Fernando Fernandes dos Santos

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Education

2011–2014   **Bachelors degree**, *Universidade Estadual do Oeste do Paraná UNIOESTE*, Cascavel, Brazil.
Advised by Professor Marcio Seiji Oyamada the final research work was Exploring DM3730 SoC parallelism resources

2015–2016   **Master degree**, *Universidade Federal do Rio Grande do Sul UFRGS*, Porto Alegre, Brazil.

2017– Ongoing   **Ph. D. degree**, *Universidade Federal do Rio Grande do Sul UFRGS*, Porto Alegre, Brazil.
Advised by Professor Paolo Rech. The main research topics are:
- Reliability of Object detection Algorithms
- Embedded GPU reliability
- Fault tolerance against soft errors

Master thesis

Title   *Reliability evaluation and error mitigation in pedestrian detection algorithms for embedded GPUs*

Advisor   Professor Paolo Rech

Description   My MSc thesis presents an experimental evaluation and analytical study of the reliability of two types of object detection algorithms: Histogram of Oriented Gradients and Deep Neural Networks. The research purpose was not only to quantify but also to qualify the radiation-induced errors on object detection applications executed in embedded GPUs.

Experience

September 2020 – Today   **Teaching Assistant**, *UFRGS*, Universidade Federal do Rio Grande do Sul - UFRGS.

I am a Teaching Assistant at UFRGS. Now I am in teaching Introduction to programming for students on STEM courses.

June – July 2019   **Research internship**, *LANL*, Los Alamos National Laboratory, Los Alamos, New Mexico - USA.

1st Radiation Effects Summer School. It was an internship at Los Alamos National Laboratory (LANL) that consisted of training in single event effects testing, total ionizing dose testing, and laser testing. I also attended a variety of lectures given by distinguished researchers at LANL. My project was focused on embedded GPU reliability for space exploration.

June 2018   **Research internship**, *ChipIr Facility*, Harwell Science and Innovation Campus, Chilton, Oxfordshire - UK.

A one-month internship on beam testing experiments. The focus was on testing Deep Neural Networks and HPC benchmarks, using NVIDIA GPUs exposed to high energy and thermal neutrons.

2013–2014   **Internship**, *COOPAVEL Agroindustrial Cooperative*, Cascavel, PR Brazil.

A three-month internship on software development at the head office of Coopavel. The focus was on software implementation and test using $C\#$ and Delphi.

Languages

Portuguese   Native language
English   Advanced
Spanish   Beginner

Computer skills

Programing languages   C++, CUDA, C, Python, Data manipulation libraries (Pandas, Numpy, Plotly)

Frameworks   NVIDIA cuBLAS, NVIDIA SASSIFI and NVBITFI (fault injectors), CAFFE (deep learning), OpenCV (image processing)

NVIDIA embedded plataforms   Jetson development kits

NVIDIA architectures   Kepler, Maxwell, Pascal, and Volta

General embedded plataforms   Raspberry Pi, Beagleboard, and Cubietruck

Maintained frameworks

CAROL-FI CAROL-FI is a CUDA-GDB fault injector to access the reliability characteristics of modern GPUs (including Pascal and Volta), available in: `https://github.com/UFRGS-CAROL/carol-fi.git`

Interests

Embedded systems

Fault tolerance and software test

Parallel devices

PETComp

2012–2014 PET is a Ministry of Education scholarship program for undergraduate students. PETComp is the Computer Science PET Group at UNIOESTE. In my period within PETComp the main developed activities were:

- Undergraduate research project on embedded systems using C language and Beagleboard platform.
- University to community extension program for teaching programming for high school students.

Publications

Journal papers

[1] D. Oliveira, **F. Fernandes dos Santos**, G. P. Davila, C. Cazzaniga, C. Frost, R. C. Baumann, and P. Rech. High-energy vs. thermal neutron contribution to processor and memory error rates. *IEEE Transactions on Nuclear Science*, pages 1–1, 2020.

[2] Daniel Oliveira, Sean Blanchard, Nathan DeBardeleben, **F. Fernandes dos Santos**, Gabriel Piscoya Dávila, Philippe Navaux, Andrea Favalli, Opale Schappert, Stephen Wender, Carlo Cazzaniga, Christopher Frost, and Paolo Rech. Thermal neutrons: a possible threat for supercomputer reliability. *The Journal of Supercomputing*, May 2020.

[3] P. M. Basso, **F. Fernandes dos Santos**, and P. Rech. Impact of tensor cores and mixed precision on the reliability of matrix multiplication in gpus. *IEEE Transactions on Nuclear Science*, 67(7):1560–1565, 2020.

[4] **F. Fernandes dos Santos**, P. F. Pimenta, C. Lunardi, L. Draghetti, L. Carro, D. Kaeli, and P. Rech. Analyzing and increasing the reliability of convolutional neural networks on gpus. *IEEE Transactions on Reliability*, pages 1–15, 2018.

[5] **F. Fernandes dos Santos**, Luigi Carro, and Paolo Rech. Kernel and layer vulnerability factor to evaluate object detection reliability in gpus. *IET Computers & Digital Techniques*, September 2018.

[6] **F. Fernandes dos Santos**, Lucas Weigel, Claudio Jung, Philippe Navaux, Luigi Carro, and Paolo Rech. Evaluation of histogram of oriented gradients soft errors criticality for automotive applications. *ACM Trans. Archit. Code Optim.*, 13(4):38:1–38:25, November 2016.

