IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Technologies for Future Space Transportation Systems (5)

Author: Dr. Sheng Zhao
China Academy of Launch Vehicle Technology (CALT), China, zhaosheng@buaa.edu.cn

Mr. Pengfei Du
China Academy of Launch Vehicle Technology (CALT), China, dupengfei5401@126.com
Mr. Jianbo Zhao
China Academy of Launch Vehicle Technology (CALT), China, zhaojb_calt@163.com
Mr. Bo Shen
China Academy of Launch Vehicle Technology (CALT), China, shenb_2017@163.com

DESIGN 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 usually required. Typically, a multiple "on-off" device consists of solenoid valves and orifice plates is used to control the pressure of the tank. The structure and the control of the device is simple, but continual on-off motion of the solenoid valves often leads to wastage of sealing surface and fluctuation of pressure in the tank. Moreover, the device is considered difficult to adapt to large-range thrust regulation. With the development of control theory, computer and stepping motor technology, it is ready to use digital signals, instead of on-off signals, to continuously control the pressurization system. Steady and precise pressure control of the propulsion system in new launch vehicles can be achieved. In this paper, a pressurization system with variable area cavitating venturis is proposed. A pintle is actuated by a stepping motor to move forward and backward, instead of switching on and switching off of solenoid valves. The motion of the stepping motor is controlled by pressure signals in the tank. If the pressure in lower than needed, the pintle moves backward to increase the tunnel area, and the mass flow rate of pressurant gas increases, and vice versa. The continuously controlled pressurization system is verified with AMESim. The results indicate that the system can control the tank pressure steadily and precisely. The limited reusability of existing pressurization systems is also solved with reduced wastage of sealing surface. At the same time, the requirement of large-range thrust regulation can be achieved by adjusting the tunnel area of single venturi.