

# Fabiano Libano

## Bio

Birthday: March 8, 1996 | Birthplace: Madrid, Spain | Nationality: Brazilian  
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## Education

### Doctor's Degree I Computer Engineering

Arizona State University, ASU, Tempe, United States.

Ongoing

Advisor: John Brunhaver

Topic: Novel hardened-by-design machine learning architectures for FPGAs/ASICs.

### Master's Degree I Computer Engineering

Universidade Federal do Rio Grande do Sul, UFRGS, Porto Alegre, Brazil

2017 - 2018

Advisor: Paolo Rech

Topic: Reliability analysis and hardening of neural networks on FPGAs.

### Bachelor's Degree I Computer Engineering

Universidade Federal do Rio Grande do Sul, UFRGS, Porto Alegre, Brazil

2013 - 2017

### High Education

Colégio Anchieta, ANCHIETA, Porto Alegre, Brazil

2011 - 2012

### Secondary Education

Escola de Educação Básica Rainha do Brasil, EEB RB, Brazil

2008 - 2010

### Primary Education

Colégio Marista Champagnat, CHAMPAGNAT, Brazil

2002 - 2007

## **Languages**

### **Portuguese**

Understanding, Speaking, Writing, Reading: Mother Language

### **English**

Understanding, Speaking, Writing, Reading: Fluent

### **Spanish**

Understanding, Speaking, Writing, Reading: Fluent

## **Main Fields of Interest**

1. Fault-Tolerance, Reliability & Radiation Effects
2. Computer Architecture, Digital Systems & FPGAs
3. Artificial Intelligence & Machine Learning
4. Space Exploration
5. Bioinformatics

## **Skills & Expertise**

1. **Radiation Testing:** More than 500 hours of hands on experience with neutron beam testing at ChipIR (UK) and at LANL (US). In addition to that, I have also had a brief experience with with gamma cells for TID effects, and laser sources for evaluating potential architectural vulnerabilities (AVF) in integrated circuits.
2. **RTL & FPGAs:** About 5 years of experience with FPGAs, writing application-specific, high-performance RTL descriptions, as well as fast prototyping with high-level synthesis (HLS). Particularly, I have a vast knowledge of the Xilinx environment, devices and development tools.
3. **AI & Machine Learning:** Experience with modeling, training and deploying artificial neural networks for image processing, linear regression and classification tasks. Furthermore, I have experience with reduced precision training and trimming techniques for neural networks. I have worked extensively with two main machine learning frameworks: TensorFlow and Caffe.

## Publications

1. F. Libano, P. Rech, "Reliability Analysis of Feed-Forward Artificial Neural Networks in System on Chips", presented at Silicon Errors in Logic-Systems Effects (IEEE), 2017.
2. F. Libano, P. Rech, L. Tambara, J. Tonfat, F. Kastensmidt, "Evaluation of Feed-Forward Artificial Neural Networks Reliability in FPGAs", presented at Nuclear and Space Radiation Effects Conference (IEEE), 2017.
3. F. Libano, P. Rech, L. Tambara, J. Tonfat, F. Kastensmidt, "On the Reliability of Feed-Forward Artificial Neural Networks in FPGAs", at IEEE Transactions on Nuclear Science, 2017.
4. F. Libano, B. Wilson, M. Wirthlin, P. Rech, "Selective Hardening for Neural Networks in FPGAs", at Nuclear and Space Radiation Effects Conference (IEEE), 2018.
5. F. Benevenuti, F. Libano, V. Pouget, F. Kastensmidt, P. Rech, "Comparative Analysis of Inference Errors in a Neural Network Implemented in SRAM-Based FPGA Induced by Neutron Irradiation and Fault Injection Methods", presented at Symposium on Integrated Circuits and Systems Design (IEEE), 2018.
6. F. Libano, B. Wilson, J. Anderson, M. Wirthlin, C. Cazzaniga, C. Frost, P. Rech, "Selective Hardening for Neural Networks in FPGAs", at IEEE Transactions on Nuclear Science, 2018.
7. F. Santos, C. Lunardi, D. Oliveira, F. Libano, P. Rech, "Reliability Evaluation of Mixed-Precision Architectures", at International Symposium on High-Performance Computer Architecture (IEEE), 2019.
8. F. Libano et al, "Understanding the Impact of Binary Quantization on the Reliability of Neural Networks on FPGAs" to be presented at Radiation and its Effects on Components and Systems (IEEE), 2019.

## Work Experience

### ASU I PhD Student & Research Assistant

Ongoing

I am currently working on novel architectures for neural networks on FPGAs/ASICs, targeting radiation hardness, higher performance and lower power consumption, as well as on the development of auxiliary tools that enable a seamless transition from training frameworks (such as TensorFlow) to high quality RTL descriptions. In addition to that, I am involved on the development of a full custom chip, which integrates multiple different dedicated hardware accelerators, executing simultaneously. This is a large scale project, in which a number of researchers are collaborating, but I am particularly assigned to tasks like RTL generation and communication channels/protocols. Furthermore, I am also working on adding architectural features to an existing rad-hard processor's Verilog, and verifying its functionality using different hierarchical granularities.

## **Los Alamos National Laboratory | Intern/Student @ Radiation Effects Summer School**

Summer 2019

The experience at LANL was very unique, in the sense that I was able to do a lot of hands-on work with different types of radiation experiments (neutron generators for evaluating SEEs, gamma cells for evaluating TID effects, and laser sources for evaluating architectural vulnerabilities). At the same time, I have learned a lot from the theoretical stand point, as I have attended more than 50 hours of classes and lectures, from world-renowned researchers on a number of very relevant topics, ranging from particle physics, radiation testing methodologies, high-performance computing, space applications and beyond. Particularly, I have evaluated the impact of reducing the floating-point precision on neural networks in FPGAs, both in terms of accuracy and radiation sensitivity.

## **UFRGS | M.S. Student sponsored by CAPES-MEC (Coordination of Improvement of Graduate Level Personnel - Ministry of Education - Brazil)**

2017 - 2018

Researcher with specialization in reliability and fault tolerance of FPGA and SoC components under harsh conditions, such as radiation-rich environments. The main focus of my research has been to evaluate the behavior of Artificial Neural Networks, used in safety-critical applications such as autonomous driving and space missions, most often for real-time image processing. I've also been working on proposing out-of-the-box selective hardening techniques, based on AVF, in order to improve the overall system reliability with very low overhead in terms of resources and power. The results have been presented in relevant conferences as well as published in IEEE journals.

## **UFRGS | Intern in the Scientific Initiation Program of CNPq (National Council of Scientific and Technological Development - Brazil)**

2015 - 2017

As an undergraduate student, the focus of my research was to evaluate the reliability of simple Artificial Neural Networks, used for Pattern Recognition and Linear Regression, implemented in FPGA. The obtained results were presented in IEEE conferences.

## **Queen Mob | iOS Developer**

03/2012 - 10/2012

Worked on new apps, such as "Turismo Bento" and other mobile solutions for regional clients of southern Brazil.

## **Apple | Licensed Developer**

2010 - 2013

Developer of personal projects, including an app called "iTaxi" with a high level of acceptance by the users, coverage by national magazines, newspapers and tv shows.

## References

John Brunhaver  
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Rutherford Appleton Laboratory