Paper ID: 98302
student

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

Author: Mr. Karam Safarli
Azerbaijan State Oil and Industry University (ASOIU), Azerbaijan

Mr. Ayaz Damirov
Azerbaijan State Oil and Industry University (ASOIU), Azerbaijan

ACCELERATED FLIGHT VERIFICATION FOR NEXT-GENERATION PROPULSION AND LAUNCH SYSTEMS

Abstract

Verification for the next generation of launch vehicle and in-space propulsion systems will be performed through a focused series of flight experiments framework to elevate technology-readiness levels. The aim of this framework is to systematically increase the current level of technology readiness of next-generation launch vehicles and space propulsion systems through dedicated flight experiments. The framework developed employs an innovative dual-stage test bed that integrates advanced sensor suites, adaptive control algorithms, and real-time telemetry to assess the performance of critical subsystems in realistic flight environments continuously.

The test campaign focuses largely on a next-generation propulsion module for maximum reuse and efficiency, alongside an AI-driven fault detection system designed to actively detect and mitigate anomalies during flight. Operating in the atmospheric ascent to orbital maneuvering phase of the mission, the system acts as a highly configurable test bed that can accommodate multiple payloads and experiments. Complementing ground simulations and pre-flight analyses used to strengthen these test campaigns to account for uncertainties in the system's operation and mitigate operational risks.

Early experimentation indicates that this integrated verification framework may accelerate the flight of technologies while delivering key performance data on the maturation of high-risk technologies. The results thus lay the foundation for an in-flight experiment system capable of validating high-power propulsion and control-related technologies. The new standard for innovations in the transportation of space is set by the application of technologies spread over flight test beds-testing. Rapid loop iterations and refinement of complex system components increase the integrity and efficiency of any downstream space transportation architecture.