GUFI

Clereco
Cross-Layer Early Reliability Evaluation for the Computing cOntinuum

FP7-CLERECO
Grant Agreement FP7-611404
SEVENTH FRAMEWORK PROGRAMME

Microarchitecture Level Reliability Evaluation of NVIDIA GPUs

March 2016

Product overview

GUFI is a tool for comprehensive reliability assessments of NVIDIA GPU Architectures. It is built on top of a state-of-the art micro-architectural simulator GPGPU-Sim. It reports the vulnerability of many on chip hardware components based on **F**ault **I**njection (**FI**) or **A**rchitectural **C**orrect **E**xecution (**ACE**) analysis.

Supported Architectures

⇒G80 (Quadro FX 5600)

⇒GT200 (Quadro FX 5800)

⇒Fermi (GeForce GTX 480, Tesla C2050)

Extensions & Tools

Fully automated tools for:

- **Fault Injection**
  1. running the golden run
  2. fault mask generation
  3. actual fault injection in GPGPU-Sim
  4. fault classification (Configurable parser according to user needs)
- **ACE Analysis**
- **Both methodologies can be applied to:**
  - **the whole CUDA application**
    comprehensive reliability evaluation of a hardware component for an application
  - **a specific kernel invocation**
    reliability evaluation of a hardware component for a given invocation of a CUDA kernel

Target Components

- General Purpose Register file
- Shared Memory
- **S**ingle **I**nstruction **M**ultiple **T**hread (**SIMT**) Stacks
- Valid bit of Instruction buffer entries

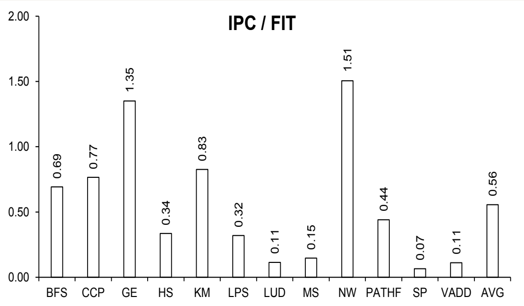
Supported Fault Models

- Transient
- Intermittent
- Permanent

any multiple combination of model, component, entry and cycle

Measurements

- **A**rchitectural **V**ulnerability **F**actor **(AVF)**
- **AVF** of **util**ized resources **(AVF util)**
- **F**ailures **I**n **T**ime **(FIT)**
- **M**ean **I**nstructions to **F**ailure **(MITF)**
- **Fault effect classification:**
  1. **Masked**
  2. **Detectable Unrecoverable Error (DUE)**
  3. **Silent Data Corruption (SDC)**



> *"Microarchitecture Level Reliability Evaluation of NVIDIA GPU Architectures based on Fault Injection or ACE-Analysis"*
>
> *- Computer Architecture Lab*

Ways to use GUFI

GUFI is a useful tool either for architects (early in the design phase) or programmers:

- Architects may evaluate the reliability of various GPU models.
  - Hardware based protection techniques may be incorporated and also evaluated in terms of performance and reliability.
- Programmers can break the vulnerability of an entire application down to the vulnerability of its kernels.
  - Adding software based error protection only to the most vulnerable kernel of an application can deliver remarkable improvements on its error resilience combined with low loss in performance.

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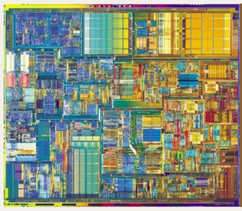

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