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HYBRID PROPULSION MOTOR OPTIMIZATION FOR APPLICATION AS SMALL LAUNCHER UPPER STAGE TO SUPPORT LEO MISSIONS.

Abstract

Economically viable and safe delivery of a payload into its pre-determined orbit compels for an improved rocket design at various stages of flight. A possible solution can be found on moderating with the Hybrid rocket motors, which can minimise the loss of combustion performance, as demonstrated and utilized by various available Hybrid rocket motors. In the design of launchers, optimization methods for maximizing the payload mass or minimizing the propellant mass for a given mission take place by finding a suitable trajectory for that mission. During the optimization process, a way to maximize the overall vehicle performance is handling a combination of different propulsion systems to form the vehicle stages or manipulating the propulsion system characteristics, which results in modifications in the motor design. This paper addresses both approaches, but focusing on the evaluation of the current novel developments and studies regarding hybrid propulsion systems, with applicability and performance analyses of those technologies in a small launcher upper stage via optimization methods. The upper stage sizing depending on the launcher previous stage compositions. In this study, the small launcher consists of two solid rocket motors (SRMs) in the first and second stages, and a hybrid motor (HM) as upper stage. In order to bring this analysis into a more realistic frame, two small launcher models will be assembled using as first stage the Italian SRMs Zefiro 40 and Zefiro 23, combined with the Brazilian SRM S-50 as second stage. The third stage, formed by a HM, will be a consequence of the technologies evaluation and optimization methods to accomplish a given LEO mission.