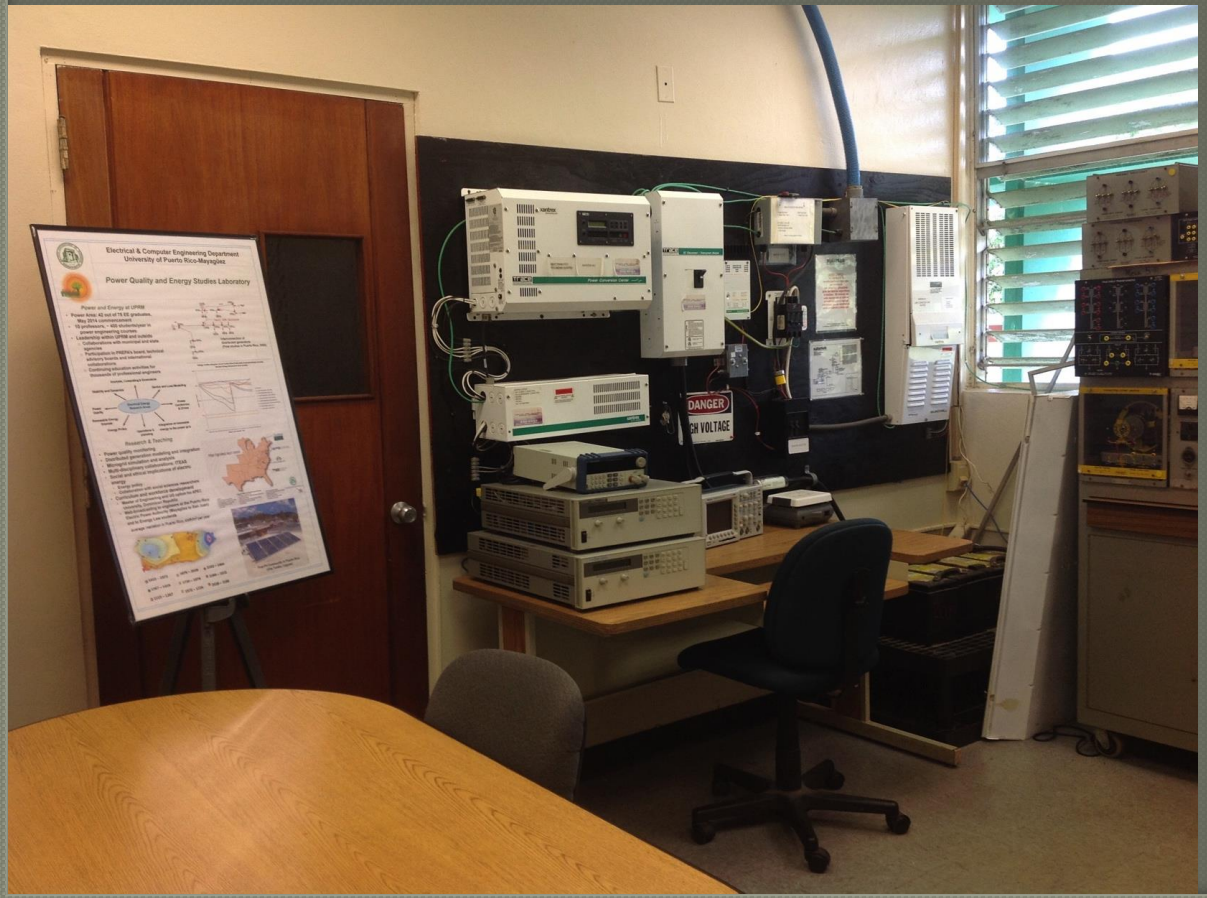
Research Laboratory Facilties

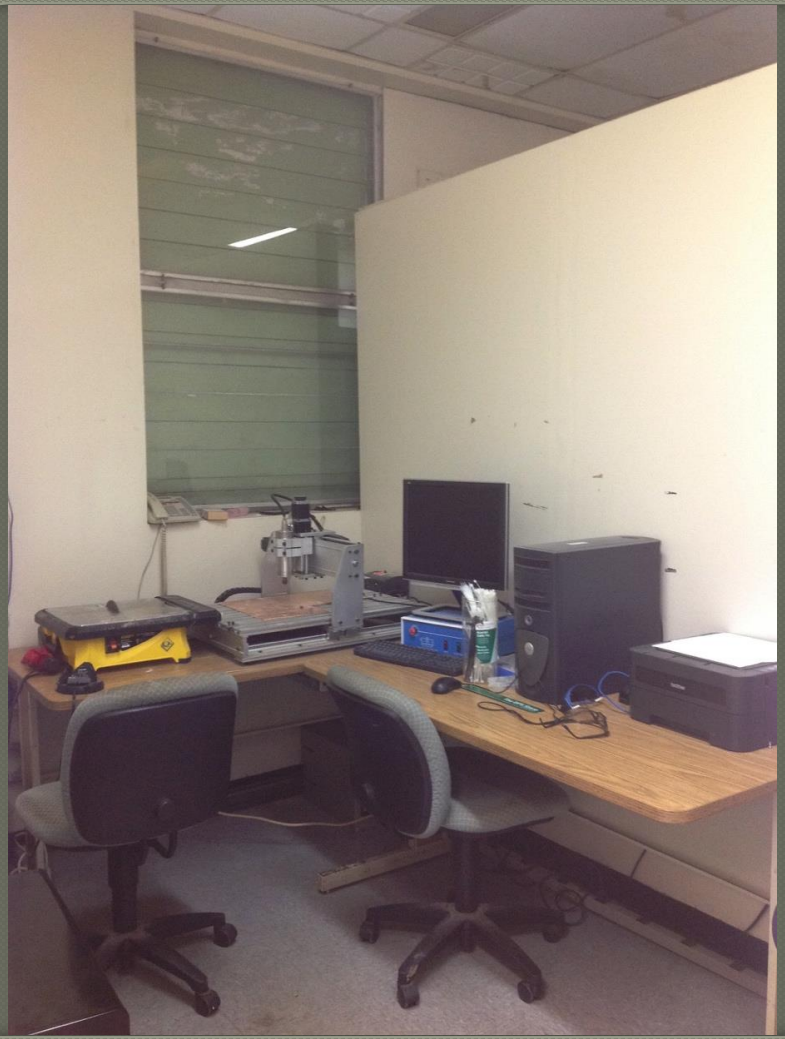
Department of Electrical and Computer Engineering

Energy Systems

Power Quality and Energy Studies Laboratory

- Contact: Dr. Efraín O'Neill Carrillo
- The Power Quality and Energy Studies (PQES) is located in CID F-218/220 and has experimental facilities dedicated to energy research. This laboratory will be electrically connected to the Microgrid Research Laboratory to allow energy researchers to use both laboratories and share resources. The laboratories have a combined area of about 1,000 sq. ft.
  - Computer-based testbench for implementation of control and identification algorithms for drive systems. The system is based on the rapid prototyping system for control algorithms using Dspace board. It is designed for fractional horsepower motors and include, in addition to the Dspace system, instrumentation for voltages and currents, power electronics, and a Magtrol Dynamometer.
  - Computer-based test bed for the validation of electrothermal models for power electronic modules. It consists of a LabWindows/CVI from National Instruments DAC system in conjunction with several Keithley digital multimeters connected using the GPIB protocol. Instrumentation collects voltage and current as well as thermocouple measurements.
- Supports courses: INEL 6096 Power Quality, INEL 6085 Power Electronics, INEL 6058 High Frequency Converters, INEL 6025 Alternate Energy Conversion, INEL 6995 Regulatory Issues in EE, INEL 6066 Drives.


