



# GPS LADO Ground System - Mission Planning with *FreeFlyer*<sup>®</sup>

Integrating GPS constellation ground support, from separation through disposal

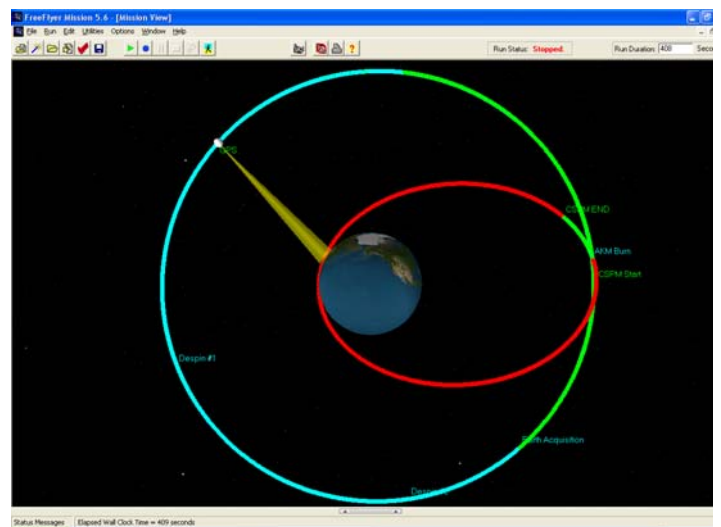
With the successful launch of GPS IIR-17M in October 2007, the new GPS Launch and Early Orbit, Anomaly Resolutions and Disposal Operations (LADO) ground system became operational. The new commercial-off-the-shelf (COTS), PC-based ground system replaces the legacy mainframe based Command-and-Control System (CCS) and provides integrated telemetry command and control, mission planning and mission operations support for the entire GPS constellation of satellites. In addition, implementation of the LADO system allows all GPS constellation support, from spacecraft separation through end of life disposal, to be consolidated under the authority of the Air Force 2nd Space Operations Squadron (2SOPS) located at Schriever Air Force Base, Colorado Springs, CO.

**a.i. solutions** is the developer of *FreeFlyer*<sup>®</sup>, a commercial software tool used for pre-mission analysis and satellite operations. Because of **a.i. solutions'** experience in mission planning, satellite operations and ground system development, coupled with *FreeFlyer's* seamless integration with other tools and advanced flight dynamics capability, **a.i. solutions** was chosen to deliver a *FreeFlyer*-based mission planning subsystem for the LADO ground system.

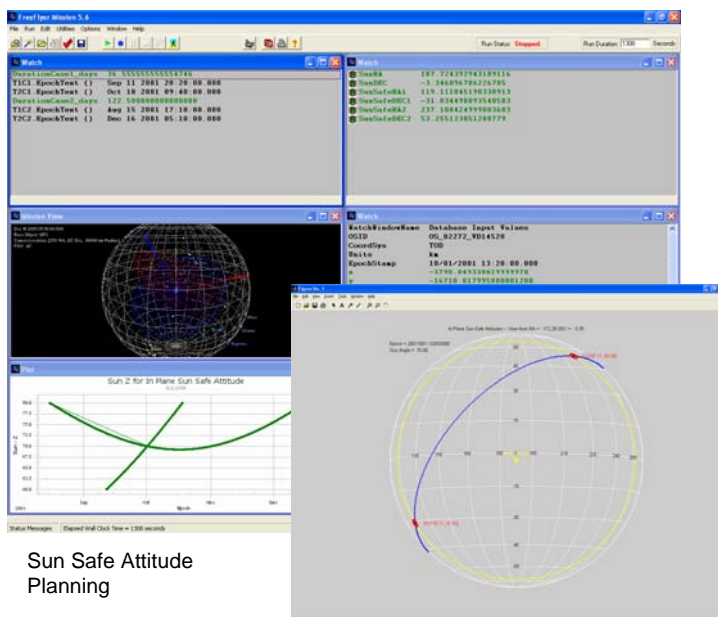
Current GPS satellites are launched into a highly eccentric orbit and follow a series of orbit and attitude maneuvers to achieve the desired mission orbit and spacecraft orientation. The *FreeFlyer*-based mission planning element not only provides flight dynamics support for the ascent phase, but is also designed to support end-of-life disposal and anomalous and contingency operations when the satellite is operating in a non-nominal orbit or attitude state. The new system also supports the direct injection to operational orbit of future GPS Block IIF satellites.



