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COMMON PITFALLS OF TESTING HYBRID ROCKET ENGINES AT STUDENT LED FACILITIES

Abstract

A permanent test facility was designed and built to enable the McGill Rocket Team's first hybrid rocket engine, using nitrous oxide as oxidizer and eicosane as fuel. The objective was double: to support the engine's testing campaign and to validate an in-house developed computational model simulating its performance. Throughout the three years of its development on McGill University's MacDonald campus, several obstacles and challenges were encountered while setting up this facility, which hampered with testing progress and accuracy of sensor measurements. Since this location was also considered to be an eventual testing grounds for research activities and other student rocketry partners, the reliability of testing performance was highly critical. With this facility now fully operational, the current work presents the common obstacles and performance problems encountered, and details solutions undertaken to reduce their impact as to pave the way for future iterations of such student-led facilities. As a project led by the students of the McGill Rocket Team, the propulsion sub team was responsible for the development of the test site. This endeavor required segregating the work amongst three major divisions: electrical systems, plumbing, and infrastructure. The electrical systems division took charge of handling electrical safety, power management and distribution, data acquisition systems, control systems, and an oxidizer heating system for winter operations. The plumbing division addressed the challenges surrounding cleaning for oxygen service, mitigating against nitrous oxide thermal decomposition, oxidizer tank mass measurement, and tank design. Finally, the infrastructure team solved issues regarding the development and modeling of the test stand, the reinforcements of the C-sections of the container bed, and the integration of the engine to the test bed. Overall, these challenges were considerable but did not prevent progress on the hybrid rocket engine program, which is now nearing its target of accurate engine characterization. With the foundations of this facility now established, it is considered a base for an eventual expansion to bi-propellant rocket engines.