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Heated Gas Propulsion System Conceptual Design for the SAMSON Nano-Satellite

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Abstract

This paper presents a new cold gas concept of a heated gas propulsion system for the 6U SAMSON nano-satellite. In this type of system, the entire propellant tank is heated to an operational temperature prior to system operation and let to cool down immediately afterwards. The current analysis shows that it is possible to meet mission requirements by using 310 gr of CO_2 contained in a capsule-shaped propellant tank. The study shows that the required thrust of 80 mN can be obtained by choosing a nozzle geometry with aspect ratio of 400 and nozzle diameter of 0.25 mm. The resulting specific impulse of such a configuration is approximately 67 sec. It also analyzes the benefits of operating the propulsion system at various operational temperatures between 40°C and 80°C. The analysis shows that low operational temperatures lead to a relatively lightweight propulsion system, short operation readiness durations, and low attainable ΔV per operation. On the other hand, high operational temperatures lead to a heavier system, longer operation readiness duration, and high attainable ΔV per operation.

1. Introduction

The Space Autonomous Mission for Swarming and geOlocation with Nano-satellites (SAMSON) project is an endeavor to test new algorithms for cluster keeping and geolocation using a three nano-satellite cluster in Low Earth Orbit (LEO). The project, led by the Asher Space Research Institute (ASRI) at the Technion, involves the design, development, integration, and mission execution of all three nano-satellites and algorithms (Gurfil, P. et al. 2012). Each satellite will be a 6U CubeSat and will have a target nominal launch mass of less than 8 kg. The satellites are planned to be launched in 2017, with mission duration of at least 12 months.

To perform cluster keeping and orbit maneuvers, each of the three nano-satellites requires some means

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