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Author: Mr. Junlong Liang
Northwestern Polytechnical University, China, liangjl067@163.com

Mr. Zhang Guitian
China, guocanlin@126.com

Dr. Baoyuan Wu
China, wuby_xa@qq.com

INVESTIGATION OF RAMJET ENGINE REAL-TIME SIMULATOR MODELING AND SIMULATING

Abstract

Ramjet Engine Real-time Simulator(RERS) is a product package of electrical hardware and software which numerically simulates the unsteady behavior of a ramjet engine. Different parameters of the components of a ramjet engine is the input to these programs. Depending on these given parameters the programs output the behaviors of those components. These numerical results are then used to guide the design and analysis of a ramjet engine, to examine engine electrical system, and to carry on engine hardware-in-the-loop simulation test. It is particularly important to RD of ramjet engine real-time simulator. The effective use of a RERS can greatly reduce the experiment times, save development cost, and thus shorten the engine's development cycle. At present, a ramjet engine is generally modeled as a complicated system with various pneumatic and hydraulic elements such as air intake, combustion chamber, nozzle, turbopump, turbine, fuel regulator, valves, orifices, etc. This model is a multivariable aerodynamic and thermodynamic system, and it has strong nonlinear and unsteady characteristics. Therefore, it is very difficult to be implemented in a real-time simulator by means of a microcomputer. In order to use this hardware and software package effectively, one needs to have a high-performance model of a ramjet engine. The paper aims to develop a real-time simulating model of such an engine system with high-fidelity, high-efficiency, and dynamic characteristics. The ramjet real-time process model takes into account the dynamic response of the fuel flow, chamber pressure, inlet export parameters and the position of the shock wave. And all these dynamic characters are modeled as transfer function in the simulator. Then ramjet real-time simulation with 1ms cycle time is applied by MATLAB/dSPACE platform. The validity of RERS has been checked by comparing with the combustion test data of this ramjet engine. And the simulation agrees well with of the test results of unsteady response in startup and variable condition and steady state working condition. REDS has been constructed with flexibility to apply to a new type of a ramjet engine.