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ADVANCED COMPUTING SYSTEMS FOR NANOSATELLITES

Abstract

CubeSats are widely regarded amongst the small satellite community as a platform that has the potential to achieve great things in the coming years. The pressure on these tiny spacecraft to perform as well as their more portly, big brothers is increasing and mission developers expect CubeSats to be able meet very demanding performance levels. This is a refreshing change in perspective from the previous assessment of, 'i can't see that a CubeSat could do anything useful', but this optimism comes with increasing pressure on CubeSat technology developers to provide the performance whilst still hitting the low cost expectations of 'performance optimists. AND, of course, this thing still has to work in space - a tall order.

Computing on board CubeSats is one of the main areas of focus. There is little power on-board a CubeSat, with down link speeds to match. Therefore, all of these grandiose ideas to fly super payloads on CubeSats needs some way of efficiently processing this data on-board so that only the 'good' data needs to be downloaded (i.e. not images of empty ocean).

With this in mind, an FPGA based Mission Interface Computer (MIC) has been developed to provide next generation on-board computing capability. The MIC is still low-cost, but provides a highly-reliable, low-power, yet capable on-board computing capability. The design has been specifically developed to meet Telemetry and Telecommand operations, as well as providing a platform to perform advanced on-board pre-processing of data, allowing for more sophisticated analysis to be performed and more efficient use of available downlink bandwidths. Other key features of the MIC include a scalable mass data storage capability, allowing data from multiple payload units to be stored centrally. There is also the ability to reprogram the on-board processing units, allowing in-flight updates of algorithms to be performed as well as novel concepts to be supported such as the re-purposing of the entire platform to a new mission.

This paper provides an overview of the MIC, the development process and the results of testing. The MIC will have its first flight in 2011 on the UKube-1 platform where it is expected to demonstrate a new level of processing capability on CubeSat and nanosatellite platforms.