhere on the earth.

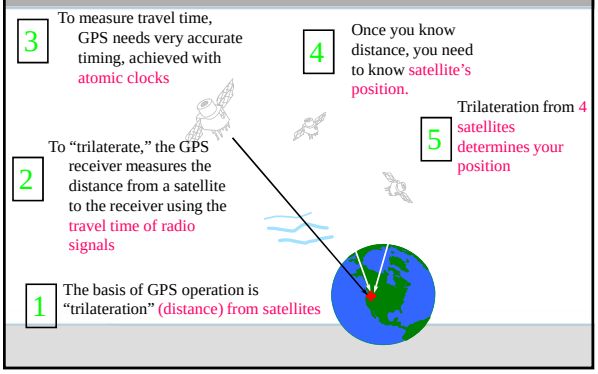
Other Satellite Navigation Systems

- The Russian counterpart to GPS is called GLONASS (Global Navigation Satellite System) and was used as a backup by some commercial GPS receivers.
- The European Union and European Space Agency have agreed (March 2002) to introduce their own alternative to GPS, called Galileo, pending a review in 2003.
- China has started to launch a series of satellites intended to form a system called the Beidou navigation system.

How GPS Works?

- In other words…..when you turn the GPS unit on……What happens?
- 1st, if it's working, you will lock onto at least one satellite
- You get a location and elevation information
- How?

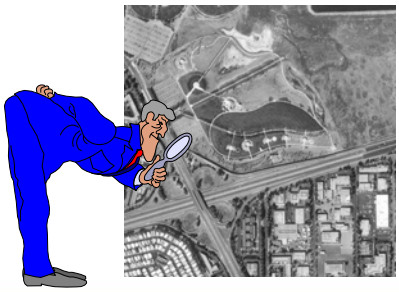
How Does GPS Work?



4 Steps of a GPS Project

1. Field Reconnaissance (Field)
2. Project Planning (Mission) (Lab)
3. Data Collection/Data Update (Field)
4. Data Processing (Lab)

1. Field Reconnaissance



1. Field Reconnaissance

- A field reconnaissance allows you to identify the features that will be collected in the field.
- These features can be entered into a *data dictionary* which guides your data collection session.
- Furthermore, a field reconnaissance helps you identify the attributes you need to include for accurate analysis and an up-to-date database.

1. Field Reconnaissance

- What kinds of features do you want to map?
- Are these features: Points? Lines? Areas?
- What about attributes?
- What about attribute values?

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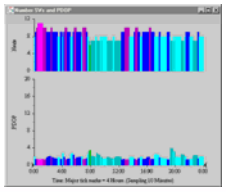
2. Mission Planning

A. Mission planning is carried out prior to field work in order to:

- to identify the best and worst time periods for GPS data collection at any location

- Number of visible satellites
- Where they will travel
- PDOP (Indication)



b. Equipment Setup

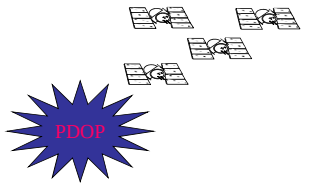
- **Fresh or Charged Batteries or Power Supply?**
- **Is Equipment Functioning Properly? Test!**
- **Configure Rover Receiver**
  - **The configuration determines how data is collected, entered, displayed, and communicated with external devices.**

Example: Critical Settings

Options	Recommended	Setting
PDOP Mask	6	critical
Elevation Mask	15	critical
SNR Mask	6	critical

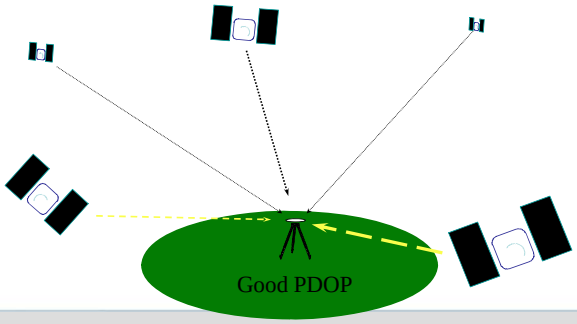
PDOP

Position
Dilution
Of
Precision

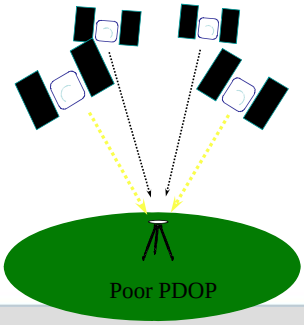


- **Satellite Geometry**
- **Good PDOP is less than 4 , acceptable 4-6**

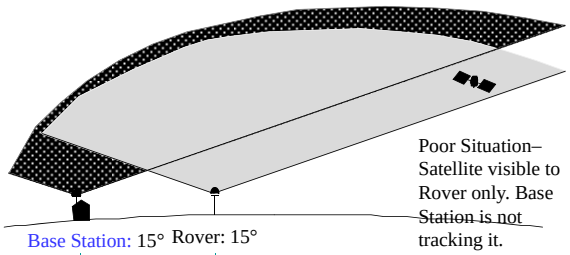
Good Satellite Geometry



Poor Satellite Geometry



Elevation Masks

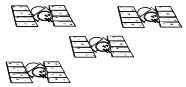


Poor Situation– Satellite visible to Rover only. Base Station is not tracking it.

