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A SURVEY ON RADIATION EFFECT CHARACTERISTICS OF COMPUTATION ORIENTED DEVICES AND ITS LEADING STRATEGIES FOR A PERFORMANCE DEMANDING AVIONICS DESIGN

Abstract

It has been a consensus that the continuous request to in-orbit computation power, coupled with the reduction to feature size and power dissipation, has triggered the exploitation to devise computation oriented devices to meet this demanding. Using whether commercial off the shelves (COTS) devices or customized high performance devices, the reliability should be the first concern to the mission directors, since the energetic ions in extremely environment can cause errors to these computation system if the charge generation by particles striking is larger than the noise margin of the subsequent gates to cause a circuit upset. This paper surveys the recent evaluations to such performance oriented devices, including DSP (Digital Signal Processor), GPGPU (General-Purpose Graphics Processing Unit), FPGA (Field Programmable Gates Array) and ASIC (Application Specific Integrate Circuits), and try to find which competitors would lead the future directions of the future performance-demanding avionics in reliability, flexibility, availability and portability. Typical benchmarks are summarized here and the radiation tests on these devices are carrying out to evaluate the sensitivity. Particular hardening techniques are also summarized. It can be demonstrated that with the survey results, FPGA and customized GP-MPSoC (General Purpose MultiProessor System-on-Chip) offer more flexibility and availability than GPU and ASIC. With transparent hardware and software (HW/SW) fault tolerance techniques, reliability can be guaranteed.

Leading by this conclusion, a flexible DSP core and a NoC (Network-on-Chip) connected MPSoC have been developed by our team to meet this requisite. We put our our emphases on deliver the above mentioned capability with configurable architectural parameters, HW hardening with minimal overhead, multilevel redundancy and easy programmable code patterns.

Since memories devices and high bandwidth data exchange interface also play an essential role in obtaining high performance, memory ICs and interfaces are also investigated in this paper to gain a systematic review on the performance oriented reliable computing in space.