Electrical & Computer Engineering Department
University of Puerto Rico-Mayagüez
Power Quality and Energy Studies Laboratory
DANGER



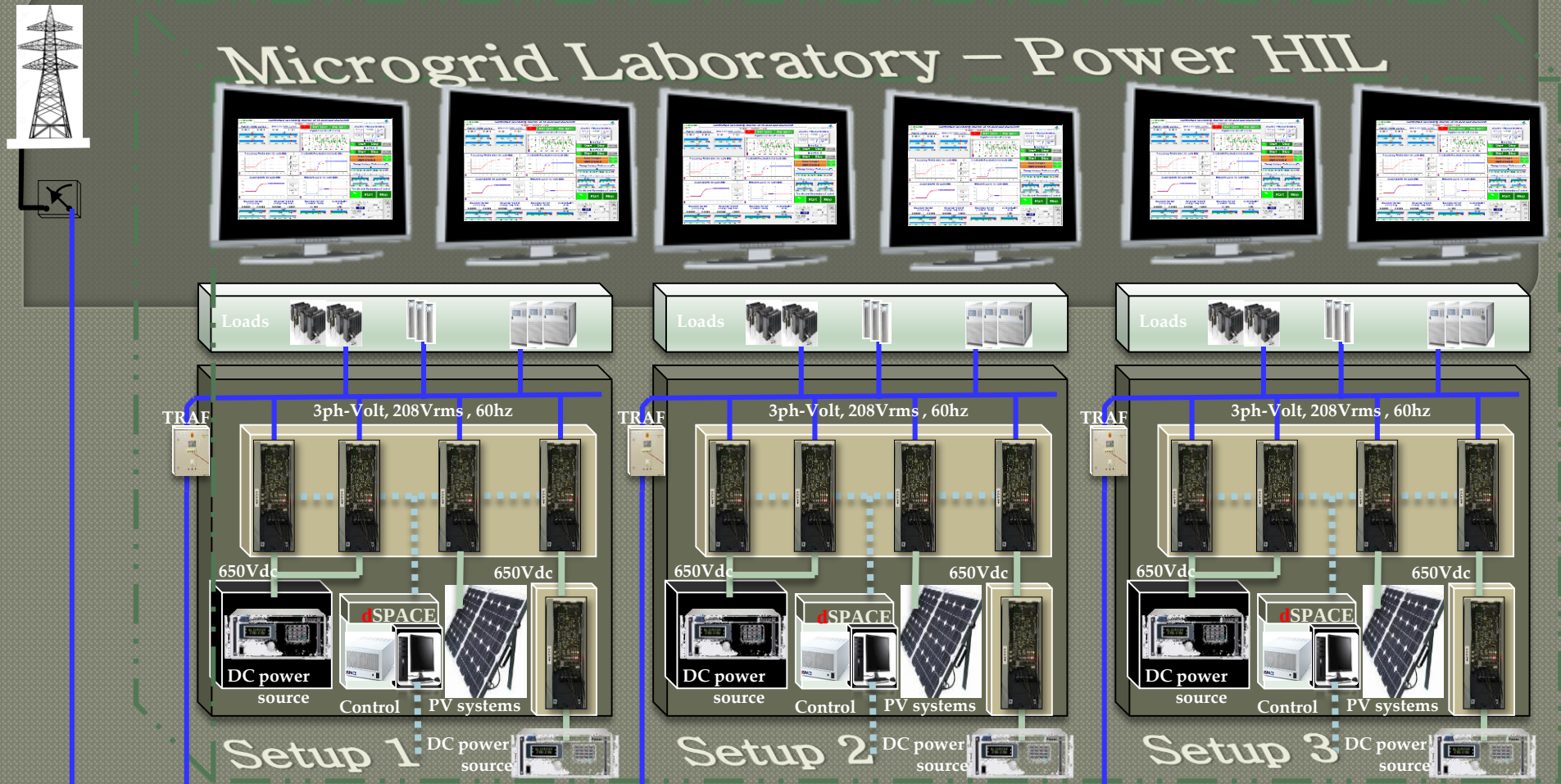
PQES Instrumentation

- Magtrol HD-705-6 Dynamometer (max. torque 50 lb-in., 1.4 kW max - 5 min)
- Magtrol HD-815-6N Dynamometer
- Brushless DC 1 hp motor (APIGettys)
- 5 hp Brushless DC and induction motors with controllers
- Several fractional horsepower three-phase induction and brushless motors
- Circuit Boards for controller implementation: Analog Devices ADSP 2102, ADMC200-EVAL; DSPACE DS1102 DSP Controller Board.
- HP function generators
- Power supplies from fraction volts to 500 Vdc
- Color thermal imager
- DSPACE DS1102 DSP Controller Board (TI C31)
- Motor Control Cards (e.g., dSpace ACE1103, CP1103),
- General measurement equipment available: Digital scope - HP 54602B, 150 MHz High voltage and high current probes HP table multimeters Tektronic THS 720P portable scope QUADTech 2200 Transformer Test System
- Schaffner voltage surge generator (Schaffner NSG 2050, PNW 2050-2225, CDN 133/153) for generation of transient disturbances,
- 3 Siemens M75 photovoltaic modules
- Fluke 43 Power Quality Analyzers (3).
- Two photovoltaic systems with a combined energy output of 1 kW. Systems include BP Solar panels, AC Delco Lead-Acid Sealed Deep Cycle Batteries of 115 Ah @ 12 volts (4 pieces), Trace SW 2512 True-Sine Wave Inverter, 2500 W, 12 volts DC, 120 VAC 60Hz, GC-1000 Intertie True-Sine Wave Inverter, 1000W, 48 volts DC, 120 VAC 60Hz, Trace Charge Controller Regulator Model C40 for 12, 24, and 48 VDC.

Microgrid Research Laboratory

- Dr. Fabio Andrade
- The Microgrid Laboratory is located in CID F-222 and consists of two inverter-based generators, which can simulate different microgrid configurations. The system includes 1×dSPACE ds1103, 2×2.2kW DANFOSS DC/AC inverters (FC302) and some electronic boards. To generate the DC link that supplies each DC/AC inverter the laboratory has a 1×5kW AC/DC power electronics system. The Laboratory can offer several experimental R&D platforms integrated in a single operational system, such as: renewable energy sources, power electronics control and protection, energy load and end-use appliances, and agent-based energy management systems.
