

IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

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RAVEN: TEST BENCH AND TEST PLAN DEVELOPMENT

Abstract

RAVEN, Rocketry and Aerospace Vehicle Engineering in Norrbotten, is the first student rocket project at Luleå University of Technology, Sweden. The project aims to design, build and launch a hybrid-propellant rocket with a 10 kg payload, capable of reaching a minimum altitude of 10 km. Since presenting the preliminary rocket design at IAC 2021, a more thorough analysis of the rocket's performance and structural integrity was performed through extensive simulations, calculations and preliminary testing. Design changes were accordingly implemented and an extensive testing plan developed.

The RAVEN propulsion system comprises 37 kg of propellant, including self-pressurizing nitrous oxide and paraffin wax, which produces an average thrust of 6 kN over 12 seconds. Under the plan, testing of the propulsion system has been divided into three stages which reflect increasing complexity, from component level testing to system-level testing. In the latter phase, the motor will be subject to a multitude of test fires; these necessitated the development of a custom test bench with versatile capabilities. During the design process, a thorough review and trade-off between different technologies was conducted, in which ease of manufacturing and scalability were the main drivers.

The resulting bench design features a detached tank cage and interfaces which require little modification in order to accommodate differently sized rocket motors. This flexibility makes the bench amenable for reuse with future iterations of the RAVEN rocket, thus facilitating ongoing rocketry projects at the university. With the test bench, the RAVEN team will be able not only to validate the rocket motor, but to conduct an intensive study of the system. This will result in collection of important data, providing invaluable insight into the functionality of the rocket motor and hands-on experience of hardware testing. In this way, the test bench and testing plan play a crucial role in ensuring the success of project RAVEN while laying foundations and infrastructure for its successors.