

Manuel Blanco Valentin

PHD COMPUTER ENGINEERING CANDIDATE

919 Hinman Avenue, Evanston, IL - USA

☎ +1 312-566-3402 | ✉ manuel.blanco.valentin@gmail.com | 🌐 manuelblancovalentin | 🔗 manuelblancovalentin |
📺 Manuel-Blanco-Valentin

Profile

Manuel B. Valentin is a **PhD candidate in Computer Engineering** at **Northwestern University**, where he has been part of the Electrical and Computer Engineering Department since 2020. The main focus of his work and research consists in developing **next-generation hardware architectures** for **machine learning accelerators** and **smart devices**, with **on-edge reprogrammability** and **trainability** capabilities.

He is currently developing **NRCSTK**, a novel biologically inspired framework for **training AI systems directly on hardware** using local learning rules and plasticity mechanisms driven by **metabolic constraints** and **resource-aware optimization**, instead of traditional backpropagation. The model introduces an **energy-based reward structure** that promotes self-organization through **scarce resource allocation**, enabling adaptive, energy-efficient learning in low-power environments.

His work has been primarily **funded by Fermilab**, and carried out in collaboration with **CERN**, **Columbia University**, and others. His ASIC research spans applications in **quantum computing**, **particle physics**, **cryogenics**, and **radiation-hardened systems**, while also contributing to **security**, **data protection**, and **fail-safe redundancy**.

He has also contributed to EDA development through an internship at **Cadence Design Systems**, where he worked on **silicon aging estimation**, **timing closure**, and ML-driven optimization tools for **5nm and advanced nodes**, including deployments into **Tempus SSV**.

Prior to his PhD, he worked as a **deep learning specialist** in the Oil & Gas sector. His combined background in **AI**, **digital design**, and **EDA automation** positions him to drive innovation in **AI-optimized silicon**, **on-device learning systems**, and **neuromorphic hardware**.

ASIC VLSI FPGA ML accelerators Smart SoCs Deep learning Digital design High-Level Synthesis Logic verification

Education

Northwestern University

PHD. COMPUTER ENGINEERING (CANDIDATE)

GPA*: 3.9 (A) – Thesis: *In progress**

📍 Evanston, IL

📅 Sep/2020 - Present

Northwestern University

MSC. COMPUTER ENGINEERING

GPA: 3.9 (A)

📍 Evanston, IL

📅 Sep/2020 - Jan/2022

Brazilian Center for Physics Research (CBPF)

MSC. PHYSICS & SCIENTIFIC INSTRUMENTATION

GPA: 3.8 (A) – Thesis: *Deep learning methods on geological reservoir borehole log images and applications*

📍 Rio de Janeiro, Brazil

📅 Sep/2015 - May/2018

Polytechnical University of Barcelona (UPC-Tech)

BS. ROBOTICS AND ELECTRONICS ENGINEERING

GPA: 3.3 (A-) – Thesis: *Design and implementation of the autonomous navigation control system of a model tugboat*

📍 Barcelona, Spain

📅 Sep/2010 - Jun/2014

Experience

Northwestern University

PHD CANDIDATE – THESIS RESEARCH: *Neuromorphic AI & Edge Learning Architectures*

📍 Evanston, IL

📅 Sep 2023 – Present

- Developed **NRCSTK**, a novel neuromorphic framework enabling on-device AI training through local learning rules and metabolic optimization, removing reliance on backpropagation.
- Designed and validated models for **event-driven neural dynamics**, structural plasticity, and localized reward mechanisms.
- Built a simulation platform in Python/PyTorch for **spiking and graded potential neurons** under metabolic constraints.
- Targeted ultra-low-power training through **sparsity**, **locality**, and **phase synchronization**.
- Bridged neuroscience and scalable AI hardware frameworks for edge-deployable adaptive systems.

