

Advancing the Arizona State University Knowledge Enterprise

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Effective Triplication for Flexible and Real-Time Soft Error Resilience

-Background

The increasing use of digital systems in everyday life has made reliability a key factor in the design of modern microprocessors. Soft errors are caused by highenergy particles, power supply noises, transistor variability, and can modify the logic value stored in microprocessor memory elements, which can cause a timing or functional failure. Historically, soft errors were considered only a challenge for high-altitude applications because most of the high-energy particles are cascaded by the earth's atmosphere before they reach ground level. However, the problem is now expanding to terrestrial-level particles due to changes in the atmosphere.

Software-level soft error tolerant schemes are promising because against hardware-based solutions, they can be applied on commercial-off-the-shelf processors selectively, either to only the safety/mission-critical applications, or only to the critical parts of an application.

Invention Description

Researchers at Arizona State University have developed NEMESIS, a novel compiler-level fine-grain soft error technique for detection, diagnosis and recovery that can provide a high degree of error-resiliency. NEMESIS runs three versions of computations and detects soft errors by checking the results of all memory write and branch operations. In the case of a mismatch, the NEMESIS recovery routine reverts the effect of error from the architectural state of the program and resumes normal execution of the program.

Potential Applications

- Autonomous vehicles
- Implantable medical devices
- High-performance computing
- Protection against hardware malfunctions for safety/security applications Benefits & Advantages
 - Able to detect all soft errors
 - Both control and data flow detection and recovery
 - Can recover from 97% of detected errors
 - Software-only reliability solution
 - Safe stop if an error is unrecoverable

Related Publication: <u>NEMESIS: A software approach for computing in presence of</u> soft errors | IEEE Conference Publication