GPS Block IIR Satellite



GPS Circularization and Earth Acquisition



Sun Safe Attitude Planning

**a.i. solutions** developed, integrated, tested and delivered the *FreeFlyer*-based mission planning element to provide:

- Spin axis attitude determination
- Coarse and fine spin axis precession maneuver planning
- AKM maneuver planning and execution
- De-spin maneuver planning and execution
- Earth acquisition planning
- Contact predictions/planning
- Orbit and attitude products generation

The *FreeFlyer*-based mission planning element also provides advanced database capabilities, supporting all current GPS satellites and an unlimited number of future GPS satellites. *FreeFlyer* drives the autonomous database population of all orbit and attitude state parameters for the entire GPS constellation of satellites.



# GPS LADO Ground System - Mission Planning with *FreeFlyer*<sup>®</sup>

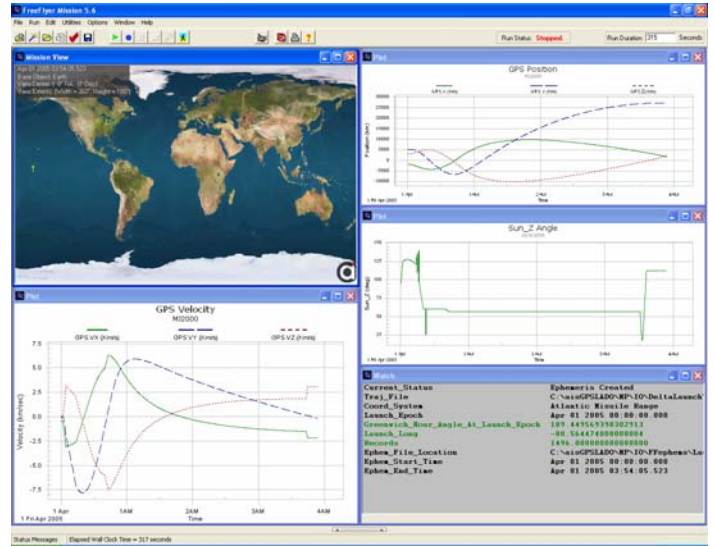
Integrating GPS constellation ground support, from separation through disposal

## System Highlights:

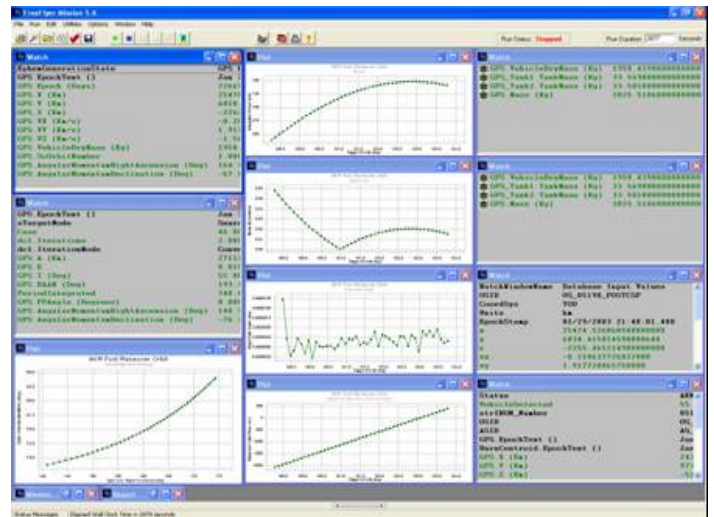
- GUI driven system reducing input errors
- Spin axis attitude determination
- Coarse and fine spin axis precession maneuver planning
- AKM maneuver planning and execution
- Spin maneuver planning and execution
- Earth acquisition planning
- Contact predictions/planning
- Orbit and attitude products generation
- Fully integrated with TT&C system
- Automated database population of satellite orbit and attitude states
- Anomaly resolution support
- Disposal maneuver planning and execution
- Modular design for easier maintenance
- Scripting language use allows customization/modification without altering core COTS product
- Provides comprehensive toolset for off-line analysis

## GPS LADO – Mission Planning Element Operating Environment:

- PC Running Windows 2000 or newer
- 2 GHz Processor Speed or Faster
- 1 GB RAM or more
- 64 MB accelerated graphics card or better



Launch Vehicle Ascent



AKM Maneuver Planning



Attitude Sensor Coverage Predictions (Nutation Modeling Option Shown)

To Learn More About GPS LADO, please contact:

Nick Netreba  
 301-306-1756 ext. 105  
[nick.netreba@ai-solutions.com](mailto:nick.netreba@ai-solutions.com)  
[www.ai-solutions.com](http://www.ai-solutions.com)

To Learn More About please contact:

Paul Noonan  
 301-306-1756 ext. 108  
[paul.noonan@ai-solutions.com](mailto:paul.noonan@ai-solutions.com)  
[www.ai-solutions.com](http://www.ai-solutions.com)