Cadence Design Systems

TEMPUS SSV GRADUATE INTERN

- Researched **silicon drift and aging effects** in 5nm CMOS nodes and their impact on timing closure.
- Developed software modules for **silicon drift estimation** integrated into **Tempus SSV**.
- Created tools for **drift-related library characterization** and enhanced Tempus core algorithms.
- Explored machine learning for drift-aware timing closure prediction.

 *San Jose, CA*
 *Mar 2023 – Sep 2023*

Northwestern University | Fermilab

PHD CANDIDATE / ASIC DESIGN RESEARCHER

- Led design and tapeout of **AI accelerators** in GF 22nm, TSMC 28nm, and TSMC 65nm processes.
- Automated full ASIC flows: synthesis, PnR, QRC extraction, metal fill, and signoff using Cadence and Mentor tools.
- Implemented **radiation-hardened logic** with TMR; developed RTL manipulation tools for redundancy injection.
- Deployed **high-level synthesis** flows for AI accelerator design using Catapult HLS.
- Applied ML-driven optimization and maintained internal digital design libraries and PDKs.

 *Evanston, IL*
 *Jun 2020 – Mar 2023*



CERN INFIERI School – Universidad Autónoma de Madrid

INVITED INSTRUCTOR

- Delivered 5-day lecture series on ASIC design and verification to over 20 international students.
- Developed academic labs and automated flows covering synthesis, PnR, DRC/LVS, and signoff.

 *Madrid, Spain*
 *Aug 2021 – Sep 2021*



PETROBRAS

DEEP LEARNING SPECIALIST

- Developed AI models for **oil & gas reservoir characterization** using seismic and borehole image data.
- Built convolutional and generative workflows for regression, classification, and simulation tasks.
- Applied **Bayesian deep learning** for uncertainty quantification and model robustness.
- Delivered advanced imaging tools for **spectral fluid analysis** and **artifact removal**.

 *Rio de Janeiro, Brazil*
 *Sep 2015 – Jun 2020*

Skills

Programming

C/C++

Python

Verilog/VHDL

Tcl/Tk

Bash/tcsh

Cadence SKILL

SPICE

Java

Assembly

CAD Tools

Virtuoso

Innovus

Genus

Xcelium

Tempus

Voltus

Quantus

Calibre nmDRC/LVS

Mentor Catapult HLS

AI & ML

TensorFlow/Keras

PyTorch

Pandas

NumPy

Google Cloud ML

AWS ML

Operating Systems

Linux (expert)

macOS

Windows

Languages

Spanish

Catalan

Portuguese

English

French (basic)

Additional information

- 33 y.o.
- EU citizenship (Spain)
- Place of birth: Barcelona
- F1 Visa
- US, European and Brazilian valid driver's licenses
- Permanent residence permit in Brazil
- Covid-19 fully vaccinated (Moderna)
- Availability to travel and relocate

(Projects portfolio, Publications, Patents and Freelance work experience sections below)

Hardware design portfolio

GF 22nm

TSMC 28nm

TSMC 65nm

AI accelerator

RISC-V

Hard-rad resistance

High-level Synthesis

Logic & Formal verification

(2023) CMS28 v2 – AI-In-Pixel Readout Chip for HL-LHC



- Designed and implemented full digital logic and layout of the SoC for a radiation-hard pixel ASIC in 28nm CMOS.
- Integrated neural network classifiers using **hls4ml** and **Catapult HLS**, achieving sub-10ns latency and minimal area.



(2023) CITC2 – Cryogenic Mixed-Signal Readout ASIC



- Developed digital controller, configuration interface, and scan/SPI readout for a mixed-signal cryogenic ASIC in 22nm FD-SOI.
- Led RTL-to-GDSII backend flow, achieving timing closure at 200 MHz under cryogenic constraints.



