Advanced Systems & Development

Satellite Operations Automation

Capt Uri Mandelbaum

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Envisioning and Shaping the Future of Space
Overview

• Automation Goals
• Research, Development, Test and Evaluation (RDT&E) Support Complex (RSC) Introduction
• RSC Automation History
• Automation Results and Status
• Next Steps
Automation Goals

• Move space personnel away from routine operations tasks to gain the ability to “rapidly characterize adversary intent, accelerate decisions, and ultimately support warfighter actions”

• Cost-savings

• ‘Lights-dim’ operations
RDT&E Support Complex (RSC)

Introduction

• 24x7 contractor-operated Satellite Operations Center
  • Ops floor for day-to-day satellite housekeeping
  • 5 Payload Test Centers (PTCs) for experiment ops
• From unclassified through classified ops
  • Tailorable data distribution over multiple networks
• Full range of TT&C capabilities
  • Mission planning, including orbit determination, antenna scheduling, and command plan generation
  • Ground equipment configuration and control
  • Real-time satellite commanding and anomaly response
  • Telemetry processing, analysis, and display
  • Mission and satellite bus data archiving and distribution
• Backup operations facility for operational satellites
• Access to Air Force Satellite Control Network (AFSCN) and organic antennas
• Flexible and reconfigurable capabilities to meet unique user requirements
• Began implementing contact execution automation on Space Test Program Satellite (STPSat)-2 in Spring 2014
  • Paused operations in Summer 2014
  • Completed automation when operations resumed in Summer 2015

• Began contact execution automation project for STPSat-3 in September 2014
  • Operationalized automation on STPSat-3 in January 2015

• Concurrently built scripts to reduce work for STPSat-2 and STPSat-3 Orbital Analysis
RSC Automation History

• Began Operationally Responsive Space (ORS)-1 Contact Execution Automation Project in March 2015
  
  • Phase 1 – Air Force Satellite Control Network (AFSCN) connections, track supports - completed September 2015
  
  • Phase 2 – Basic downloads – completed February 2016
  
  • Phase 3/4 – Uploads and Basic Anomaly Response – Expect completion April/May 2016
Contact Execution Automation Results

- STPSat-2 Automation – saving $5k per month
- STPSat-3 Automation – saving $15k per month
- ORS-1 – Enabled 12x7 operations, reduced needed personnel by 40%
Horizon Automation Metrics

• Stats from previous ten months (03/15-01/16) – prior data included testing periods

• 1706 total automated contacts
  • 343 STPSat-2
  • 1363 STPSat-3

• 220 failed contacts (88% contact success rate)
  • Automation designed to spacecraft tolerance
  • No data has ever been lost due to failed automated contacts – 100% mission success
Orbital Analysis Automation

• Automated Flight Dynamics Data Processor, Orbit Determination Tool Kit (ODTK), Systems Took Kit (STK) tasks via scripts

• Saves 92% of daily task time, 33% of weekly task time

• Total savings of 9 hours/week for each mission
Next Steps

• Air Force Steps:
  • Incremental script improvements
  • Standardized scripting frameworks
  • Integrate automation into future missions

• Industry Steps:
  • Avoid graphical user interface dependence
  • Integrate standard ground system protocols (i.e. Goddard Mission Services Evolution Center (GMSEC))
Conclusion

• Automation Goals
• RSC Automation History
• Horizon Automation
• Orbital Analysis Automation
• Next Steps
Questions?
Backup Slides
Horizon Scripts: Evaluate telemetry, send commands, and log results automatically

3 enabling tools:
- Auto-Distributed Communications Control (DCC) Controller: Controls AFSCN connection
- Auto-HEIM Tool: Controls telemetry recorder
- ALERT Tool: Reviews script logs and sounds audible alarm if any issue found
## Automation Problem areas

<table>
<thead>
<tr>
<th>Issue</th>
<th>Number of Occurrences</th>
<th>Percentage of Failed Contacts</th>
<th>Percentage of Total Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFSCN Site Timing</td>
<td>107</td>
<td>60%</td>
<td>8%</td>
</tr>
<tr>
<td>Communication Link Issues</td>
<td>32</td>
<td>18%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Horizon/MMSOC 2.0 Issues</td>
<td>20</td>
<td>11%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Fault with automation scripts or procedures</td>
<td>20</td>
<td>11%</td>
<td>1.5%</td>
</tr>
</tbody>
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