# NELSON E. SEPÚLVEDA-RAMOS

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## RESEARCH INTEREST

My research centers on exploring the reliability of transistor devices. I utilize pulsed-DC measurement techniques to investigate their operational limits and the stresses they can endure without compromising performance or shortening their expected lifespan. By reducing self-heating effects, these measurements are essential for understanding how thermal factors influence device performance. This approach enables the development of more precise models, aiding circuit designers in maximizing the potential of current technologies.

## EDUCATION

**Georgia Institute of Technology** *August 2019 - May 2025 (Expected)*
Doctor of Philosophy, Electrical and Computer Engineering
Technical Interest Areas: Nanotechnology and Electromagnetics

**Pulsed-SOA and RF-breakdown**
The goal of this project is to extend learning from pulsed-DC characterization to predict when transistors fail under RF operation without destroying the device under test. DC-SOA definitions were explored using pulsed measurement techniques, and SOA limits were found and compared against hard-failure of RF measurements.

- Defined a new approach to measuring SOA limits using pulse measurements.
- Extracted Isothermal response of device for model validation.
- Predicted hard-failure under RF-operation using pulsed-measurements.

**Back end of line (BEOL) impact of performance and reliability**
The project goal is to study the impact of the BEOL on DC and RF reliability and improvements in both small- and large-signal performance.

- Measured custom structures with different amounts of BEOL metal layers.
- Characterized both high-current and mixed-mode degradation due to the BEOl.
- Measured small- and large devices using load-pull techniques to find RF-breakdown.

**Thermal Parameters Extraction and Modeling**
The project goal is to study and implement the methodology of thermal parameters extraction to improve current transistor models.

- Found experimentally the thermal parameters of transistor devices using known techniques.
- Used the thermal parameters to update the HICUM model to have an accurate representation of the self-heating of transistor devices.
- Wrote Verilog-A code to include in-house thermal networks to improve industry-standard process development kit (PDK) models.

**Pulse-DC Device Characterization**
The goal of this project is to redefine the safe-operating area of transistors. One method is to use pulsed measurement techniques. These are still not a perfect representation of the stress that a device will experience under RF operation. Nevertheless, it is a stepping stone to identifying the relevant variables that affect the RF operating area (SOA).

- Measured and compared different variables using pulse measurement, from pulse-width to duty cycle effects to find the optimal conditions to reduce device self-heating.

- Wrote C language code to automatize, measure, and save data using a pulsed Semiconductor Analyzer System Keithley 4200-SCS.
- Experimentally proved that we could extend the safe operating area of devices using pulsed measurements. A short pulse width of about 100 ns reduced self-heating significantly to create similar conditions to RF operation.

**University of Puerto Rico, Mayagüez**
Bachelor of Science, Electrical Engineering *Cum laude*
Material Science Minor

**Study of the Electrical Properties of a Bio-Composite Containing Ferroelectric Nanoparticles**

- Characterized the electrical properties of a novel material, combining organic materials with ferroelectric nanoparticles to aid the energy storage capacity of the material.
- I designed a measurement set-up to measure the material potential using a parallel plate capacitor.

## WORK EXPERIENCE

**Texas Instruments** Dallas, TX *Summer 2022*
*Process Development Intern*

The project aimed to improve a pulse-width set-up to model the diffusion charge storage during saturation accurately.

- Standardized a protocol to reliably measure extrinsic base-collector (BC) junction diffusion charge on bipolar devices.
- Compared both simulation and measured data to model when the transistor is switched from saturation to forward operation.

**Georgia Institute of Technology** , Atlanta,GA *August 2019 - December 2019*
*Teaching Assistant*

- In charge of the senior design course for ECE. Supervise students with their designs, including inspecting 3D models for printing, grading their lab notes, programming, and debugging microprocessors.

**University of California Berkeley,** Berkeley, CA *Summer 2018*
*Summer Research Assistant*

The project goal was to research the magnetic properties of different materials to find the most suitable candidate for a microfluidic valve controlled by an electric field.

- Simulated different micro-disks with different materials and dimensions to find a no-flux magnetic configuration (vortex).
- Created a cluster of virtual machines with Ubuntu to run 40 simulations with a run time of 24 to 72 hours to compute.

**Georgia Institute of Technology,** Atlanta, GA *Summer 2017*
*Summer Research Assistant*

The project goal was to understand Negative Capacitance and the Dynamics of ferroelectric Capacitors.

- Developed a program using LabVIEW to control a digital oscilloscope and function generator to measure electrical properties.
- Created an algorithm using MATLAB to filter noise signals and process signals acquired experimentally.

**NASA Goddard Space Flight Center,** Maryland, MD *Summer 2016*
*Summer Intern*

The project goal was to develop a proof of concept where we could simulate outer space conditions' possible problems with electrostatic insulated blankets and develop a solution on how to overcome them.

- Proved that particles from insulating blankets can hold an electrostatic charge that causes them to stick to spacecraft surfaces, tested methods using pressurized gas to clean the particles.
- Designed and printed 3D models using Sketch Up to protect flight hardware from wear degradation.

**Michigan State University,** East Lansing, MI *Summer 2015*
*Summer Research Assistant*

The project goal was to create an autonomous tracking system using LabVIEW to track the micro-mechanical movement of Vanadium Dioxide which can be activated using a laser.

- Developed a wireless tracking system to monitor and control the movement of VO2-based water-walking arthropod devices.
- Implemented LabVIEW and an Arduino microcontroller to produce the locomotion mechanism of VO2 devices.