(2022) CryoAI v2



- Development of hardware for on-edge ML accelerator for **quantum** readout and control in a **GF 22nm** process for **low power cryogenic** performance
 - Integration and deployment of AI model, from algorithm to hardware.
 - Synthesis and hardware integration of **eFPGA** processor.
 - **Funding: Fermilab, Northwestern U., Columbia U.**



(2022) In-pixel AI v1



- Development of hardware for **photon science** and particle detection/imaging in a **TSMC 65nm** process
 - Development of complete automatic digital design flow for **TSMC 65nm** process.
 - Integration of analog circuits into hardware.
 - Synthesis and hardware integration of AI-accelerator on-chip.
 - Digital and Logic verification.
 - **Funding: Fermilab, Northwestern U.**



(2022) Radhard-AI v1



- Development of **hard-radiation-resistant** hardware for on-edge ML accelerator for tiny anomaly detection in particle-physics in a **TSMC 28nm** process
 - Construction of complete digital flow for automatic digital design for **TSMC 28nm**.
 - Integration and deployment of AI model, from algorithm to hardware.
 - Synthesis and hardware integration of RISC-V processor.
 - Development of an automatic flow for **automatic module redundancy triplication (TMR)** scheme for radiation resistance.
 - **Funding: Fermilab, Northwestern U., Columbia U.**



(2021) CryoAI v1



- Development of hardware for on-edge ML accelerator for data classification in a **GF 22nm** process for **low power cryogenic** performance
 - Construction of complete digital flow for automatic digital design for **GF 22nm**.
 - Integration and deployment of AI model, from algorithm to hardware.
 - Synthesis and hardware integration of RISC-V processor.
 - Compilation, synthesis and integration of **custom 22nm** memories and **e-Magnetic RAMs**.
 - **Funding: Fermilab, Northwestern U., Columbia U.**



(2021) ECON AI - CMS v1



- Development of on-edge **reprogrammable AI accelerator** in **TSMC 65nm** process and auxiliary systems for the new generation calorimeter for the **CMS experiment at CERN**, able to reliably process and transfer information at **extremely high-rates** in radiation-hard environments.
 - **Simulation and verification** of the synthesized digital systems under expected work conditions.
 - Development of an automatic flow for **automatic module redundancy triplication (TMR)** scheme for radiation resistance.
 - **Verification** of expected fail-safe behavior of triplicated cells by **simulating particle events caused by radiation** (single event effects, single event upsets).
 - Development of redundancy circuitry schemes for hard-radiation protection.
 - **Funding: CERN, Fermilab, Northwestern U., Columbia U, MIT, Brown U., CalTech, FIT, IPB.**



Machine Learning portfolio

DeepCNN ResNets GANs RNN RISC-V Hard-rad resistance High-level Synthesis Logic & Formal verification

(2019/20) astroDGAN - DESI Smart CCDs



DEEP LEARNING SPECIALIST



- Design and implementation of **Deep learning and artificial intelligence** methodologies to **cosmic microwave background** (CMB) for data decomposition, reconstruction and generation.
 - Development of **deep generational adversarial models** for map transformation.
 - Study of physics-aware loss functions.
 - Study of advanced techniques for neural networks training.
 - Development of **deep residual models** for map conversion.
 - **Developed the deep model that is able to delens CMB maps, and transform them into the required E, κ, B maps by using a generational approach.**
- Characterization of **Dark energy survey silicon (DESI) CCDs** for dark matter observation in space and discussion on application of **artificial intelligence on-chip** for smart sparse processing.

Freelance



JBS Foods group

Worldwide

AI PROCESS AUTOMATION CONSULTANT

Sporadic

- Quality assertion automation of meat production line
 - Development of AI smart algorithms for object detection and image processing and classification for quality assertion



HashData, Inc.

Worldwide

AI AUTOMATION CONSULTANT

Sporadic

- Implementation of AI systems for production automation
- Integration of deep learning algorithms into cloud BI platforms



SEARA, Inc.

Multiple loc., Brazil

AI PROCESS AUTOMATION CONSULTANT

Sporadic

- Quality assertion automation of meat production line
 - Development of AI smart algorithms for object detection and image processing and classification for quality assertion
 - Production line status monitoring and integration with telemetrically controlled business intelligence (BI) systems



Venturi Unmanned Technologies, Inc.

