The ARGOS Project

- Reliable Computing in Space
  - Autonomous navigation and data processing
  - Radiation-hardened components
    - Expensive, old technology, unavailable
- Commercial Off-the-Shelf (COTS) Components
  - Comparative evaluation in space

http://crc.stanford.edu/projects/argos.html
ARGOS Satellite Computing Testbed

- Rad-hard vs. COTS components
- Evaluate Software-Implemented Hardware Fault Tolerance (SIHFT)
- Error data collection in a real space experiment (no simulation or fault injection)

The ARGOS Satellite

- Advanced Research and Global Observations Satellite
- Launch: Feb. 23, 1999
- Orbit: 800 km Altitude, Sun Synchronous, 98° Inclination
- Two Processor Boards
  - Radiation-Hardened
  - COTS
Computing Testbed

- Hard Board
  - Harris RH3000 radiation-hardened chip set
    - Self-checking pair
  - SOI SRAMs
  - EDAC memory
- COTS Board
  - IDT R3081
  - No error detection hardware
    - No EDAC

Software-Implemented Error Detection

- Time Redundancy
  - Error Detection by Duplicated Instructions (EDDI)
- Control Flow Checking
  - Control Flow Checking by Software Signatures (CFCSS)
- Compiler Support
Software-Implemented Error Detection

- Software-Implemented EDAC
  - Compensate for lack of hardware EDAC
- Other
  - Software duplication/TMR
  - Watchdog task and timers
  - Algorithm-Based Fault Tolerance (ABFT)
  - Assertions

Summary

- Actual Space Radiation Test
  - No artificial fault injections
- Testing Efficacy of COTS and SIHFT
References (1)


References (2)