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DEVELOPMENT FRAMEWORK FOR AN AUTOCODED ADCS SOFTWARE IN A CUBESAT SCENARIO

Abstract

Efficiency and performance are critical aspects in the design of spaceborne applications, in particular in embedded satellites where the utilization of low-level programming languages like C/C++ becomes essential to ensure optimal operations. However, the convenience of graphical environments like Simulink, coupled with MATLAB functionalities, facilitates rapid design and testing of high-level models such as Guidance, Navigation, and Control (GNC) systems. The MATLAB Coder tool is employed to achieve the automatic conversion from the Simulink environment to C code.

One of the primary challenges lies in the necessity for tailored development of Simulink blocks to consistently integrate with the autocoding process. Unlike traditional development methods, where the focus is on the design within Simulink, autocoding necessitates a paradigm shift, requiring engineers to conceptualize designs with autocoding compatibility from the initial phase. Failure to do so can result in lengthy and time-consuming conversion processes, reducing development efficiency.

The main objective of this paper is to define a comprehensive autocoding framework which serves as a guide for engineers to integrate autocoding into their development workflows. The development process is addressed, emphasizing the necessity of customizing Simulink blocks for efficient autocoding.
To demonstrate the effectiveness of the proposed approach, the 6S Cubesat project, made by PoliSpace students from Politecnico di Milano is presented as a real-world case study, focused on the generation of its Attitude Determination and Control System (ADCS) On-board Software (SW). This application is optimized for low-memory and low-performance On-Board Computers (OBCs). The paper presents examples of the framework's implementation, including the separation of subsystems, the management of Input/Output, and the creation of bus structures. Thus, this work aims to contribute to the advancement of autocoding methodologies by providing a robust framework for the generation of C and C++ code from Simulink block diagrams, making it available to the wider technical public and increasing awareness in future generations of engineers.