

Fernando Fernandes dos Santos | Ph.D. student

Porto Alegre – Rio Grande do Sul – Brazil

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Education

Universidade Estadual do Oeste do Paraná UNIOESTE **Cascavel**
Bachelor's degree in Computer Science, Brazil 2011–2014

Universidade Federal do Rio Grande do Sul UFRGS **Porto Alegre**
Master's degree in Computer Science, Brazil 2015–2016

Universidade Federal do Rio Grande do Sul UFRGS **Porto Alegre**
Ph. D. degree in Computer Science, Brazil 2017–Ongoing

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

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

I am currently teaching Introduction to programming for students on STEM courses.

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

1st Radiation Effects Summer School was an internship at LANL focused on testing devices on single event effects, total ionizing dose, and lasers. I also attended a variety of lectures given by distinguished researchers at LANL. My project was focused on embedded GPU reliability for space exploration.

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

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.

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

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] **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.
- [3] 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.
- [4] D. Oliveira, S. Blanchard, N. Debardeleben, **F. Fernandes dos Santos**, G. P. Dávila, P. Navaux, C. Cazzaniga, C. Frost, R. C. Baumann, and P. Rech. Thermal neutrons: a possible threat for supercomputers and safety critical applications. In *2020 IEEE European Test Symposium (ETS)*, pages 1–6, 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 aplicação ao hpc de geofísica em um cluster de baixo consumo. *16th WSCAD - Simpósio em Sistemas Computacionais de Alto Desempenho*, 2015.