



# FER STUDENT SATELLITE PROJECT



## FERSAT ORBIT

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FERSAT



# Some details about our CubeSat's orbit

- Sun-synchronous orbit (SSO)
- Low Earth orbit (LEO)
- Near polar orbit
- Most likely a retrograde orbit
- Nadir orientation
- 2 years lifetime
- Orbit specifics dependent on launch time



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# Why the Sun-synchronous orbit?

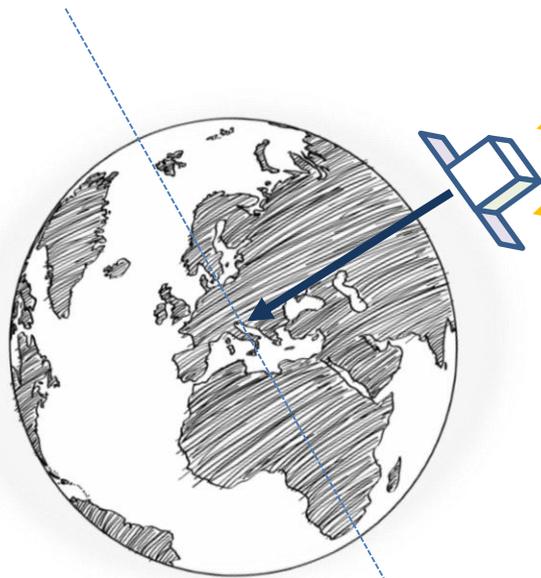
- Because...
  - it is arranged so that it precesses through one complete revolution each year, so it always maintains the same relationship with the Sun
  - the satellite spends 2/3 of time in sunlight
  - it offers consistent lighting for imaging



# About the other orbital parameters

Orbits per day	Period (h)	Height above Earth's surface (km)	Maximal latitude	Inclination
16	$1\frac{1}{2} = 1:30$	282	83.4°	96.6°
15	$1\frac{3}{5} = 1:36$	574	82.3°	97.7°
14	$1\frac{5}{7} \approx 1:43$	901	81.0°	99.0°
13	$1\frac{11}{13} \approx 1:51$	1269	79.3°	100.7°
12	2	1688	77.0°	103.0°
11	$2\frac{2}{11} \approx 2:11$	2169	74.0°	106.0°
10	$2\frac{2}{5} = 2:24$	2730	69.9°	110.1°
9	$2\frac{2}{3} = 2:40$	3392	64.0°	116.0°
8	3	4189	54.7°	125.3°
7	$3\frac{3}{7} \approx 3:26$	5172	37.9°	142.1°

- LEO – between 500 and 650 km above Earth surface
- other parameters dependent on the fact we want the orbit to be an SSO



Nadir oriented satellite's solar panels are always facing the Sun, while its camera and antennae are always facing the Earth

# Importance of tracking the orbit

- Predicting the orbit well helps us to know:
  - when will the satellite be visible from the ground station
  - Where to point the ground station antenna
  - when will the satellite be above a location we might want to take a picture of
  - if something's wrong



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# Orbit tracking and predictions

- The satellite does not have a GPS system
- No orbit tracking programs are ran on the satellite
- All components of the orbit tracking and prediction program are ran on computers and servers on the ground station
- The program is being developed by Ultima



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# How does the program work?

