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# Fernando Fernandes dos Santos

*Ph.D. student at UFRGS*

## 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– **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

- June - July 2019 **Research internship**, *LANL*, Los Alamos National Laboratory, Los Alamos, New Mexico - USA.  
1<sup>st</sup> 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**, *Chiplr 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 management libraries (Pandas, Numpy, Plotly)
- Frameworks NVIDIA cuBLAS, NVIDIA SASSIFI (fault injection), 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 effi-

ciency 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] 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.
- [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] **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.
- [5] **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.
- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.

- [10] **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.
- [11] **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.
- [12] 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.
- [13] **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.
- [14] 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.
- [15] 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.