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DESIGN OF A THROTTLEABLE HYBRID ROCKET PROPULSION PLATFORM FOR PLANETARY SOFT LANDING

Abstract

A throttleable rocket motor can continuously follow the most economical thrust curve in a given situation, which is often required for planetary landing. Storable propellants such as nitrogen tetroxide (NTO), monomethyl hydrazine (MMH) and unsymmetrical-dimethyl hydrazine (UDMH) are usually used in planetary soft landing cases. However, these propellants are toxic and less attractive for future manned missions. On the other hand, hybrid rocket motors can provide distinct advantages such as simplicity, safety, low cost and shutdown-restart capability with environmentally friendly propellants. It is easy for a hybrid rocket motor to achieve deep throttling by simply controlling the oxidizer flow. In this paper, a hybrid rocket propulsion platform is designed for planetary soft landing based on previous experiment results. The platform consists of four descent motors, spanning a total thrust range of 500-5000 N, that decelerate the vehicle and provide attitude and translational control. The platform also contains eight 100 N control motors for attitude control. Hydrogen peroxide is used as oxidizer and polyethylene is used as fuel. A pressure-fed system is adopted and the pressurizing gas is helium. Solenoid valves and variable area cavitating valves are utilized in the feeding system to control the oxidizer mass flow rate. Hydrogen peroxide is catalytically decomposed at the head of the motors to ignite solid fuels. Parameters and configuration of the platform are calculated and the performance is evaluated according to a typical lunar landing procedure. The specific impulse is expected to achieve 320 s. The results show that the hybrid rocket motor may be a viable option with respect to liquid rocket motors with storable propellants.