

## **IV. EMERGING TECHNOLOGY**

The Autonomous Flight Safety System (AFSS) is a joint project with GSFC/WFF and KSC. The AFSS is an independent and autonomous onboard flight termination subsystem intended for expendable launch vehicles. It replaces the traditional ground-based human-in-the-loop system and uses tracking and attitude data from onboard sensors and configurable rule-based algorithms to make flight termination decisions. The ultimate objectives of the AFSS are to increase capabilities by allowing launches from locations without range safety infrastructure, to reduce costs by eliminating some downrange tracking and communication assets, and to reduce the reaction time for flight termination decisions.

### **A. Defense Advanced Research Project Agency (DARPA)**

The NASA AFSS team worked with Northrop Grumman on their Safety and Mission Planning for Air Launch (SAMPAL) project for DARPA Airborne Launch Assist Space Access (ALASA) program that is designed to produce a rocket capable of launching a 100-pound satellite into low Earth orbit for less than \$1 million on short notice. The Joint Advanced Range Safety System (JARSS) and AFSS are tightly integrated into SAMPAL. JARSS automatically generates the AFSS flight safety rules and the configuration file. The rules are tested as the mission is planned. The AFSS algorithms verify the final mission data load and perform mission analysis. Additional simulations validated the AFSS algorithms. The NASA team also provided advice on various hardware designs and implementation.

### **B. Updated Software**

The NASA AFSS team is working closely with the 30th Space Wing to modify the original NASA AFSS safety software so it is compliant with the Motor Industry Software Reliability Association (MISRA) standard. This effort is also supported by the 45th Space Wing, DARPA ALASA, and Millennium Engineering and Integration Company (MEI). This updated software is known as the Operational Responsive Space (ORS) Fork because the modifications began as part of an ORS project. This software will undergo additional testing with the goal of providing improved AFSS safety software for government and private users.

The goals are to provide the following by September 2014.

- MISRA-compliant AFSS safety software
- Automated unit testing code
- System level testing using representative launches with documented failure scenarios
- Demonstration that this code will compile and run on a typical embedded processor

### **C. Flight Analyst Workstation**

The Flight Analyst Workstation is an integrated flight analyst software suite using the NASA AFSS code and the JARSS environment to make the AFSS mission rules configuration files and visualize the trajectory, boundaries and AFSS decisions; all running on a single PC. The target user is the flight analyst preparing for a launch using AFSS to be able to visualize and verify the AFSS rules and performance. A screen capture of the workstation is available in Figure 8. The blue circle in the center right shows a destruct limit violation. The red lights in the left panels indicate a destruct condition.

The safety rules file can be made using the configuration file maker developed in 2012. MEI is the primary contractor and the project is supported by WFF and the 45 SW and 30 SW. Funding is provided by NASA KSC GSDO and the DARPA ALASA project. The alpha-version was delivered in September 2013. A beta version with many more features for post-test analysis, data logging, and sensor emulation will be delivered by the end of FY14. The long range plan is to migrate to the ORS Fork software when it is available.

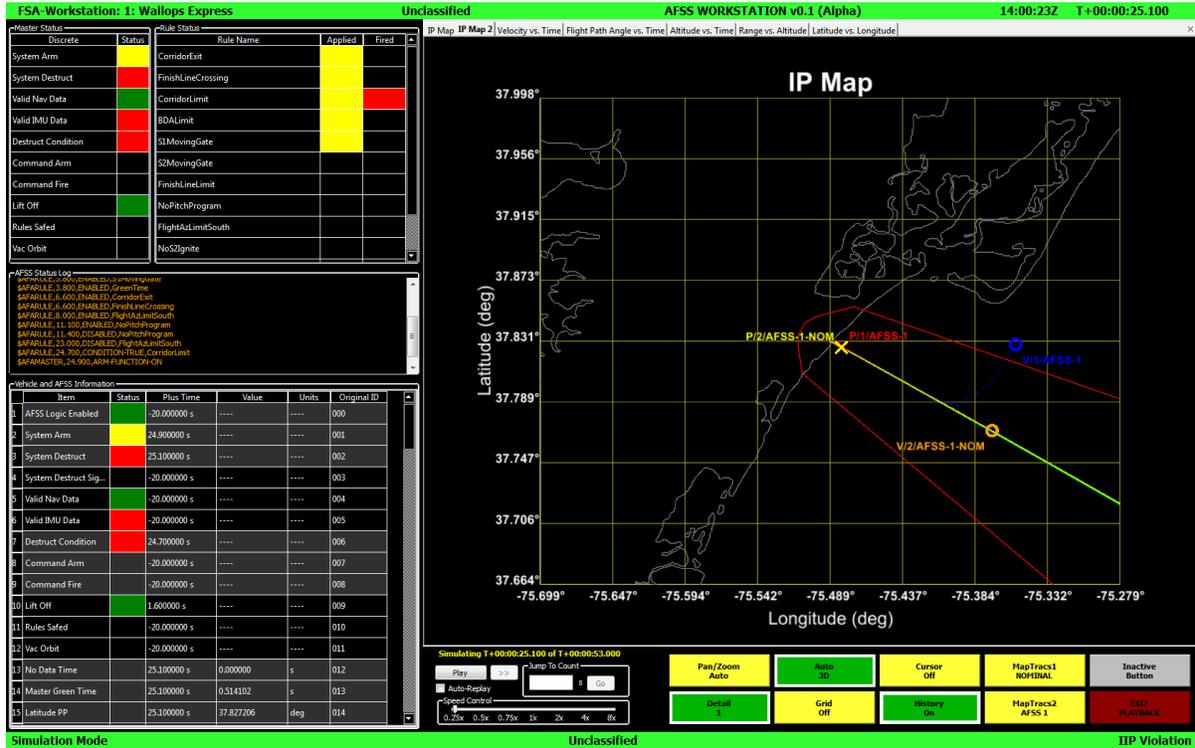


FIGURE 8: FLIGHT ANALYST WORKSTATION SCREEN CAPTURE