Agenda

- History
- Description of AOA System
- Demo
History of AOA

- In 1990, Northrop Grumman developed a system known as AUTOmated Orbit Determination (AUTOOD) which was written for a VAX/VMS computer architecture.
  - This system incorporated the collective experience and knowledge of many expert orbit analysts
    - Hundreds of quality checks
    - Historical trending used in the checks
    - Wrapped NG proprietary orbit determination software
  - This system has been continually improved and customers are extremely satisfied with its features and performance.
In 2005, NG became a member of the Mobile User Objective System (MUOS) team and one of the NG tasks was to provide an automated orbit analysis system with the following characteristics:

- COTS based
- Database driven
- Automated and unattended operations
- Tight ephemeris accuracy requirements
- Complex station-keeping strategy implemented so as to simplify the station-keeping planning task
History of AOA (cont)

- Based on the legacy AUTOOOD system and the new MUOS requirements, an Automated Orbit Analysis (AOA) software system was designed and implemented.
  - Uses AGI’s STK and ODTK to perform all of the orbit related calculations
    - STK/Astrogator used for station-keeping planning
    - ODTK used for orbit determination
    - STK/Pro used to generate most orbit related products for internal and external interfaces
    - MySQL used for database storage
Automation

- Provides scheduling
- Monitoring capabilities
- Multiple Security levels
  - Viewer Only (read permission only)
  - OA (perform OD, schedule tasks, database read/write, station-keeping planning, etc)
  - Senior OA (all of above + set rules, give permissions, add steps or checks, etc)
- Maintains rules for quality assurance checks
- Data handling and archiving
- Status viewing capabilities
- Master dataset extraction tools
Automated Orbit Analysis Situational Awareness

- Schedule Timeline is Re-Scaleable
- Current status of scheduled item: Default – Nominal, Yellow – Warning, Red – Error
- Gantt chart shows scheduled events:
  - Black – Scheduled Events
  - Green – Good Result
  - Yellow – Warning Result
  - Red – Bad Result
- Schedule is Shift-able
- Schedule zoomed to approximately 4 days
- Now
OA System Schedule

Task/Event Icon Categories
- Dependent Tasks
- Events (Read-Only)
  - Maneuvers
  - Eclipse
  - Node Crossing
- Task Execution Status/State

Schedule Icons
- Completion Status
- Execution State
- Scheduled
  - Metadata
Database Description

- Databases contain:
  - Rules for automation (i.e. schedule, frequency, tasks to be performed)
  - OD quality rules (i.e. overlap checks, historical trends, etc)
  - Master datasets
    - Ephemeris
    - Covariance
    - Orbit Events (i.e. eclipse, node crossings, rise/set, maneuvers, etc)
  - OD Trending data (i.e. solar radiation pressure solved-for values, tracking data biases solved-for values, etc)
Task Scheduling (Tab 1)

Schedule a Task
- Single Instance
- Series
Task Scheduling (Tab 2)

- Category on Schedule (for Icon)
- Task Selection
- COTS visibility during Task Execution
- Comment Field
- Task Execution Steps
  - Enable/Disable
- Task/Step Configurable Arguments (OA an Senior OA Editable)
Task Engine

- Similar to Task Scheduling (Tab 2)
  - Senior OA ability to modify baseline Tasks (available in all modes)
  - Available to OA in Simulation and Test modes, for training
Task Modification

Task Modifications
- Add
- Rename (F2)
- Delete Step (Del)
- Step Statistics (Ctrl+5)

Script/Step Modifications
- Edit Script (Ctrl+E)
- Delete Step (Del)
- Step Statistics (Ctrl+5)
Step/Script Editing

- Scripts in VB.net
- Options for modification of a Task Script/Step.
New Maneuver Plan
Manual Maneuver

- Inputs most up-to-date ephemeris information into STK maneuver planning scenario
- User manually interacts with STK scenario to plan EOL and Relocation maneuvers
- Data for maneuvers is extracted from STK scenario and put into OAS database
- Maneuvers planned appear on Maneuver planning GUI and can be sent to MUS.
Planned Maneuvers
Changing Maneuver State

- Chart FX Graphing options
- Satellite State vector used to plan future maneuvers
- Out of Tolerance limits for orbit parameters
- State of Maneuvers identified
Changing Maneuver State

-Committed maneuver identifies that MUS has been sent the Maneuver Plan. (Only a Senior OA can undo this Commit, since it requires coordination with MUS.)
Demo