Paper ID: 25223
student

44th STUDENT CONFERENCE (E2)
Student Team Competition (3-YPVF.4)

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# DESIGN OF MAIN PROPULSION SYSTEM FOR A REUSABLE SUBORBITAL ROCKET

**Abstract**

In recent years there has been an increased interest in the use of CubeSats to perform research in the realms of microgravity and earth observation. Previously, CubeSats have generally been placed into orbit as secondary payloads, piggy-backing on the launches of larger spacecraft. This has meant that CubeSat orbits and launch schedules have been decided by the requirements of other missions, restricting the manner in which they can be used. Due to the lack of flexibility in mission design afforded by traditional launch options, and the increasing competition for CubeSat launch spots, it has become desirable to develop a dedicated small satellite launch platform. This would allow for the execution of more novel and exciting missions, utilising orbits specifically designed with small satellites in mind. If a reusable launch platform were to be developed, it would additionally serve to lower launch costs, further increasing the viability of small satellite missions and the range of applications for which they could be used. Tranquility Aerospace Ltd are currently engaged in the design of a two-stage vertical takeoff and landing (VTVL) launcher, aimed at the small satellite market. Due to the many engineering challenges involved, they are aiming to first develop a suborbital launch vehicle in order to test the technologies necessary. This launch vehicle will be single-stage, capable of vertical takeoff and landing, and be powered by a combination of Hydrogen Peroxide and Kerosene. As a student project at the University of Strathclyde, the main rocket propulsion system for this vehicle is being designed. This paper will outline the development of the propulsion system, including the propellant feed system, injector plate, thrust chamber and thermal control system. The key design driver is to lower the overall system mass, including the mass of the propellant. Investigations will be carried out into novel concepts such as the use of reciprocating pumps in the feed system, and ceramic materials in the thrust chamber. Comparisons of the impact of different subsystem configurations on performance will be assessed and discussed, and a focus will be placed on aspects of the design impacted by the requirement for reusability. The goal is to produce a fully workable design which is ready for manufacture and can be operated on the reusable launch vehicle.