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USING THE DSST SEMI-ANALYTICAL ORBIT PROPAGATOR PACKAGE VIA THE NONDYWEBTOOLS/ASTRODYWEBTOOLS OPEN SCIENCE ENVIRONMENT

Abstract

Recently, an initiative has been proposed to create an open source software suite of basic tools for space situational awareness (SSA) that would be available to all space actors. This suite would include SSA applications related to observation compression, orbit propagators, state transition matrices, improved nonlinear Kalman filters, realistic process noise, atmosphere density variations, observation data association and observation data simulation. The project includes rewriting some existing tools in a modern distributed object-oriented computing environment. The project also includes encapsulation of some of the key legacy software tools. As a first step in this project, an object-oriented version of the DSST Semi-analytical Orbit Propagator Package will be implemented in the AstrodyWebTools Open Science Environment. This will enable the use of the DSST in a web-service context, by remote users via the Internet.

The DSST Semi-analytical Orbit Propagator Package combines the advantages of Special Perturbations (numerical integration) and General Perturbations (analytical) satellite theories. The semi-analytical theory for the motion of a space object replaces the conventional equations of motion with two formulas: equations of motion for the mean elements and expressions for the short periodic motion. Very complete force models have been developed for the mean element equations of motion and for the short periodic motion. There is also a semi-analytical theory for the partial derivatives of the perturbed motion. There is an interpolation strategy which greatly assists in producing the perturbed position and velocity and the partial derivatives at the output request times. The semi-analytical theory has been used extensively to study the long term evolution of orbits. Additionally, the constants in the semi-analytical theory (the mean equinoctial elements) have proven very convenient as solve-for variables in orbit determination processes based on both least squares and recursive filters.

In this paper we describe the integration of DSST orbit propagator within AstrodyWebTools project. AstrodyWebTools provides an Astrodynamics environment to support open science in which specialized

applications can be integrated, and to encourage scientific collaboration through the Internet. This framework, through a user-friendly web interface, allows the user to choose applications, introduce data and select the appropriate constraints in an intuitive and easy way, with the help of options in the graphical interface. After that, the application is executed in real-time and the critical information about the program behavior and output is shown via the same web interface or by downloading files to the users' computers.