Combined SSA Sensor Tasking for Space-to-Space and Ground-to-Space

AMOS 2017

Current Approach
- Diverse, uncoordinated, stovepipe tasking for each observation asset or small homogeneous group of assets

Improved Approach
- Coordinated, centralized, automated tasking for all available SSA observation assets in space and on the ground.

Benefits of Improved Approach
- Eliminates duplication of effort and observation gaps, reduces response time to events, allows for optimized use of assets and improved catalog quality.

Challenges
- Mainly programmatic; getting varying assets across multiple organizations to buy into centralized tasking.

Heterogeneous Constellation Tasking
- Space-based / Ground-based sensors
  - LEO, MEO, GEO orbit regimes for space assets
  - Multiple phenomenologies
  - Agile platforms & agile sensors
  - Asset-specific imaging modes
  - Assets-specific participation models

Target orbit propagation
- Space and ground asset constrained imaging opportunity determination
- Space asset agility model plug-in
- Space asset imaging model plug-in (for each imaging mode)

Target Database
- Space targets with TLE/Ephemeris
- Space search areas (2D)
- Target and area priorities
- Target properties
  - Priority
  - Time of last observation
  - Orbit covariance
  - Size, reflectivity, etc.
  - Other properties
  - Fulfillment tracking
- Scalable to tens of thousands of targets

Commonalities
- Tasking database
- Planning cycle
- Access determination
- SSA Figure-of-Merit
- Order Logic status/control
- 3D visualization
- Heterogenous asset constellation
- COTS heritage

Ground Sensors
- Scheduler algorithms
- Ground sensor modeling
- Cloud cover factor

STK Scheduler
- Multi-purpose mission planning tool
  - Any mission type, phase, or size
  - Robust task and resource specification
  - Real world physical constraints
  - Seamless interface with STK
  - Configurable algorithms and figure-of-merit
  - Schedule optimisation and deconfliction
  - Schedule validation utility
  - Manual and automated planning
  - Comprehensive API
  - Run with or without the GUI
  - Table, Gantt, and 3D map visualization
  - Web-based schedule dissemination

CPAW
- Collection Planning & Analysis Workstation
- Satellite Imagery Collection Planning Software
  - Optical and SAR satellites
  - Hi-Fidelity Spacecraft Models
  - Multiple Planning Algorithms
  - Configurable Figure Of Merit
  - Operational imagery collection plans
  - Visualization in STK and Google Earth
  - Manual and Automated Planning
  - Collaborative Constellation Planning
  - Power Modeling
  - Contact Scheduling
  - Recorder Management

Future Work
- Volumetric (3D) search areas
- Optimizing the constellation tasking plan across space and ground assets

The system described here is available for configuration and deployment TODAY

Heritage
- COTS products form the backbone of the software solution
- CPAW, STK Scheduler, STK Pro, and Order Logic
- DoD, Commercial, Civil heritage
- Hundred of deployed licenses over 15+ years

3D plan visualization and animation provides planners and operators with an intuitive way to see and understand what is happening in real-time and in the future through an interactive dashboard.

Figure of Merit
- SSA-specific factors
- Each factor normalized
- Configurable factor weighting
- Multi-part FoM balances tracking and search tasks
- FoM scores valid tasking possibilities for consideration by planning algorithms