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NUMERICAL MODEL TO AID UNIVERSITIES IN DEVELOPING SPACE NATIONS WITH SOLID-FUEL ROCKET MOTOR DESIGN

Abstract

This paper discusses the development and implementation of an open-source numerical model designed to aid university space programs within developing countries. Small rockets provide a useful platform for education and research in the field of chemistry, physics, mechanical and electrical engineering among others. Rockets can also facilitate other projects such as CANSATs which have proven to be a good means of teaching students the fundamentals of small satellite design. Unfortunately in developing countries such as South Africa there are no commercially available rocket motors and prototyping and testing of motor-related technologies is expensive with regard to time, monetary costs and materials. The model intends to reduce the cost of design, testing and prototyping and removes the need for an in-depth understanding of internal ballistic calculations, thus allowing students to focus on their primary objectives. Given a set of design specifications, such as available fuel type, materials and dimensions, the model is able to simulate, analyse and optimise motor performance as well as determine its structural integrity. The resulting outputs include pressure-time and thrust-time curves, specific impulse and other related variables which indicate the efficiency and performance of the motor. The output is directly compatible with most commercial and open-source software such as OpenRocket and when paired, students have access to a complete rocket design package. The theoretical predictions have been compared to similar models, along with rocket flight tests, and have proven to be a good fit to observed data. The project has also been implemented at the University of Cape Town, South Africa and has been a great success.