T0088-S FPGA-Based, Radiation Tolerant Computer System

Problem Statement

- Future NASA missions require increased on-board computing capability beyond what is available today.
- These computers must operate in a harsh radiation environment, which causes system failures if not mitigated.
- This flight will demonstrate a novel computer architecture that provides increased performance and radiation tolerance for space computing.

Technology Development Team

- Dr. Brock LaMeres
  lameres@ece.montana.edu

  Dr. Todd Kaiser
  tjkaiser@ece.montana.edu

  Montana State University
  Bozeman, MT 59717

- Funding through the NASA OCT Game Changing Opportunities In Technology Development

Proposed Flight Experiment

Experiment Readiness:

- This computer technology will be ready for a sounding flight demonstration by the end of 2013.

Test Vehicles:

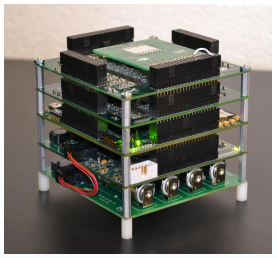
- This technology will be flown on an sRLV.

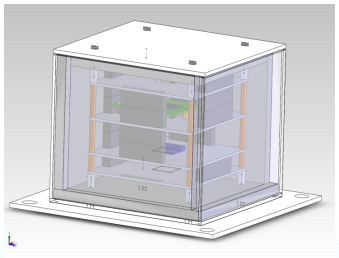
Test Environment:

- A flight on an sRLV will provide exposure to a relevant radiation environment in order to test the reliability of this computer architecture.

Test Apparatus Description:

- The computer system is implemented in a stacked configuration. A Field Programmable Gate Array (FPGA) is used to implement a redundant, many-tile computer system that has the ability to detect, avoid and repair faulted regions of the device.
- Two silicon-based radiation sensors are included in order to provide increased reliability by detecting potentially faulted regions of the FPGA.





Technology Maturation

- A successful TRL-6 demonstration of this technology involves operation throughout the entire sRLV flight with corrective action taken upon fault detection either by the FPGA circuitry or the radiation sensors.
- The computer system will be implemented in the necessary form factor dictated by the sRLV during 2013. The payload will undergo thermal-vacuum and vibration testing to prepare for a flight readiness date of January 1, 2014.

Objective of Proposed Experiment

- The objective of this flight is to demonstrate TRL-6 of a computing system that promises to deliver increased performance and reliability at a significantly lower cost than existing radiation-hardened computers systems in use today.
- A successful demonstration will allow the research team to move toward an orbital flight demonstration of this technology.

TA11: Technology and Processing Roadmap

8/2013