ORBIT DETERMINATION (OD)

- Process of estimating the position and velocity of a satellite at a specific epoch based on models of forces acting on the satellite, integration of satellite orbital motion equations and measurements to the satellites.

1. Preliminary orbit determination (improved as simplified orbit determination (SOD))
2. Precise orbit determination (POD)

PRELIMINARY ORBIT DETERMINATION

- Geometry method to estimate orbit elements from a minimum set of observations before the orbit is known from the traditional source.

(i) Gaussian orbit determination

- Determining the orbital parameters for three sets of widely spaced direction observations

(ii) Laplacian orbit determination

- To drive the initial velocity at a time instant from different combination of observation.
- Used to find the orbit from different position

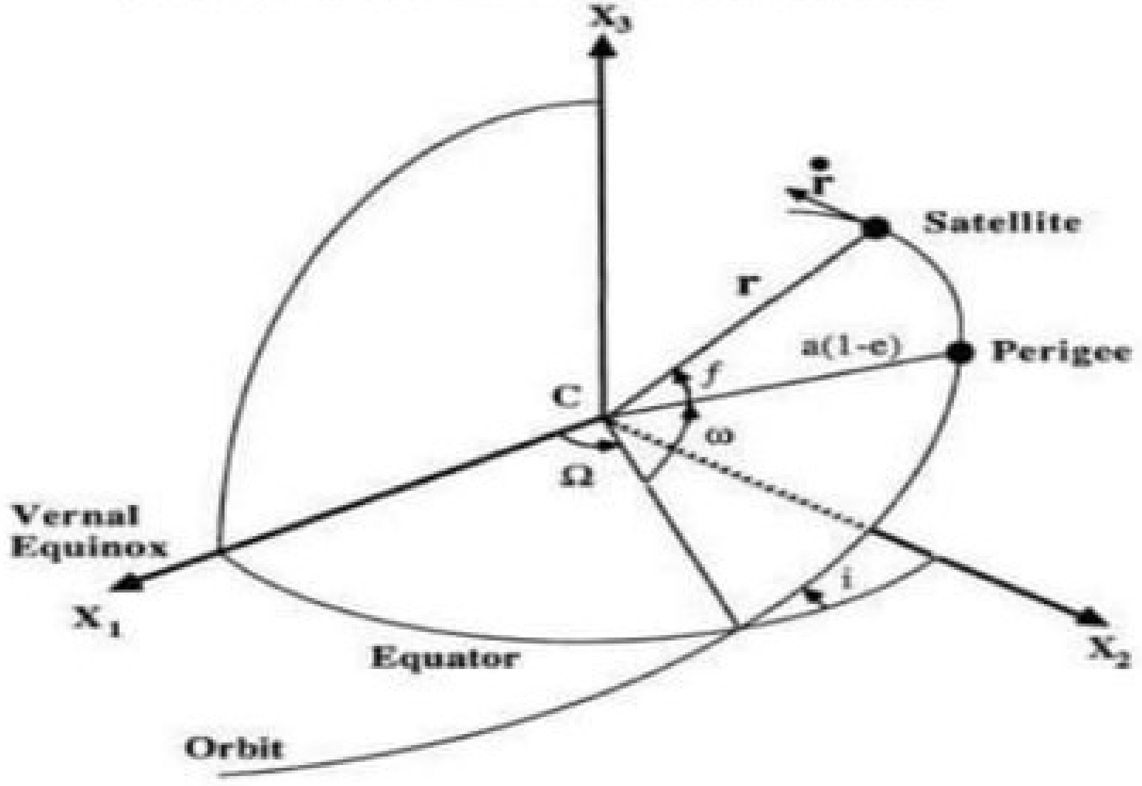
PRECISE ORBIT DETERMINATION

- Dynamic or combined geometric and dynamic method, a process completed with two distinct procedures
    a) Orbit integration
    b) Orbit improvement

ORBIT REPRESENTATION

- Representing a satellite orbit as a continuous trajectory with discrete observation data at the time of interest
- Keplerian elements method is simplest orbit representation- ellipse shape

KEPLERIAN ORBITAL ELEMENTS



ANTI-SPOOFING AND SLEECTIVE AVAILABILITY

- In US GPS is a military navigation system, in civilians used limited accuracy system.
- Standard positioning system (SPS) for civilians
- Precise positioning service (PPS) for authorized users
- SPS accuracy is 100m, 2DRMS and PPS accuracy is 10 to 20m in 3D.
- Additional limitation Viz, Anti-spoofing (AS) and selective availability (SA) was further imposed for civilian users.

ANTI-SPOOFING AND SLEECTIVE AVAILABILITY

- AS only authorized users to get access to the P-code
- By imposing SA condition positional accuracy from block II satellite was randomly offset for SPS users.
- Since may 1, 2000 according to declaration of US president SA is switched off for all users.

TASK OF CONTROL SEGMENT

- Resolves satellite anomalies
- Make pseudo-range and delta-range measurements to determine satellite clock corrections, almanac and ephemeris
- In order to perform the above functions, the control segment is comprised of three different components

1. Master control station (MCS)
2. Monitor station (MS)
3. Ground antennas

TASK OF CONTROL SEGMENT

- MS tracks the satellite and relay their positions to the master station.
- Used to determine the precise location of satellite constellation.
- Accurate atomic clocks on the satellites are also monitored and compared with the master clock
- Each satellite is capable of storing data that would accurately relay its position for next 14 days via the carrier waves.
- Its data bank is updated at every hour by the control station

TASK OF CONTROL SEGMENT

- MS while passing of satellite make pseudo-range and delta-range measurements.
- Measurements are made the two L band frequencies (L1 and L2)
- C/A code has a 1 ms period and repeats constantly
- P code transmissions is a 7 days sequence
- Repeat at every midnight Saturday/Sunday.
- Each satellites transmits this frequencies but with different ranging codes.