Castelldefels, Spain

ELECTRONICS ENGINEER CONSULTANT

Sporadic

- Design and consulting services on distribution power systems, sensing & control systems and telemetry interfaces for hydrogen-powered drones.

Patents

Analysis based on sensitivity characteristic data and hardware measurement data

 **Valentin, Manuel**; Braun, Alexander; Keller, Igor; Amin, Chirayu

 2023  US Patent Office, Cadence: 23PA168US01, SLW: 3225.403US1

Method for automatic breakout formation detection and characterization from reservoir wellbore imagery data

 **Valentin, Manuel**; P. Albuquerque, Marcelo; Bom, Clecio; Faria, Elisangela; P. Albuquerque, Marcio; Duarte, Maury; Dias, Luciana

 2019  Brazilian Patent Office, BR10201800963

Method for Pad artifact removal in wellbore ultrasound imagesMethod for Pad artifact removal in wellbore ultrasound images

 **Valentin, Manuel**; P. Albuquerque, Marcelo; Bom, Clecio; Faria, Elisangela; P. Albuquerque, Marcio; Duarte, Maury; Dias, Luciana

 2021  Brazilian Patent Office, BR1020210214473

Publications

In-pixel AI for lossy data compression at source for X-ray detectors

 **Valentin, Manuel**; Di Guglielmo, Giuseppe; et al.

 2023  Nuclear Instruments & Methods in Physics Research Section A, v. 1057  ASIC Hw. Design AI/ML  Elsevier

Radiation-Hard Smart-Pixel Detector ASIC ReadOut with Digital AI in 28nm

 Parpillon, Benjamin; Badea, Anthony; Syal, Chinar; Mills, Corrinne; **Valentin, Manuel**; et al.

 2023  U.S. Department of Energy Office of Scientific and Technical Information  ASIC Hw. Design AI/ML  Conf.

A Cryogenic Readout IC with 100 KSPS in-Pixel ADC for Skipper CCD-in-CMOS Sensors

 Quinn, Adam; **Valentin, Manuel**; Zimmerman, Thomas; Braga, Davide; Memik, Seda; Fahim, Farah

 2023  Nuclear Instruments and Methods in Physics Research Section A, Volume 1057, pp: 168665  ASIC Hw. Design AI/ML  Elsevier

Smart pixel sensors: towards on-sensor filtering of pixel clusters with deep learning

 Yoo, Jieun; Dickinson, Jennet; Swartz, Morris; **Valentin, Manuel**; et al.

 2024  Machine Learning: Science and Technology V(5),N(3), PP(035047)  ASIC Hw. Design AI/ML  IOP

A reconfigurable neural network ASIC for detector front-end data compression at the HL-LHC

 Di Guglielmo, Giuseppe; Fahim, Farah; Herwig, Christian; **Valentin, Manuel**; et al.

 2021  IEEE Transactions on Nuclear Science, PP(99):1-1  ASIC Hw. Design AI/ML  TNS

hls4ml: An Open-Source codesign Workflow to Empower Scientific Low-Power Machine Learning Devices

 Fahim, Farah; Hawks, Benjamin; Herwig, Christian; Hirschauer, James; Jindariani, Sergo; Tran, Nhan; Carloni, Luca; Di Guglielmo, Giuseppe; Harris, Philip; Krupa, Jeffrey; Rankin, Dylan; **Valentin, Manuel**; et al.

 2021  TinyML Research Symposium, 2021  High-Level synthesis  arXiv

Bayesian deep networks for absolute permeability and porosity uncertainty prediction from image borehole logs from brazilian carbonate reservoirs

 Bom, Clecio; **Valentin, Manuel**; Fraga, Bernardo; Campos, Jorge; Coutinho, Bernardo; Dias, Luciana; Faria, Elisangela; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Duarte, Maury

 2021  Journal of Petroleum Science and Engineering, Vol.201

 Petrophysics AI/ML

 [Elsevier](#)

Automatic detection of fractures and breakouts patterns in acoustic borehole image logs using fast-region convolutional neural networks

 Dias, Luciana; Bom, Clecio; Faria, Elisangela; **Valentin, Manuel**; Duarte, Maury; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; et al.

