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A DETERMINISTIC AND HIGH PERFORMANCE PARALLEL DATA PROCESSING APPROACH TO INCREASE GUIDANCE NAVIGATION AND CONTROL ROBUSTNESS.

Abstract

New generations of spacecrafts are required to perform faster onboard processing. Space exploration, rendezvous services, space robotics, etc. are all growing fields in Space that require more sensors and more computational power to perform these missions. Furthermore, new sensors in the market produce better quality data at higher rates while new processors can increase substantially the computational power. Therefore, near-future spacecrafts will be equipped with large number of sensors that will produce data at rates that has not been seen before in space, while at the same time, data processing power will be significantly increased.

In regards to guidance navigation and control applications, vision-based navigation has become increasingly important in a variety of space applications for enhancing autonomy and dependability. Future missions such as Active Debris Removal will rely on novel high-performance avionics to support advanced image processing algorithms with large workloads. Even more complex is the case of vision-based precision landing, where there needs to high rate processing can be the tipping point of a successful mission.

This new scenario of advanced Space applications and increase in data amount and processing power, has brought new challenges with it: low determinism, parallel data processing, cumbersome software development, etc. For that ESA, is promoting the use of MATLAB / Simulink autocoding tools in order increase software quality, data modelling and development process. For large and parallel data processing, like vision base navigation, however, MATLAB is not well suited to produce code that is optimal or deterministic to the destination hardware environment.

In this paper we present a novel toolset for SIMULINK that can produce deterministic and optimal code for scenarios likes the one presented above. Based cutting-edge software engineering techniques, this solution is used in aerospace and robotics applications producing data processing rates that are substantially faster than other available products. The experimental setup consists of an on-board sensor data fusion simulation with a Zynq board as processor-in-the-loop connected to the simulation via CAN-Bus, which is a technology currently promoted by ESA. The presented results show that our implementation is not only high performance and scalable but also has a friendly interface that can reduce the development time.