SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

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PROGRESS OF THE DEVELOPMENT OF AN ALL-ELECTRIC CONTROL SYSTEM OF A ROCKET ENGINE

Abstract

Over the past years research and development activities and demonstration effort were conducted in Europe through national programs with a focus on simplification, robustness and cost reduction. This effort was mainly aimed at engine sub-systems through the VULCAIN X program which included a fuel turbo-pump with hydro-static bearings and an open impeller, a gaz generator with tri-coaxial injectors, i.e. in both cases a reduced number of parts, a nozzle extension based on the sandwich technology, i.e. a reduced amount of welds. Following this effort which came to a conclusion with the testing of the TPX, GGPX and NEX in 2010-2011, a new French national program was initiated in 2011 with a focus on the engine and propulsive systems them-selves and its operation both in flight and during the acceptance phase and ground operations prior to the flight. These systems are the stage and engine command systems and the tank pressurization system. The following specific goals were assigned to the program: - Suppression of the Helium pneumatic system for valves actuation (and LOX tank pressurization) - The optimization of the communication between the three major entities that constitute the command system: the On Board Computer (or the test bench computer), the engine local controller, the valve controls. - The development of more cost efficient electronics - The improvement of valve controls

The core of the program will be the implementation of a simulation test bench which will be based on a “hardware in the loop” approach. It will include real hardware, i.e. real valve controls, coupled to computers representing the engine control, the On-board-Computer and a simulation of the engine (or stage) physical behavior. The test bench will be used: - to optimize the controller and valve control configuration - to caracterize the dynamic behavior of the system - to test failure modes

The selected applications to be tested on the simulation test bench will be applicable to all kinds of liquid propulsion systems

This program which is part of the French national investment plan (PIA) capitalizes on the activities which were performed within the frame of the VULCAIN X program with respect to the improvement of the engine controls (the “VRR” and the electrical VGC) and the Health Monitoring System. The industrial partners involved in these activities will also be involved in the “all-electric” control of a propulsive system.