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# Development of A Modular, Cold Gas Propulsion System for Small Satellite Applications

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**Abstract**

A novel cold gas propulsion system for small satellites has been developed at the University of Texas at Austin's Satellite Design Lab. The concept behind the propulsion system is to additively manufacture the main thruster module by means of the stereolithography process. In this manner, intricate features can be created and complex volumes can be used. This method is especially useful for small satellites. The propulsion system operates by releasing a saturated liquid propellant serially through three valves and a built-in converging-diverging nozzle. Through extensive tests, the propulsion system was measured with a specific impulse that ranged from 65 seconds at 24°C to over 89 seconds at 85°C . The measured thrust force provided by the propulsion system ranged from 110 mN at 24°C to over 150 mN at 85°C. A technology demonstration unit has been developed for flight onboard the University of Texas at Austin's Bevo-2 satellite. This system will have a total mass under 400 grams, including 90 grams of Dupont 236-fa as propellant. The propulsion system is expected to provide at least 10 m $s^{-1}$ of delta-v capability, which has been verified through testing.

## 1. Introduction

Recent innovations in small satellite technology, particularly in the miniaturization of electronics, have significantly reduced the cost of access to space. Small satellites allow for a faster and less expensive way to perform space missions as compared to larger traditional satellites. In particular, the CubeSat platform provides these benefits with its standard bus design. A CubeSat is a small satellite defined in standard units where each unit is ten cubic centimeters. Although CubeSats are individually simpler and less capable than their larger and more expensive counterparts, they have the advantage of being rapidly produced and easily launched into space at lower cost, enabling new mission types that were previously impossible or cost prohibitive. Additionally, this lower cost allows for innovation and development at universities, which provides valuable educational experiences to young engineers and scientists. As innovations are incorporated into the state of

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