- An extension of the laboratory is being considered this year by means of private project between UPRM and Ahkeo Holdings, LLC. The extension is composed of three microgrid setups, six electronic DC power sources, loads, a PV array at the roof of the building and three computers. The setup consists of four inverter-based generators, which can simulate different microgrid configurations.

Microgrid Laboratory – Power HIL



PWM (Electric pulses to optical pulses)

B

FC300 VLT controller

C

FC300 VLT converter 2.2kW

A

Inner and outer control loop and PWM generator

E

Current-voltage sense board

Microgrid Lab Expansion

- 1×dSPACE system, which includes: 1 CPU board (ACE2006), an expansion box (PX10), two 16-channels A/D board (DS2004) and two connections (CP2004), 2 digital I/O box (DS4003), its output board (DS5101_2) and its connector (CP5101), the box of the whole system (CPdesk), and the digital bus cable (PHS_CAB)
- 1×isolation 10kVA transformer for grid connection
- 6×2.2kW DANFOSS DC/AC inverters (FC302)
- 1×Data logger
- 1× Power quality instrument
- 2× LED screen
- 2× Computers
- 1× Electric Cabinet

In addition, to generate the DC link that will supply each DC/AC inverter the laboratory will require:

- 1×10kW bidirectional AC/DC power electronics system
- 1×5kW bidirectional AC/DC power electronics system
- 1×10kW PV system at the ceiling of the CID Building

Power Electronics Laboratory

- Contact: Dr. Eduardo Ortiz
- The Power Electronics Laboratory is located in Stefani building, S- 101, includes three workstation with specialized software for power electronics application, and motor control. This laboratory serves the major design experience course in power electronics, demos for the motor control course, and research (both graduate and undergraduate). Students in this laboratory design systems with solar power, and converting from DC to AC and vice versa.

