ORBITAL PROPAGATION

MINI PROJECT

To find the state of the satellite at a particular instant we need its position and velocity from GPS receivers. One may ask why not use GPS all the time for position determination. The answer lies in power consumption. In space we have limited power but more responsibility.

Propagator is a model whose objective is to determine the position of a satellite at any instance of time, with given acceleration and initial velocity. If we assume the earth is spherical and only earth's gravitational field is affecting satellite motion then the problem would be pretty easy to solve but the issue arises when other factors like earth oblateness, gravitational force from moon and sun, atmospheric drag and solar pressure come into play.

WEEK 01 KINEMATICS & DYNAMICS
Reference frames & Coordinate Systems
Kinematics and Dynamics of Point Masses
3D Rigid Body Kinematics and Dynamics
Keplerian Orbital Elements

WEEK 02 PERTURBATION MODELS & NUMERICAL METHODS
Orbital Perturbations
Drag Perturbation
Effect of Earth's oblateness
J2 Perturbation
J2 Special Orbits, Sun-Synchronous Orbits
Learn MATLAB basics
Learn about Numerical ODE Solvers
Newton-Raphson Iteration Method
Runge-Kutta Method

WEEK03 ORBITAL SIMULATIONS
Orbital Propagation
Two-body, Cowell's, Encke's method
TLE Two Line Element
J2 Propagation, SGP4 Propagation
Design a LEO satellite mission. Define mission parameters and objectives
Simulate a Sun-synchronous LEO using numerical techniques on MATLAB
Learn GMAT Software and simulate SSPO on GMAT
Analyze the simulated orbit results from MATLAB and GMAT and compare the results

Student Satellite Program, IIT Bombay

SOFTWARE
MATLAB, Simulink
MATLAB Aerospace Toolbox, Aerospace Blockset
GMAT R2022A https://sourceforge.net/projects/gmat/

REFERENCES
Orbital Mechanics for Engineering Students, Howard Curtis
Course on Orbital Mechanics & Spacecraft Dynamics:
https://www.youtube.com/playlist?list=PL5ebyVGQORm6IUCJIuXGYj21o91Uyrwc4
Orbital Visualisation: https://orbitalmechanics.info
MATLAB Mission Analysis with Orbital Propagator Block:
https://in.mathworks.com/help/aeroblks/mission-analysis-with-the-orbit-propagator-block.html

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