

STUDY ON AN AIR-LAUNCHED CONSTELLATION OF TACTICAL MICRO-SATELLITES FOR DEFENCE USE

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ABSTRACT

The study proposed in this paper, developed at the Department of Aerospace and Astronautical Engineering of the University of Rome *Sapienza*, matches scientific interests with Italian Air Force (ItAF) operational needs on air-launched microsattellites. The great attention on air-launched microsattellites is due on one hand to the possibilities given by the miniaturization push, making the same performances of traditional satellites achievable with smaller systems, and on the other hand to the disruptive advantages allowed by air-launch techniques, providing Italy not only with an autonomous launch capability, but also with the flexibility to choose the orbit inclination and the launch time, enabling a responsive approach at lower costs respect to ground based launches. In this study, several issues related to this subject are analyzed. A constellation of four microsattellites for electro-optical Earth Observation (EO) is conceived, namely ITAF μ SAT (i.e. ITalian Tactical Formation of μ -SATellites). ITAF μ SAT is designed to achieve a sub-metric spatial resolution and to offer a high revisit frequency on a specified target area to satisfy military needs. ITAF μ SAT is designed to be responsive and the system is conceived to guarantee a fast access to space since the mission is called, through a Plug-and-Play (PnP) approach; to provide Italy with a proprietary system, built, launched and operated on-purpose for its contingent needs; and to complete the information supplied by other EO systems with high quality images captured in a very short time.

1. INTRODUCTION

The expression Operationally Responsive Space (ORS) is related to the effort in exploiting Space as an asset of real tactical value. It refers to the whole of abilities such as rapidly positioning space assets with tailored payloads and orbits providing specific operational support to a variety of military missions. The adoption of modular PnP-based approaches and air-launch techniques allow to perform responsive operations and ensures features such as fast response (i.e. short time between mission call and constellation in-orbit deployment), independence from launch site (i.e. launch at any latitude with complete orbit accessibility), high flexibility (i.e. no waiting list for launch, freedom in choosing the orbit), Italian property of a system for space access and cost reduction.

In the study mission analysis is performed: responsive orbits are examined by pointing out pros and cons related to each one and a specific orbit for ITAF μ SAT is designed. A simulation of different possible scenarios is performed through the software Satellite Tool Kit (STK) and the related performances are obtained, in terms of revisit time, coverage, and time-to-orbit. Several launch methods are analyzed, focusing on pros and cons. The system architecture is conceived for ITAF μ SAT, consistent with air-launch constraints in terms of volume, power and mass budgets. The system engineering study is based on Commercial-Off-The-Shelf (COTS) components, reducing costs and allowing a sort of modularity. According to user requirements, the design of each subsystem and the ground architecture is performed to provide the theater commander with the required information within the least time. A cost analysis is accomplished to prove the economical feasibility of the proposed scenario. The paper wants to provide a widespread knowledge on air-launch systems and microsattellites engineering and technologies, introducing innovative ideas for possible future development.