 2020  Journal of Petroleum Science and Engineering, Vol.191

 Petrophysics AI/ML

 [Elsevier](#)

A deep residual convolutional neural network for automatic lithological facies identification of Brazilian pre-salt oilfield wellbore image logs

 **Valentin, Manuel**; Bom, Clecio; Coelho, Juliana; Duarte, Maury; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Faria, Elisangela

 2019  Journal of Petroleum Science and Engineering, Vol.179, Pages 474-503

 Petrophysics AI/ML

 [Elsevier](#)

Developing a Victorious Strategy to the Second Strong Gravitational Lensing Data Challenge

 Bom, Clecio; Fraga, Bernardo; Dias, Luciana; Schubert, Patrick; **Valentin, Manuel**; et al.

 2022  Monthly Notices of the Royal Astronomical Society

 Astrophysics AI/ML

 [Oxford](#)

The Strong Gravitational Lens Finding Challenge

 Metcalf, Benton; Meneghetti, M; Avestruz, Camille; Bom, Clecio; **Valentin, Manuel**; et al.

 2019  Astronomy Astrophysics, Vol.625, Pages A119

 Astrophysics AI/ML

 [A&A](#)

Deep learning in wide-field surveys: Fast analysis of strong lenses in ground-based cosmic experiments

 Bom, Clecio; Poh, Jason; Nord, Brian; and Blanco-Valentin, **Valentin, Manuel**; et al.

 2019  arXiv preprint

 Astrophysics AI/ML

 [arXiv](#)

Estimation of Permeability and Effective Porosity Logs using Deep Autoencoders in Borehole Image Logs from the Brazilian Pre-Salt Carbonate

 **Valentin, Manuel**; Bom, Clecio; Martins-Compan, Andre; Duarte, Maury; Menezes-Jesus, Candida; Souza, Anelise; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Faria, Elisangela

 2018  Journal of Petroleum Science and Engineering, Vol.170, Pages 315-330

 Petrophysics AI/ML

 [Elsevier](#)

Deep Learning Methods on Geological Reservoir Borehole Log Images and Applications

 **Valentin, Manuel**

 2018  MSc. Thesis - Published by Centro Brasileiro de Pesquisas Fisicas

 Petrophysics AI/ML

 [NTCBPF](#)

Porous medium permeability estimation for well imagery using complex resistivity spectra

 **Valentin, Manuel**; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Faria, Elisangela; Bom, Clecio; Duarte, Maury; Le Guevel, Yann

 2018  Notas Tecnicas do CBPF, Vol.8, Issue 1

 Petrophysics

 [NTCBPF](#)

Ultrasonic image acquisition as a didactic tool

 **Valentin, Manuel**; Bom, Clecio; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Faria, Elisangela; Duarte, Maury

 2017  Caderno Brasileiro de Ensino de Física, Vol.40, Issue 2

 Petrophysics

 [RBEF](#)

On a method for Rock Classification using Textural Features and Genetic Optimization

 **Valentin, Manuel**; Bom, Clecio; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Faria, Elisangela; Duarte, Maury; Surmas, Rodrigo

 2016  Notas Tecnicas do CBPF, Vol.7, Issue 1

 Petrophysics AI/ML

 [NTCBPF](#)

Texture Classification based on Spectral Analysis and Haralick Features

 **Valentin, Manuel**; Bom, Clecio; P. Albuquerque, Marcio; P. Albuquerque, Marcelo; Faria, Elisangela; Duarte, Maury

 2016  Notas Tecnicas do CBPF, Vol.6, Issue 1

 ML

 [NTCBPF](#)