Signals and Systems

Laboratory for Applied Remote Sensing, Imaging and Photonics (LARSIP)

- Contacts: Dr. Luis Jiménez and Dr. Emmanuel Arzuaga
- LARSIP is located in CID F-219/220/221/224 and is a multidisciplinary laboratory dedicated to the research and implementation of Remote Sensing, Hyperspectral Image Processing, Signal and Image Processing and Bio-Optics applications. The laboratory has extensive computing and image processing equipment as well as imaging equipment and portable spectrometers for fieldwork. Its 1506 sq. ft. location is divided in four rooms; two dedicated for student's research.
- http://larsip.uprm.edu


Abstract:
Approach:
Results to date:
References:

LARSIP Equipment

- Workstations
  - (2) Microway computers 12 GB RAM, Multi-Core CPU @ 2.27GHz, (2) Dell Precision T7500 computers 12 GB RAM, Multi-Core CPU @ 2.67GHz and (2) 24 GB RAM, Multi-Core CPU @ 2.27GHz, (1) Dell Presicion T7400 8 GB RAM, Multi-Core CPU @ 3.00GHz, (9) Dell Precision 690 from 8-16 GB RAM, Multi-Core CPU @ 2.00GHz, (5) Dell OptiPlex GX620 2GB RAM, Multi-Core CPU @ 3.20GHz and (2) Dell Precision 380 2GB RAM, Multi-Core CPU @ 3.20GHz (2) and (4) workstations with 16GB RAM, Multi-Core AMD A10-Series APU @ 3.7GHz.
- Servers
  - (3) Dell PowerEdge R300 24 GB RAM, Multi-Core CPU @ 2.33GHz, (1) Dell PowerEdge R310 16 GB RAM, Multi-Core CPU @ 2.93GHz, (1) Dell PowerEdge 2950 2GB RAM, Multi-Core CPU @ 3GHz and (1) Dell PowerEdge 2850 2GB RAM, Multi-Core CPU @ 3.20GHz.
- Imaging equipment
  - SOC-700 Hyperspectral Imager from Surface Optics Inc. (a VIS hyperspectral imager in the 400 to 800 nm spectral range)
  - Sherlock FE Camera from Pacific Advanced Technologies (a MWIR hyperspectral imager in the 3 to 5 μm range)
  - MikroScan 7515 LWIR camera (broadband thermal camera in the 8.0 to 14.0 μm spectral range).
- Spectrometer instruments
  - Spectravista Corporation GER 1500 VIS (measures 512 spectral bands in the range from 350 to 1050 nm, with a nominal bandwidth of 1.5 nm and automated dark current correction)
  - Spectravista Corporation HR-1024 (portable field spectrometer that measures 1024 spectral bands in the 350-2500 nm spectral range)

Biomedical Instrumentation Laboratory

- This laboratory occupies approximately 300 sq ft and is located in the Stefani Building Room S-214.
- The laboratory supports the courses
  - INEL 5208 Principles of Biomedical Engineering
  - INEL 6997 Biomedical Acoustics