Base Station: 15° Rover: 15°

300 miles or less

Signal to Noise Ratio: SNR

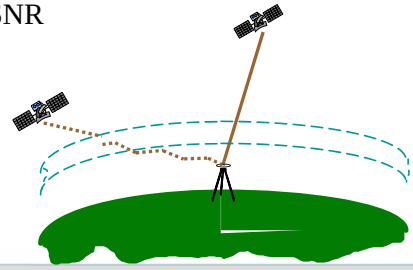


Minimum signal strength that a satellite must have to receive and be used for distance/time calculations

- SNR is usually set to 4

Signal Strength

- Satellite elevation and atmosphere effect SNR



Non-Critical Settings

Display Settings

There are 11 display settings that are located in the one of the following configuration menu options: GPS, Date, Quickmarks, or Constant Offset. Each of these configuration menu options will display a form.

Coordinate System	UTM, zone 37	Coordinate System
Units		
Coords units	Meters	Units and Display
Height units	Meters	Units and Display
Distance units	Meters	Units and Display
Velocity units	Km/hour	Units and Display
Angle units	Degrees	Units and Display
Angle format	DD.MM.SSss	Units and Display
Coordinate order	East/North	Units and Display
Altitude reference	Mean sea level	Units and Display
North reference	True North	Units and Display
Magnetic declination	Automatic	Units and Display
Null string	?	Units and Display
Language	English	Units and Display
24-hour clock	Yes	Time and Date
Date format	MM/DD/YYYY	Time and Date

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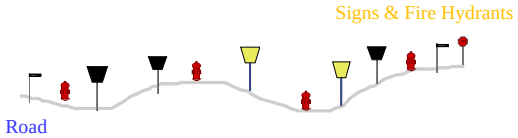
Data Collection Techniques

- **Advanced data collection techniques offer time-saving techniques for efficient data collection.**
- **Special techniques for collecting data quickly and effectively**
  - Continuing line and area / Nested points
  - Repeated features
  - Segmented lines
  - Offsets

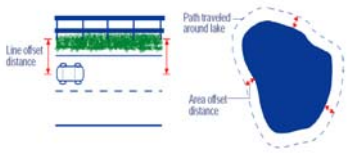
Continue: Nesting Point Features

- **Point features captured while recording a line or area feature**
- **No need to retrace steps**



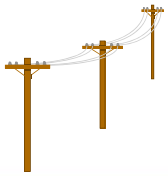
Offsets: Example

- Collecting the location of a feature without actually visiting the feature



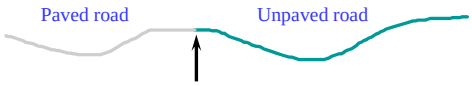
3. Repeating Features

- Attributes from a previous feature can be repeated
  - Saves time
- Useful when recording many similar features
  - Power poles
  - Trees
  - Utility access covers



4. Segmenting Lines

- Divides line features into segments
- Different attributes for each segment
- Ensures connected lines for GIS



5. External Sensor Recording

- GPS linked to other electronic devices such as
  - Laser range -finders
    - for distances, offsets and heights
  - Digital Cameras (GeoXT)
    - for photo images of features
    - Voice

2. Multipath

- GPS signal bounces before hitting antennae
- Provides inaccurate positional reading
- Causes include buildings, vehicles, rock cliffs, etc…

3. Selective Availability

- Random errors introduced by the DoD
- Intended to prevent hostile forces from fully utilizing GPS
- Largest source of error
- Errors up to 300 feet

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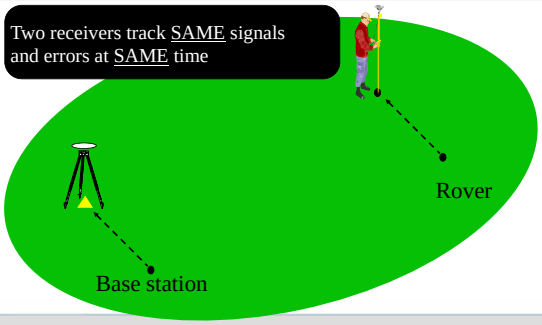
Post Processing

- **Improve the positional accuracy by manual checking**
- **Manual editing**
- **Improve the positional accuracy (Post processing – differential correction)**

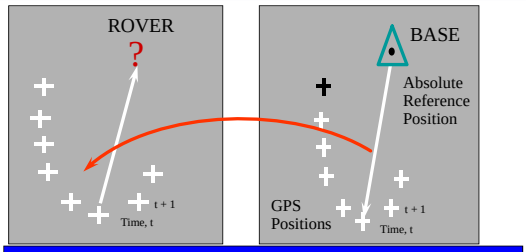
Differential GPS: What is it?

- **Differential GPS is a data collection technique that uses an extra GPS receiver and some complex calculations to increase the accuracy of GPS positions.**
- **Differential GPS involves the cooperation of two receivers, one that's stationary and another that's roving around making position measurements.**

Differential GPS



Differential Correction



…So the error calculated at the base station can be applied to the positions collected by the roving receiver…

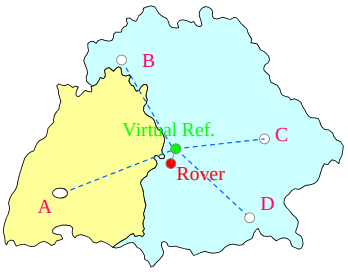
Correcting the roving receivers positions

Differential Correction Methods

- **Autonomous: No correction**
- **Differential Correction (Post processing) Process the data in the office to find real location**
  - Base stations and rovers
- **Differential GPS (DGPS) - Real Time!! Know your location in real time - radio link needed**
  - US Coast Guard Beacon
  - CORS (Continuously Operational Reference Stations) by NOAA
  - WAAS (Wide Area Augmentation System) by DOT and FAA
  - Virtual Reference Stations (from Trimble)

Virtual Reference Stations

- Uses a Network of Reference Stations (ABCD) to create Virtual Reference Stations (VRS)
- A VRS is created for each user location.



Hands-on