**Texas Tech University,** Lubbock, TX *Summer 2014*
*Summer Research Assistant*

The project goal was to develop software to control and measure the optical properties of multiple materials to study absorption and reflection for solar technology applications.

- Developed a program using LabVIEW to acquire and save data, including the need to control the stepper motor and power meters to measure the optical properties.
- Trained with multiple visible lasers, calibration, safety, and data analysis.

## SKILLS

**Relevant Coursework:** EM Radiation and Antennas, Applied Electromagnetics, Analog Electronics Design, Gigascale Integration, Microelectronics Technologies, Micro-electromechanical Devices, Si-Based Hetero Dev and Ckts
**Programming:** C, VBA, LabVIEW, Arduino, Basic and PLC, MATLAB, Linux.
**Software:** FEKO, Sketch-Up, Keysight ADS, NI LabVIEW
**Test and Measurement:** Vector Network Analyzer, Signal Generator, Oscilloscope, Spectrum Analyzer, Semiconductor Parameter Analyzer, Pulse Semiconductor Parameter Analyzer, Load-Pull Setup, On probe measurements
**Bilingual:** English  Spanish (written and oral).

## PUBLICATIONS

**Google Scholar Link:** https://scholar.google.com/citations?hl=enuser=EU83wKIAAAAJ

**N. Sepulveda-Ramos**, H. P. Lee, J. W. Teng, and J. D. Cressler, "Using Pulsed-Mode Measurements of SiGe HBTs for Non-Destructive, Improved RF-SOA Estimation," 2024 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS), 2024.

**N. Sepulveda-Ramos**, H. P. Lee, J. W. Teng and J. D. Cressler, "Assessing DC and RF Reliability of SiGe HBTs Stress-Engineered Using Dummy BEOL Layers," 2024 IEEE Transactions on Electron Devices (TED), 2024.

H. P. Lee, D. Nergui, J. W. Teng, J. P. Moody, **N. Sepulveda-Ramos** and J. D. Cressler, "Anomalous Mixed-Mode Damage Effects in SiGe HBTs at Cryogenic Temperatures," 2024 IEEE International Reliability Physics Symposium (IRPS), Grapevine, TX, USA, 2024, pp. 1-4

**N. Sepulveda-Ramos**, H. P. Lee, J. W. Teng, Adrian Ildefonso and J. D. Cressler, "Impact of Device Layout on Thermal Parameters and RF Performance of 90-nm SiGe HBTs," 2023 IEEE Transactions on Electron Devices (TED), 2023.

H. P. Lee, **N. Sepulveda-Ramos**, J. W. Teng, Moody, Jackson P, Nergui, Delgermaa and Ringel, Brett L and Brumbach, Zachary R and Premani, Alizeh and Raghunathan, Uppili S and Jain, Vibhor and J. D. Cressler, "The Effects of Carbon Doping on the Performance and Electrical Reliability of SiGe HBTs," 2023

IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS), Monterey, CA, USA, 2023, pp. 253-256

**N. Sepulveda-Ramos**, H. P. Lee, J. W. Teng, and J. D. Cressler, "Improved Electrical Reliability and Performance Enhancements in SiGe HBTs Using Dummy BEOL Metal Layers," 2022 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS), 2022.

J. W. Teng, D. Nergui, H. Parameswaran, **N. Sepulveda-Ramos**, G. N. Tzintzarov, Y. Mensah, C. D. Cheon, S. G. Rao, B. Ringel, M. Gorchichko, K. Li, H. Ying, A. Ildefonso, N. A. Dodds, R. Nathan Nowlin, E. X. Zhang, D. M. Fleetwood, and J. D. Cressler, "Response of integrated silicon microwave pin diodes to X-ray and fast-neutron irradiation," IEEE Transactions on Nuclear Science, pp. 1–1, 2022.

H. P. Lee, A. Moradinia, J. W. Teng, **N. Sepulveda-Ramos** and J. D. Cressler, "Performance vs. Reliability Tradeoffs of Medium Breakdown and High Performance Cascode Amplifier Cells," 2022 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS), Phoenix, AZ, USA, 2022, pp. 66-69

H. P. Lee, J. W. Teng, **N. Sepulveda-Ramos**, and J. D. Cressler, "Dynamic behavior of breakdown mechanisms in SIGE HBTS," 2021 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS), 2021.

A. Moradinia, R. P. Martinez, J. W. Teng **N. Sepulveda-Ramos**, H. P. Lee and J. D. Cressler, "Circuit-Level Safe-Operating-Area of a High-Speed SiGe BiCMOS Wireline Driver," 2020 IEEE BiCMOS and Compound Semiconductor Integrated Circuits and Technology Symposium (BCICTS), 2020.

## HONOR AND AWARDS

**Best Student Paper Award**, 2024 IEEE BCICTS, Fort Lauderdale *2024*

**Graduate REACH Fellow**, Georgia Institute of Technology *2021*

**National Science Foundation Graduate Fellowship** *2020*

**Georgia Tech Leadership Fellow** *2020*

**Project Connect Fellow**, IMS *2020*

**Graduate REACH Fellow**, Georgia Institute of Technology *2020*

**Alek/Halina Szlam ECE Fellowshi**, Georgia Institute of Technology *2019*

**Project Connect Fellow**, IMS *2019*

**Third Place Oral Presentation Award**, University of California Berkeley *2018*

**MIT Media Lab Travel Award for Prospective Students** *2018*