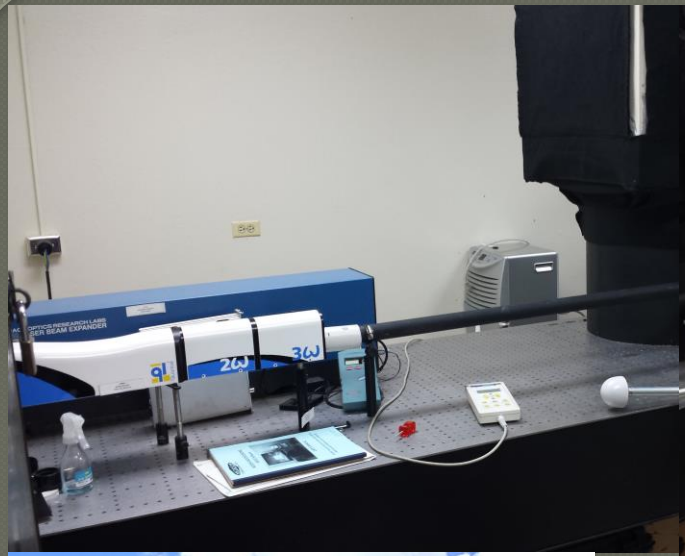

rank 3
NAVIGATOR

Biomedical Laboratory Instrumentation

- The laboratory is equipped with personal computers and data acquisition systems, electrical measurement equipment (oscilloscopes, signal generators, etc.), electronic components and tools for building custom devices and prototypes. Specialized amplifiers and acoustic transducers, as well as surgical instruments, are also available.

LIDAR Laboratory for Atmospheric Research

- Contact: Dr. Hamed Parsiani
- The laboratory is used for atmospheric characterization using multiple, in situ, remote sensing equipment. The atmospheric data via two lidars, AERONET, pyranometer, and radiosonde are obtained and saved in a website for international scientific access. The fundamental atmospheric data is used to obtain higher level products to be used toward regional atmospheric models for weather analysis/prediction.
- Specialized areas: Remote sensing, Optical signal processing, laser/telescope
- http://ece.uprm.edu/noaa-crest/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Lidar Laboratory Instrumentation

- Three Wavelength LIDAR (atmospheric profile of aerosol backscatter at multiple wavelengths, at 7.5m resolution)
  - Brilliant B laser of 14 Watts at 20Hz with 3 wavelengths: 355nm, 532nm, and 1064nm.
  - 20 inch telescope
- Ceilometer – measures aerosol backscatter, all weather Lidar, single wavelength (910 nm) at 10 m resolution
- AERONET (CIMEL310 Solar Radiometer) with 8 wavelengths
- Three pyranometers on the roof, measure solar radiation in a wide band range from 300nm to 1100nm.

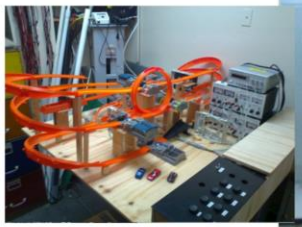
Communications and Signal Processing Laboratory

- Contact: Dr. Shawn Hunt
- The Communication and Signal Processing Laboratory has 14 workstations. Each station has a Dell Precision T3400 with external DSP boards, and peripheral instrumentation equipment. The lab also has four 2.3GHz Spectrum Analyzers. The laboratory software consists of Matlab, Texas Instruments Assembly and Floating Point tools including Code Composer, Microsoft Office, and Microsoft Visual C++.

Robotics and Automation Laboratory

- Contact: Dr. Raúl E. Torres
- The Robotics Laboratory includes two A225 robots, one Epson Robot, three analog vision systems, and two PLC families (Rockwell and Panasonic) with their supporting software development tools. The Robotics and Automation Laboratory includes two PC used to assist a CRS 5-DOF robotic arm, and one Epson 4-DOF Robot with a PC-Based Controller. There is one machine vision system for advanced projects in robots vision, and a second vision station for projects in the capstone course or in graduate projects. There are also six multi-purpose workstations, each equipped with a Dell Precision 370. These can be setup to program and implement PLC designs, to create simulation of manufacturing processes, and to program microcontrollers for mobile robots applications. Finally, there are two stand-alone LabVolt pneumatic stations for students to practice some theoretical concepts in the area, and 14 virtual pneumatics stations that can be accessed through the web from any part of the campus.


