Course Announcement – Spring 2015

ASE 389P 4-METHODS ORBIT DETERMINATION (unique: 13397)

TTH - 200 to 330p; GDC 2.402, BETTADPUR, S

Background:

This class bridges between the basics of orbital mechanics and orbit determination, and the topics encountered in professional engineering practice and research applications of astrodynamics & space-flight mechanics. It is assumed that you have a graduate-level understanding on the two-body problem (CM), of orbit perturbations (e.g. Geodesy or Applied Orbital Mechanics), and of the use of differential corrections for orbit determination (Stat OD).

Course Topics:

The Orbit Determination (OD) Problem

- OD: Intro; Framework and Requirements; Orbit & the Observer
- Relevance, requirements, and basics of Preliminary and Precise OD
- Covariance Analysis & its applications
- OD Problem Geometry and Formulation:
    - LEO (brief review) & planetary objects
    - Interplanetary artificial satellites

The Prediction Problem

- Mean orbital elements, Two-Line Elements (TLEs) and the SGP4
- Applications to modern (Space Situational Awareness) problems

Orbit Measurement Methods

- Historical survey
- Clocks and Oscillators: Principles, models & relevance to OD
- Radiometric and Laser tracking methods
    - Measurement Technology and Observation Parametrization
    - Survey of the error sources and the state of the art

References: There is no textbook for this course. The following books, however, contain all of the information for this class, and more.

Statistical Orbit Determination, Byron Tapley, Bob Schutz & George Born, Elsevier Academic Press (2004).

Methods of Orbit Determination, Pedro Ramon Escobal, Krieger Publishing (1976) reprint (with corrections) of the original J Wiley (1965) edition.

Satellite Orbits, Oliver Montenbruck & Eberhard Gill, Springer (2005), corrected 3rd printing.

Fundamentals of Astrodynamics & Applications, David Vallado, Space Technology Library, Microcosm Press/Springer, 3rd Edition (2007).

Astrodynamics Volume-1: OD, Navigation & CM, Samuel Herrick, van Nostrand Reinhold (1971).

Formulation for Observed and Computed Values of Deep Space Network Data Types for Navigation, Theodore Moyer, JPL Deep Space Communication and Navigation Series (Joseph Yuen, Series Editor), Wiley Interscience (2003).

Radiometric Tracking Techniques for Deep Space Navigation, Catherine Thornton and James Broder, JPL Deep Space Communication and Navigation Series (Joseph Yuen, Series Editor), Wiley Interscience (2003).

Satellite Geodesy, Günter Seeber, 2nd Edition, de Gruyter (2003).

Theory of Satellite Geodesy, William Kaula, Dover Publications (2000).

Mathematical Geodesy, Martin Hotine, ESSA Monograph 2, Dept of Commerce, Washington DC (1969).

Methods of Celestial Mechanics, Dirk Brouwer and Gerald M. Clemence, Academic Press (1961).

Mathematical Formulation of the Double Precision Orbit Determination Program (DPODP), Theodore Moyer, JPL Technical Report 32-1527 (1971). As NASA CR 118673, this is available in PDF from the NASA/NTRS. The Wiley Interscience books by Moyer (above) are a more complete form of this document.

Fundamentals of Celestial Mechanics, J.M.A. Danby, Willman Bell (2nd Edition).