TASK OF CONTROL SEGMENT

- Navigation data helps the receiver to determine the location of the satellite at the time of signal transmission
- Ranging code used to determine the satellite time to the users
- Used in computer programmes to assist in position solutions.

RECEIVERS:

1. Hand-held receivers
2. Geodetic receivers
3. Single frequency receivers
4. Dual-frequency receivers

HAND-HELD RECEIVERS

- Data recorder which may be capable of tracking up to 6 satellites SIS
- Leica MX 8600 series is a typical of this type of equipment.
- For differential work use the MX 8650 base station, tracking with 12 satellite
- Using mapping by the utilities and local authorities
- Base station would be permanently mounted at the office or depot.
- I to 5m accuracy in MX 8601 using pseudo-range measurements
- 2 cm accuracy in MX 8612 and 8614 use both ranges.

GEODETIC RECEIVERS

- Currently little available
- Used in geodetic surveying and precise navigation
- Used to start with single frequency C/A code receivers with four channels
- L2 added and tracking capability was increased & leading manufacturers have gone for code-less, non sequencing L2 technique.
- WILD/LEITZ (heerbrugg, Switzerland) and MAGNAVOX (Torrance, California) have jointly developed WM 101 geodetic receiver in 1986.
- Codes are observed once per seconds
- 4 channel C/A code receivers, 3 channels track 6 satellites and 4 channels collect the satellite messages periodically

DATA PROCESSING

- It is most important consideration
- Collect the good quality data, for example avoiding multipath including environments, correct measurement of antenna height, adequate battery power, no signal observations (tree etc..) or interference (microwave transmission, etc...) appropriate length observation sessions, etc.
- Repair, detect are appropriately pre-processed.

Appropriate observation modeling and processing software:

- Matched to the accuracy required so that the correct strategy is used to account for the GPS measurement biases and in particular the cycle ambiguities

Appropriate processing procedure:

- Recognizes that GPS phase data reduction involves a numbers of steps executed in sequence.

Degree of sophistication of data modeling and processing:

- Used at wide range and verity of GPS modeling and software options that are available
- The surveying applications may be categorized according to three general ranges of accuracy
- Class A (Scientific) - better than 1 ppm- precise engineering
- Class B (Geodetic) -1 to 10 ppm-Geodetic densification, mapping, resource development app.
- Class C (General surveying) - lower than 10 ppm-urban, cadastral, general purpose survey)

DATA PRE-PROCESSING:

a) Initial data transfer and decoding

b) Data screening and editing

c) Data reporting and data base creation and entry

d) Point positioning using pseudo-range data.

- Carried out on a single-station basis, and can therefore be carried out in the field office.
- The result should be a set of appropriately formatted and pre-processed, observations, together with ephemeris information and approximate station co ordinates.

INITIAL DATA ANALYSIS:

- Final data adjustment
- Using two or more GPS in field observation
- Cycle slip detection and repair
- Preliminary baseline solution based on triple-differenced phase data or double-differenced pseudo-range data

FINAL ADJUSTMENT:

- Formation of the phase data differences
- Definition of the apriority weight matrices
- Estimation of relative station coordinates

FINAL ADJUSTMENT:

- Estimation of carrier beat phase ambiguities and fixing them to integers
- Output of estimated parameters and covariance matrix
- Adjustment of GPS observations can be performed in two ways

1. By combining single baseline solutions into a network adjustment of the baseline components
2. By a direct simultaneous solution involving all the GPS observations for a session or complete network.

TRAVERSING AND TRIANGULATION

GENERAL INFORMATION

- GPS used to other surveying tool.
- It can accomplish certain goals if we are conscious of its strengths and limitations.
- When surveying with GPS we do not need to have inter-visibility b/n the stations to measure a baseline.
- The only constraint to receive the signals is having a clear of the sky.

NETWORK DESIGN ON MAP

- To make a map of the station in a good geometric figure, both fixed control points and unknown points for the entire project area
- Scale and distance between the two stations are important factor
- Confidence level is not only the accuracy level also the configuration
- To fulfill the basic role a strong and reliable reference frame work
- It must be homogeneous
- Individual figures should be well-shaped

NETWORK DESIGN ON MAP

- To Stations should be evenly spaced as possible
- Adjacent pairs of stations in the network should preferably be connected by direct measurement.
- Ratio of longest length to the shortest length should never be greater then 1:5 and usually should be much less
- Higher difference in heights b/n two stations will be avoided in the network
- Designed several small closed loops within the large network
- The areas in which the ground does not permit to design the network like traverse

TYPES OF CONTROL

1. Horizontal control
2. Vertical control

HORIZONTAL CONTROL

- Minimum 3 to 4 fixed control points for average size of project with complete adjustments
- More number of control produce better redundancy with higher quantity of check
- Four control points two at both ends of the network are required to established for network adjustments

TYPES OF CONTROL

VERTICAL CONTROL

- MSL height are not to be confused with GPS height
- GPS height is based on the WGS 84 ellipsoid
- MSL height is based on an equipotential surface coinciding with MSL called the geoids
- Need to know the geoidal undulation at that point for convert the GPS and MSL height (ex: separation b/n geoid & ellipsoid)
- Connect maximum number of points to connect the height and level adjustments
- GPS control points which is not connected with levelling line will be adjusted by adjustment program with the help of fixed vertical control points and EGM96 geoid model, used to find unknown vertical points on to the same datum as fixed point.

THANK YOU