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EXPERIMENTAL INVESTIGATION OF A CONTINUOUSLY CONTROLLED PRESSURIZATION SYSTEM FOR REUSABLE LAUNCH VEHICLES

Abstract

At present, the aerospace transportation system is transforming from single-use to multiple use, in which a reusable and variable-thrust propulsion system is often required. Usually, solenoid valves and orifice plates is used to control the pressure of the tank. However, continual on-off motion of solenoid valves often leads to wastage of sealing surface and fluctuation of pressure in the tank. Recently, a pressurization system based on variable area cavitating venturis is proposed to solve the limited reusability of existing solenoid valve systems. Simulation results show that the tank pressure can be continuously controlled in the system. In this paper, an experimental setup is designed and manufactured to investigate the performance of the continuously controlled system. Two 40 L high-pressure nitrogen gas cylinders, a water tank, a flow meter, solenoid valves, variable area cavitating venturis and pressurization lines are contained in the system. At the exit of the tank, a manual valve is used to simulate the load of variable-thrust rocket motors by changing the opening area of the valve, while the target pressure of the tank stays the same during tests. Tank pressure signals are detected by sensors to change the mass flow rate of pressurant gas through the variable area cavitating venturis. Pressurization process of the system is investigated under both constant and variable propellant mass flow rate. Experimental results show that the system can keep the tank pressure steadily and precisely around the target value in both constant and variable propellant mass flow rate cases. With this system, it is believed that the limited reusability of existing pressurization systems can be solved and the requirement of large-range thrust regulation can be fulfilled.