Paper ID: 47718
oral

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Technologies to Enable Space Systems (3)

Author: Mr. Daniele Luchena
ARCA Dynamics, Italy

Mr. Vincenzo Schiattarella
Sapienza University of Rome, Italy
Dr. Dario Spiller
ARCA Dynamics, Italy
Prof. Fabio Curti
Sapienza University of Rome, Italy
Mr. Marco Moriani
ARCA Dynamics, Italy

A NEW COMPLEMENTARY MULTI-CORE DATA PROCESSOR FOR SPACE APPLICATIONS

Abstract

Analyzing the trend of the aerospace technology market, two of the most prominent research and development areas are represented by completely autonomous spacecrafts and space robotics technology advancement. To satisfy this development, the near future space missions will increasingly need enhanced computational capabilities to satisfy the demand of the new on-board subsystems. In these last years, NASA and ESA have already demonstrated to be interested in multi-core processors for space applications. In this paper, ARCA Dynamics will present a complementary multi-core data processor built with COTS components, prototyped and developed to satisfy the technology need for high computational capabilities. It takes advantage of a graphics processing unit (GPU) using a CUDA framework for parallel computing. Such device, considered as a processing unit complementary to the on-board computer, would enable small spacecrafts to autonomously perform complex tasks that nowadays can only be performed on-ground. In the frame of this work, the example applications that will be reported are the following:

1. Autonomous image processing tasks without needing ground data post-processing. Objects detection and tracking will be considered as primary test case, but the results of this example can be easily extended to computer vision for proximity operations and shape recognition.
2. The implementation of highly demanding artificial intelligence algorithms to support autonomous operations for guidance, navigation and control.

These example test-cases will be performed in order to stress the autonomy of the GPU-based device in performing real-time operations. To prove the capabilities of the proposed multi-core data processor, several hardware-in-the-loop and software-in-the-loop tests will be performed. These tests, performed both in real-time and post-processing conditions, will prove that the complementary multi-core data processor works effectively and outperforms a CPU board when a great amount of data is processed. This paper will demonstrate that autonomous and real-time complex operations can be carried out only considering a GPU-based computational board. Discussions and preliminary tests to spatialize the COTS-based device will be described to prove the effectiveness of using this technology for space applications. This paper will thoroughly describe the proposed technology and its capabilities including results from experimental tests and comparison with state-of-the-art computational devices. Conclusions will address the future applications of GPU-based boards for space applications.