[7] Jean Luca Bez, Eliezer E. Bernart, **F. Fernandes dos Santos**, Lucas Mello Schnorr, and Philippe Olivier Alexandre Navaux. Performance and energy efficiency analysis of hpc physics simulation applications in a cluster of arm processors. *Concurrency and Computation: Practice and Experience*, pages n/a–n/a, 2016. cpe.4014.

Conference papers

[1] **F. Fernandes dos Santos**, Siva Kumar Sastry Hari, Pedro Martins Basso, Luigi Carro, and Paolo Rech. Unveiling gpu vulnerabilities: Comparing and combining beam, fault simulation, and profiling. In *35th IEEE International Parallel and Distributed Processing Symposium IPDPS*, May 2021.

[2] L. K. Draghetti, **F. Fernandes dos Santos**, L. Carro, and P. Rech. Detecting errors in convolutional neural networks using inter frame spatio-temporal correlation. In *2019 IEEE 25th International Symposium on On-Line Testing and Robust System Design (IOLTS)*, pages 310–315, July 2019.

[3] **F. Fernandes dos Santos**, M. Brandalero, P. M. Basso, M. Hubner, L. Carro, and P. Rech. Reduced-precision dwc for mixed-precision gpus. In *2020 IEEE 26th International Symposium on On-Line Testing and Robust System Design (IOLTS)*, pages 1–6, 2020.

[4] D. Oliveira, S. Blanchard, N. DeBardeleben, **F. Fernandes dos Santos**, G. Dávila, P. Navaux, S. Wender, C. Cazzaniga, C. Frost, R. Baumann, and P. Rech. An overview of the risk posed by thermal neutrons to the reliability of computing devices. In *2020 50th Annual IEEE-IFIP International Conference on Dependable Systems and Networks-Supplemental Volume (DSN-S)*, pages 92–97, 2020.

[5] **F. Fernandes dos Santos**, C. Lunardi, D. Oliveira, F. Libano, and P. Rech. Reliability evaluation of mixed-precision architectures. In *2019 IEEE International Symposium on High Performance Computer Architecture (HPCA)*, pages 238–249, Feb 2019.

[6] **F. Fernandes dos Santos**, P. Navaux, L. Carro, and P. Rech. Impact of reduced precision in the reliability of deep neural networks for object detection. In *2019 IEEE European Test Symposium (ETS)*, pages 1–6, May 2019.

[7] L. K. Draghetti, **F. Fernandes dos Santos**, L. Carro, and P. Rech. Detecting errors in convolutional neural networks using inter frame spatio-temporal correlation. In *2019 IEEE 25th International Symposium on On-Line Testing and Robust System Design (IOLTS)*, pages 310–315, July 2019.

[8] V. Fratin, D. Oliveira, C. Lunardi, **F. Fernandes dos Santos**, G. Rodrigues, and P. Rech. Code-dependent and architecture-dependent reliability behaviors. In *2018 48th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN)*, volume 00, pages 13–26, Jun 2018.

[9] L. Sekanina, Z. Vasicek, A. Bosio, M. Traiola, P. Rech, D. Oliveria, **F. Fernandes dos Santos**, and S. Di Carlo. Special session: How approximate computing impacts verification, test and reliability. In *2018 IEEE 36th VLSI Test Symposium (VTS)*, pages 1–1, April 2018.

[10] L. Weigel, **F. Fernandes dos Santos**, P. Navaux, and P. Rech. Kernel vulnerability factor and efficient hardening for histogram of oriented gradients. In *2017 IEEE International Symposium on Defect and Fault Tolerance in VLSI and Nanotechnology Systems (DFT)*, pages 1–6, Oct 2017.

[11] **F. Fernandes dos Santos** and Paolo Rech. Analyzing the criticality of transient faults-induced sdcs on gpu applications. In *Proceedings of the 8th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems*, ScalA '17, pages 1:1–1:7, New York, NY, USA, 2017. ACM.

[12] **F. Fernandes dos Santos**, L. Draghetti, L. Weigel, L. Carro, P. Navaux, and P. Rech. Evaluation and mitigation of soft-errors in neural network-based object detection in three gpu architectures. In *2017 47th Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops (DSN-W)*, pages 169–176, June 2017.

[13] D. A. G. D. Oliveira, L. L. Pilla, M. Hanzich, V. Fratin, **F. Fernandes dos Santos**, C. Lunardi, J. M. Cela, P. O. A. Navaux, L. Carro, and P. Rech. Radiation-induced error criticality in modern hpc parallel accelerators. In *2017 IEEE International Symposium on High Performance Computer Architecture (HPCA)*, pages 577–588, Feb 2017.

[14] **F. Fernandes dos Santos**, Lucas Weigel, Claudio Jung, Philippe Navaux, Luigi Carro, and Paolo Rech. Radiation sensitivity evaluation of pedestrian detection algorithm. *Radiation and its Effects on Components and Systems (RADECS)*, September 2016.

[15] D. Oliveira, L. Pilla, **F. Fernandes dos Santos**, C. Lunardi, I. Koren, P. Navaux, L. Carro, and P. Rech. Input size effects on the radiation-sensitivity of modern parallel processors. In *2016 IEEE Radiation Effects Data Workshop (REDW)*, pages 1–6, July 2016.

[16] Jean Luca Bez, Eliezer E Bernart, **F. Fernandes dos Santos**, Lucas Mello Schnorr, and Philippe OA Navaux. Análise da eficiência energética de uma aplicaç ao hpc de geofısica em um cluster de baixo consumo. *16th WSCAD - Simpósio em Sistemas Computacionais de Alto Desempenho*, 2015.