SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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RESEARCH ON THE OPTIMUM SCRUBBING STRATEGY FOR SPACE USED SRAM-BASED FPGA

Abstract

Static-RAM (SRAM)-based Field Programmable Gate Arrays (FPGAs), with their great flexibility,abundant resourcesand increasinglydiversified functions, have been extensively applied in space electronic systems. However, the undesirable thing is the severe hazard toSRAM-based FPGAs caused by SEU(Single event upset). Scrubbing is an effective SEU mitigation technique to reload the memory array of SRAM-based FPGAs. Scrubbing is usually applied together with TMR(triple modular redundancy),which can provide significant fault-tolerance in SRAM-based FPGAs. A variety of strategies can be adopted in scrubbing, including blind scrubbing, readback verification scrubbing, self-scrubbing, JTAG scrubbing, parallel port scrubbing, etc. It is necessary to find out the strategy with the highestefficiency and reliability for spacemissions. We designed thescrubbing experiment system to implement all strategies mentioned above and detected their scrubbingvalidity. With the high-energy ionexperiments on the ground,weconfirmed the following phenomenon :(1) The higher the scrubbing frequency is,the better the effect will be and the securer the FPGA programwill be. (2) With the same scrubbing frequency, the effect of readback verification scrubbingis consistent with that of blind scrubbing.(3)The self-scrubbing has the highest risks.(4)Compared with parallel port scrubbing, JTAG scrubbing is more reliable. Therefore,we drew the conclusion thatthe most suitable strategy for space mission is toimplement blind scrubbingwith the highest possiblefrequency via port JTAG.