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IMPLEMENTATION OF THE RAMJET CONTROL ALGORITHM IN THE CONNECTED PIPE TEST BENCH

Abstract

Experimental investigation of a liquid-fuel ramjet motor makes an essential part of the jet propulsion development methodology. Testing a newly designed engine may be accompanied by failures related to high pressure and temperature loads in the motor's duct. A precise estimation of the motor's flow properties, especially in its thermally loaded part, is significant not only for the organization of the test program and flow control algorithm that would correspond to motor flight conditions but also for the safe system operation of the test bench. The complete mathematical model of the internal ramjet flow based on analytical, numerical, and empirical approaches implemented in a connected pipe test bench is presented in the current work. The developed ramjet test motor makes part of the maneuverable flight vehicle design project developed by the Chemical Propulsion Laboratory of the University of Brasilia. The connected pipe test facility and the ramjet test motor were designed, assembled, and characterized in the Laboratory. Subsystems of the airflow and fuel supply, engine ignition were built and tested. They are based on the flow control equipment and feedback system designed in the Laboratory. Over 100 experimental tests on air and fuel control for various test regimes were executed, allowing to build and validate the flow model. The engine ignition process and the hot test sequence on the test bench were elaborated based on the previously made cold flow experiments and safety principles that would allow in the future to provide the full-scale hot tests of the ramjet motor. A simulated environment has been used to implement the model, and its operation has been successively validated.