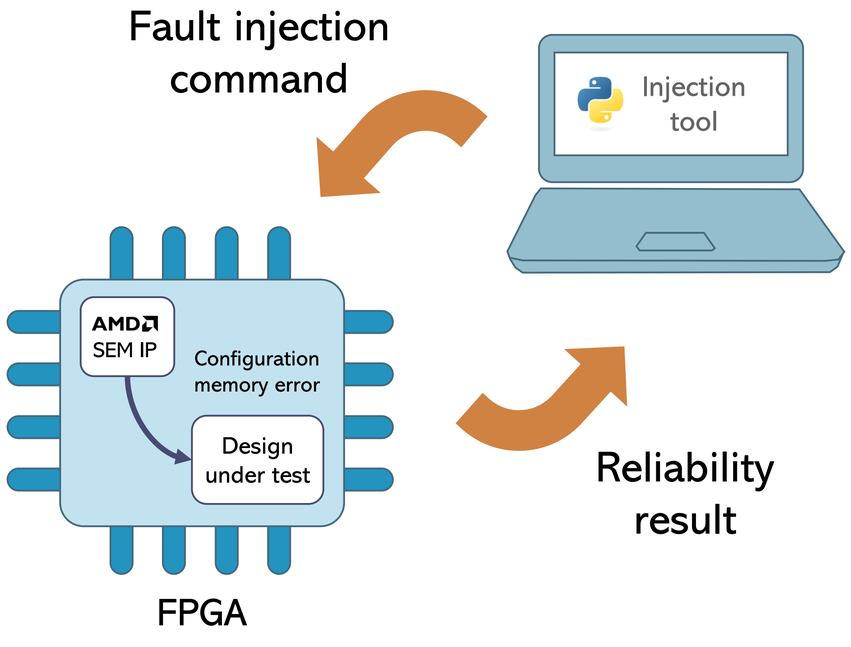
Reliability Testing of SRAM-Based FPGA Designs through Fault Injection

Luis Alberto Aranda, Francisco J. Garcia-Espinosa, Iván Ramírez
Universidad Rey Juan Carlos, Madrid, Spain (contact: luis.aranda@urjc.es)

Universidad Rey Juan Carlos

INTRODUCTION

- SRAM-based FPGAs are vulnerable to radiation-induced soft errors, impacting their reliability in space applications.
- Traditional reliability tests are performed after the manufacturing process, limiting early validation.
- We propose an approach to assess fault tolerance during the design phase, improving robustness while reducing costs by selectively targeting specific design components using fault injection techniques.

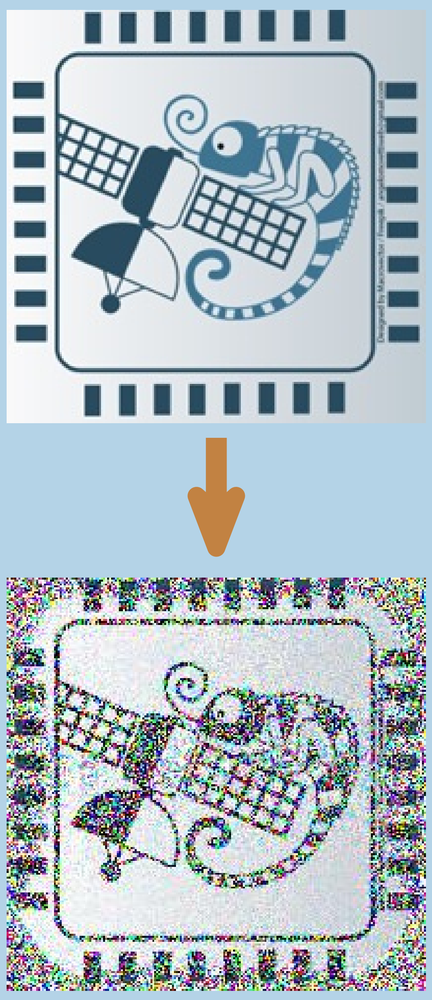


METHODOLOGY

1. **Create the digital design and program the FPGA**
2. **Connect the FPGA to a computer via a serial port**
3. **Launch our open-source, Python-based fault injection tool**
4. **Select the FPGA, injection mode, and target resources for testing**
5. **Run the fault injection campaign and analyze the reliability results**

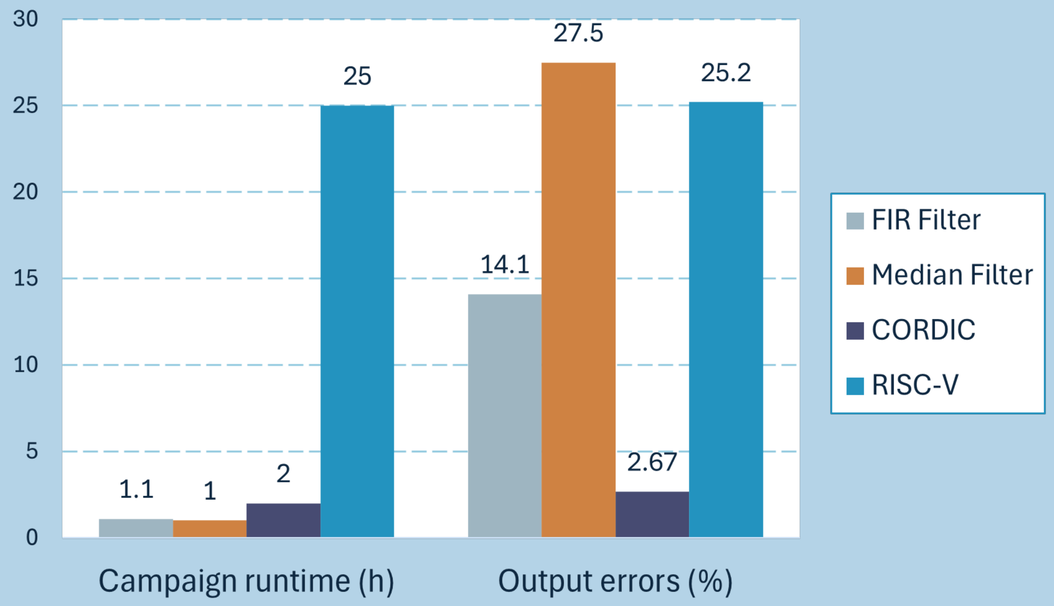
FAULT INJECTION RESULTS

Original image



Corrupted image (bit flip in median filter)

Testing different designs on AMD Kintex UltraScale



Highlights

- Fault injection methodology integrated into the design phase for early-stage reliability assessment.
- Customizable injection strategies: exhaustive, random, module-specific, or pattern-based to simulate radiation effects.
- Python GUI, user manual, and VHDL examples for easier adoption.

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For more information about the fault injection tool, you can send an email to luis.aranda@urjc.es or check the GitHub repository by scanning the QR code on the right.

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