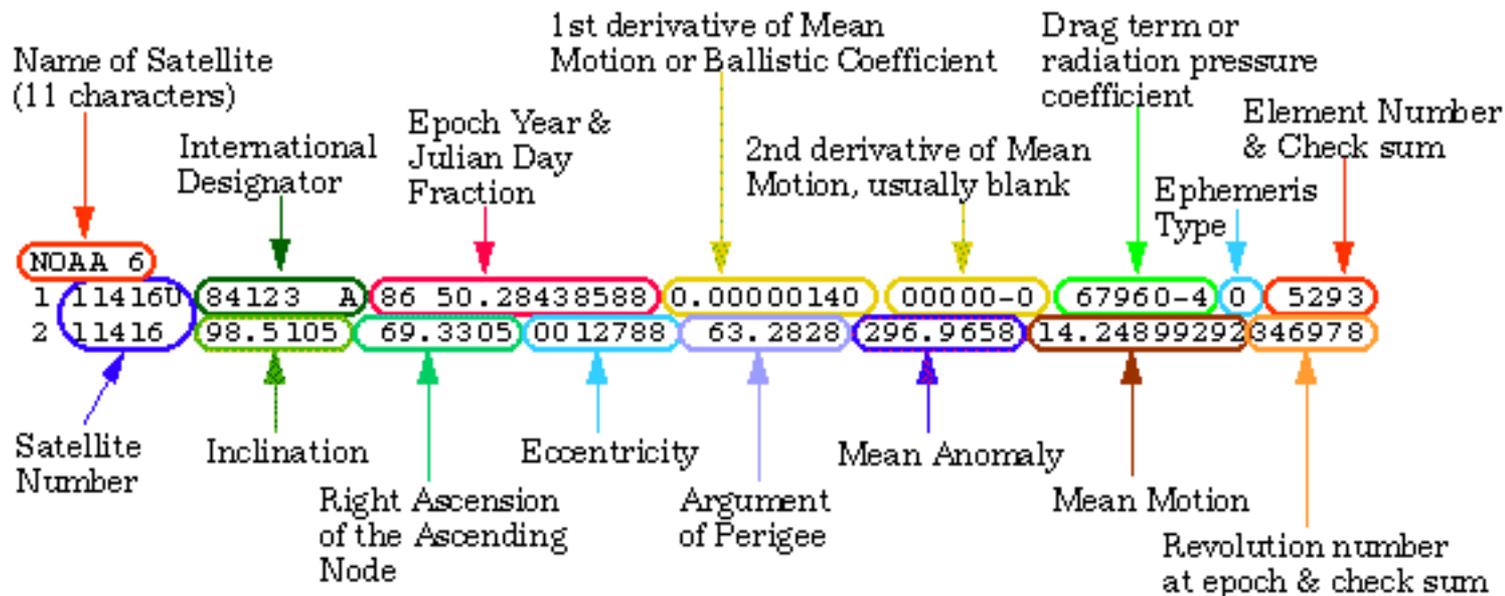
- Uses TLE data from NORAD
- From TLE predicts the position of the satellite for next 24 hours by using SGP4 algorithm
- Calculates the azimuth angle, elevation, doppler shift and distance to the satellite
- The azimuth angle and elevation are then used to automatically turn the antenna towards the satellite when its visible from the ground station

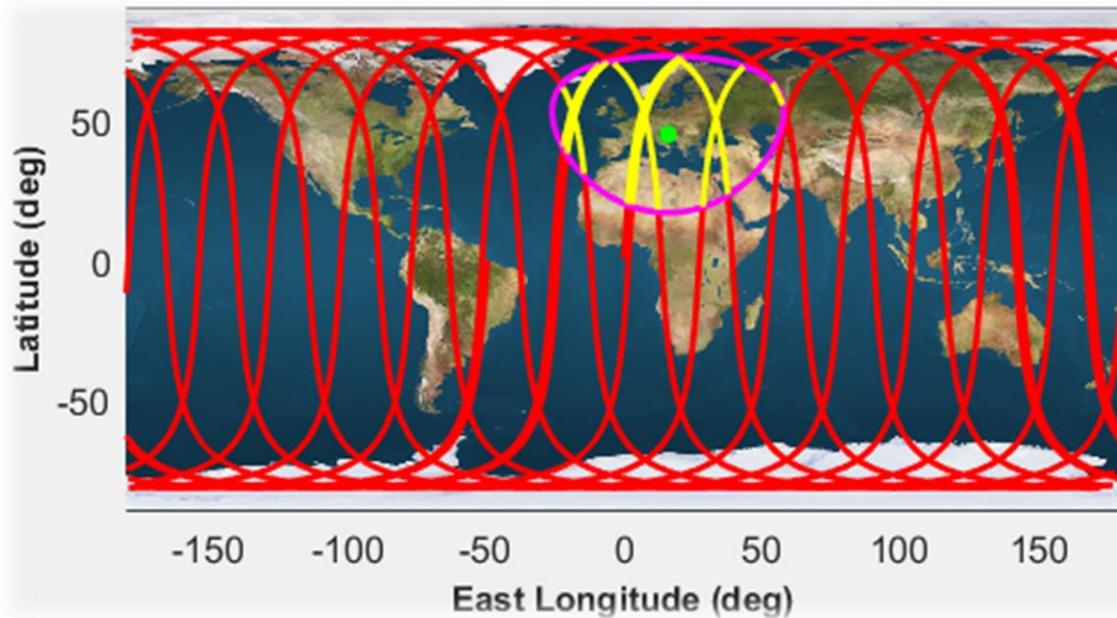


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# Definition of Two-line Element Set Coordinate System





Picture shows the location of the ground station and the area in which the satellite is visible from it