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ANALYSIS ON PROPULSION TECHNOLOGICAL DEVELOPMENT SYNERGY AND APPLICATIONS FOR FUTURE BRAZILIAN LAUNCH VEHICLES

Abstract

This work aims to yield an analysis on different approaches for propulsion technologies to be used on upper stages of a theoretical Brazilian launcher in an equatorial orbit mission, owing to the advantageous position of the Alcantara Launch Center for providing access to strategic lower orbit inclinations. The study focuses on the launch of a conceptual small remote sensing satellite of 500 kg, derived from recent advances of a Satellite Multi-Mission Platform (MMP), developed by the Brazilian Space Agency (AEB) and National Institute for Space Research (INPE).

The Brazilian Space Program has a long history of research and development on suborbital sounding rockets with major efforts devoted to Solid Propulsion Motors (SPM). Last year the largest SPM developed by Brazil, the S-50, was operated at a static test bench for the first time. Designed to have 270 seconds of specific impulse, the SPM provides 80 seconds of thrust burning 12 tons of composite solid propellant. Future national launch vehicle projects will focus on the utilization of the S-50 SPM as the main motor, progressing and scaling existing technologies from the sounding rocket VS-50 to small orbital launch vehicles such as the VLM and other larger rockets.

Although all Brazilian sounding rockets up to date have utilized solid propulsion, advances were made in the field of liquid and hybrid propulsion by our technological institutes and universities. Albeit currently validated on lower maturity levels and smaller scale, national alternative propulsion projects are considered in this study as a means of prospecting future technological possibilities for the case study of optimal orbital launchers tailored to Brazil recent capabilities and novel strategic missions.

In this work a simulated mission is based on existing and developing national propulsion technology, focusing on different upper stage propulsion choices (solid, liquid and hybrid propellants) for an existing 1st and 2nd stages Solid Propulsion Motors (SPM) configuration. Each upper stage propulsion choice is fit to parameters and estimates that will be evaluated in a decision matrix. The main parameters considered are development costs and schedule, current propulsion trends and available national technology, accessible materials and capabilities, performance, operational advantages, and considerations relative to existing national technology roadmaps and economic panorama.