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DEVELOPMENT OF ROCKET-RAMJET PROPULSION BASED ON CONTINUOUSLY ROTATING DETONATION

Abstract

Continuously rotating detonation (CRD) is a very promising mode of combustion in propulsion systems, since it offer significant improvement of propulsion efficiency as well as decreasing of pollutant emission for such engines and also significant reduction of engine size due to shortening of combustion chamber of the engine. Recently numerous research on that subject are carried out in many countries on possible application of the CRD to gas turbines, turbojet as well as the rocket or ramjet engines. Very little research were conducted on possible applications of the CRD to combined cycle propulsion systems. At the Institute of Aviation in Warsaw research on applications of CRD to combined cycle rocket-ramjet engine were recently initiated. The paper describe numerical simulation and laboratory tests of such propulsion system. Basic core of this propulsion system is the rocket engine which is supply by gaseous methane and oxygen. Initially performance of the rocket engine supply by such propellants was tested for different fuel/oxygen equivalence ratio and for different rate of propellant supply (different initial pressure in detonation chamber). As it could be expected optimum operational performance (maximum specific impulse) was measured for rich mixtures. In such conditions not all fuel is reacting in combustion chamber and afterburning of the partially reacted products is clearly visible behind aerospike nozzle of the rocket engine. Obviously, during atmospheric flight, afterburning of those products with atmospheric air can be effectively used in the ramjet part of combined cycle rocket-ramjet engine and significantly improve propulsion efficiency. To optimize the geometry of rocket-ramjet engine numerical simulation of such system was performed. Then combined cycle rocket engine was fabricated. Then experimental tests of the engine were performed at the subsonic conditions. Research were conducted for wide range of incoming air velocity changing from zero to up to about 200 m/s. It was found that performance of the combined cycle rocket-ramjet engine can be increased at least by 30