IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Launch Services, Missions, Operations, and Facilities (2)

Author: Mr. Mariano Sánchez-Nogales
SENER, Spain

Mr. Sergio Ramírez Navidad
SENER, Spain
Ms. Cristina Tato
SENER Ingenieria y Sistemas, S.A., Spain
Mr. Stefano Caporossi
Gilmour Space Technologies, Australia

# NEXT GENERATION AUTONOMOUS FLIGHT TERMINATION SYSTEM (AFTS) FOR LAUNCHERS

**Abstract**

Safety regulations identify the mission abort in case nominal flight envelope be potentially violated resulting in unacceptable risk levels.

A traditional flight termination architecture ensures independency from the vehicle functional chain using a radar network with human involvement in the decision-making process. This means:

- Considerable budget share for infrastructure and operations
- Limited flexibility (radar network needed)
- Vehicle monitoring restricted to LOS conditions
- Delay inherent to communications and human reaction

Thanks to maturation of several technologies, it is possible to overcome those limitations by targeting autonomous concepts:

- GNSS has been proven feasible to track launchers, but it shows radio frequency-related limitations (noise, jamming, blackout, ...). Hybridisation of GNSS with IMU is a useful mitigation strategy, being complementary observables from a data fusion algorithm perspective.
- Increase of computational capabilities to implement complex algorithms on-board. It is realistic to think of on-board processing architectures able to process sensor information, compute vehicle state and evaluate flight safety rules (IIP, corridor) to trigger a termination command autonomously.
- Utilisation of an efficient avionics SW execution platform based on NASA CFS to isolate HW features to mission-specific implementations while promoting SW reuse.

From a general standpoint, an autonomous FTS will have to:

- Process tracking data from on-board sensors together with health-monitoring sensors.
- Determine the current vehicle state vector, health status and the predicted safety variables.
- Apply SW-based mission rules through redundant processors to determine flight termination.

- Generate flight termination commands based on a fail-safe operational logic implemented in redundant boards to activate termination devices

This solution will bring important benefits to launcher operators and ultimately to end user by reducing the overall price and by increasing the flexibility (geographical and temporal).

SENER is engaged with Gilmour Space to develop an autonomous FTS for its Eris launcher, leveraging on experience acquired through the development of: (1) launcher hybrid navigation unit for VEGA-C, which meets stringent performance and reliability requirements, (2) atmospheric GNC subsystems (IXV, Space Rider) with safety critical requirements and (3) flight heritage in avionics.

The paper describes the general problem and the proposed solution for an affordable autonomous FTS suitable for a broad range of launchers and in particular the application case to the Eris launcher under development by Gilmour Space.