

## SMALL SATELLITE MISSIONS SYMPOSIUM (B4)

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## THE MAJOR ADVANTAGES, THE PRELIMINARY SYSTEM DESIGN AND THE LEO PERFORMANCE OF A SMALL LAUNCH VEHICLE BASED ON HYBRID PROPULSION.

**Abstract**

The recent event log, mainly US, relevant to the use of Hybrid Propulsion (HP), is a sign of recognition of the overall cost benefit of its key characteristics, mainly in terms of low non recurring cost, hazard reduction, and environment impact mitigation. Since the minimisation of the non recurring investment (for both motors manufacturing and operations phases) is one of the bigger needs for the profitability of a new Launch Service (LS), a preliminary design of a Small Launch Vehicle (LV) capable to inject a 350-550 Kg class Payload in LEO, has been carried out, and is the subject of this Paper. After an introduction aimed to summarise the HP characteristics and to analyse their exploitation potential in the frame of the LV design, a reference implementation scenario is defined, such to maximise the potential benefit resulting from the use of the HP. This scenario includes the availability of existing motors manufacturing plants, of Launch Base infrastructures, the level of Public Institutions sensitivity to Safety, as well as environment pollution, aspects. The analysis of the scenario brings to the definition of the LS main requirements and, from them, the design drivers of the Launch Vehicle are identified. Finally, the System preliminary design of the Vehicle is carried out, total Delta Velocity need, staging strategy and resulting propellant load, stage re-entry approach safety issues, calculation of optimal trajectory and on orbit performances. The “shift” of above mentioned performance as a function of the HP main features (namely Specific Impulse, max thrust, and achievable stage Structural Ratio) is reported, in order to allow the judgement of the service risk associated to the running HP technology development.