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XSPANCION: MODULAR SATELLITE PLATFORM DESIGN FOR SCALABLE AND ADAPTIVE PRODUCTION

Abstract

Small satellites are playing an ever-increasing role in creating new opportunities for agencies and the commercial sector to apply value-added services that benefit and improve life on Earth. From disaster management and climate change monitoring to improving agricultural yields and establishing robust global communications network, the market demands for satellite data, both in quantity and quality, is rapidly growing.

xSPANCION is a part of the European Space Agency (ESA) ARTES Partnership Projects Pioneer programme, between industry, academia, and space agencies to address the need for a sustainable framework of delivering space data and services, quickly and at low cost. To meet the changing commercial market demands while also being scalable for efficient high-volume production of satellites, it is important to design satellites with modularity and flexibility in mind. The adoption of a Model-Based Systems Engineering (MBSE) approach enables an engineering team to capture and manage complex system interactions, dependencies, and requirements across the entire system development lifecycle. Consistent design and analytical satellite models that are traceable to engineering rationales can be re-used and re-baselined for future satellite missions, driving efficiency in the design cycle. To ensure efficient and cost-effective production of CubeSats, high-volume manufacturing and production methodologies such as Design for Manufacture (DfM) and Design for Test (DfT) are also adopted. This approach considers the use of automated assembly and testing systems, as well as adaptable ground support equipment (GSE) to streamline and standardise production and test processes.

This paper provides an overview of the innovative satellite system designed within the xSPANCION programme, specifically focussing on the modular and scalable aspects of the platform design and the engineering processes involved in maturing the design concept for rapid constellation production and test. A range of expected satellite constellation missions and services is first presented together with the envisioned changes in the satellite platform design to enable these mission concepts. The requirements derivation, systems analysis, and trade-study of the satellite system performance is conducted. Through an iterative process, the system architecture gradually solidifies to highlight the standardised aspects of design and those elements of the design that are mission specific. Finally, a discussion on the balance between standardisation and change is presented in the context of the verification and validation strategy of the satellite system.