EPSON


PEK



Process Control and Instrumentation Laboratory

- Contact: Dr. Gerson Beauchamp
- The Process Control and Instrumentation Laboratory is used as a workshop to develop and work on term projects for five advanced courses of the EE Program. The laboratory is also used to give control system demonstrations to visiting high school students. The Process Instrumentation and Control Laboratory includes 12 Dell Precision T3400 and 5 Dell Precision 390. All workstations include data acquisition equipment and software either from National Instruments, MATLAB or Quanser Consulting. It includes demonstrative control equipment such as inverted pendulum, fluid level control, magnetic levitation, vibration control, and others for simple projects to supplement four courses in the automatic control area.

Electronics

Electronic Testing and Characterization Laboratory

- Contacts: Dr. Manuel Jiménez, Dr. Rogelio Palomera, Dr. Gladys Ducoudray, Dr. Guillermo Serrano
- The Electronics Testing & Characterization Laboratory is located in Room 114B of the Stefani building in the University of Puerto Rico. The facility provides 270 sq. ft. devoted to the task of designing and integration of test hardware and automation software. The lab was established in the summer of 2009 and was completed in the spring semester of 2010 with the major sponsorship of Texas Instruments (TI) and other contributors like Keithley Instruments. It currently provides 5 different workspaces for students working on projects in the area of Electronics Testing and Automation Design among others. The facility is equipped with a Probe Station for performing on wafer measurements, an oven for testing across different temperature ranges, two Keithley 2612 source measurement units, power supplies, pulse/pattern generator, a 600MHz LeCroy Wavesurfer and a digital multimeter; all of which are fully programmable. Following the UPRM-TI Collaborative Program, the ETC lab was created in order to complement the Integrated Circuit Design Laboratory (ICDL) with a laboratory specifically dedicated to testing. With this addition the ECE Department is closer to fully encompass the major fields involved in the area of Semiconductor Manufacturing. The main goal of the ETC lab is to help prepare students in the area of Electronics Testing & Automation Design by helping them acquire the knowledge and skills they will need to be successful in this field.
- http://www.ece.uprm.edu/~etclab


Automated R_{DSon} Characterization for Power MOSFETS
6th Latin American Symposium on Circuits and Systems LASCAS 2015

ETC Instrumentation

- Agilent 81104A : Pattern Generator
- Agilent E3634A : Power Supply
- Agilent 34401A : Digital Multimeter
- Agilent 89410A : Vector Signal Analyzer
- Hewlett Packard 54720D : Oscilloscope
- Keithley 2612 : Dual Channel SMU
- LeCroy WaveSurfer 64XS : Oscilloscope
- TestEquity Half Cube : Temperature Chamber
- Micromanipulator : Probe Station

Rapid System Prototyping Laboratory (RASP)

- Contacts: Dr. Manuel Jiménez, Dr. Rogelio Palomera, Dr. Gladys Ducoudray, Dr. Guillermo Serrano
- The main mission of the RASP Laboratory is to enable graduate students acquire the necessary training, skills, expertise, and capabilities to conduct academic and industrial research work in the field of rapid prototyping digital and mixed-signal electronic systems.

RASP Equipment

- 8 x Work-stations with desktop computers and wired high speed internet.
- 1 x Hewlett Packard 34420A Nano Volt / Micro Ohm Meter.
- 1 x Agilent 34401A Multimeter.
- 1 x Agilent 53131A 225Mhz Universal Counter.
- 2 x Agilent 33120A 15Mhz Function / Arbitrary Waveform Generator.
- 1 x Agilent E3631A Triple Output DC Power Supply.
- 1 x Hewlett Packard 54645A Oscilloscope.
- 1 x Agilent 54622D Mixed Signal Oscilloscope.
- 1 x NEC VT695 Video Beam Projector.
- 20 x Miscellaneous evaluation modules of Texas Instruments to develop applications based in microcontrollers.

Integrated Circuit Design Laboratory (ICDL)

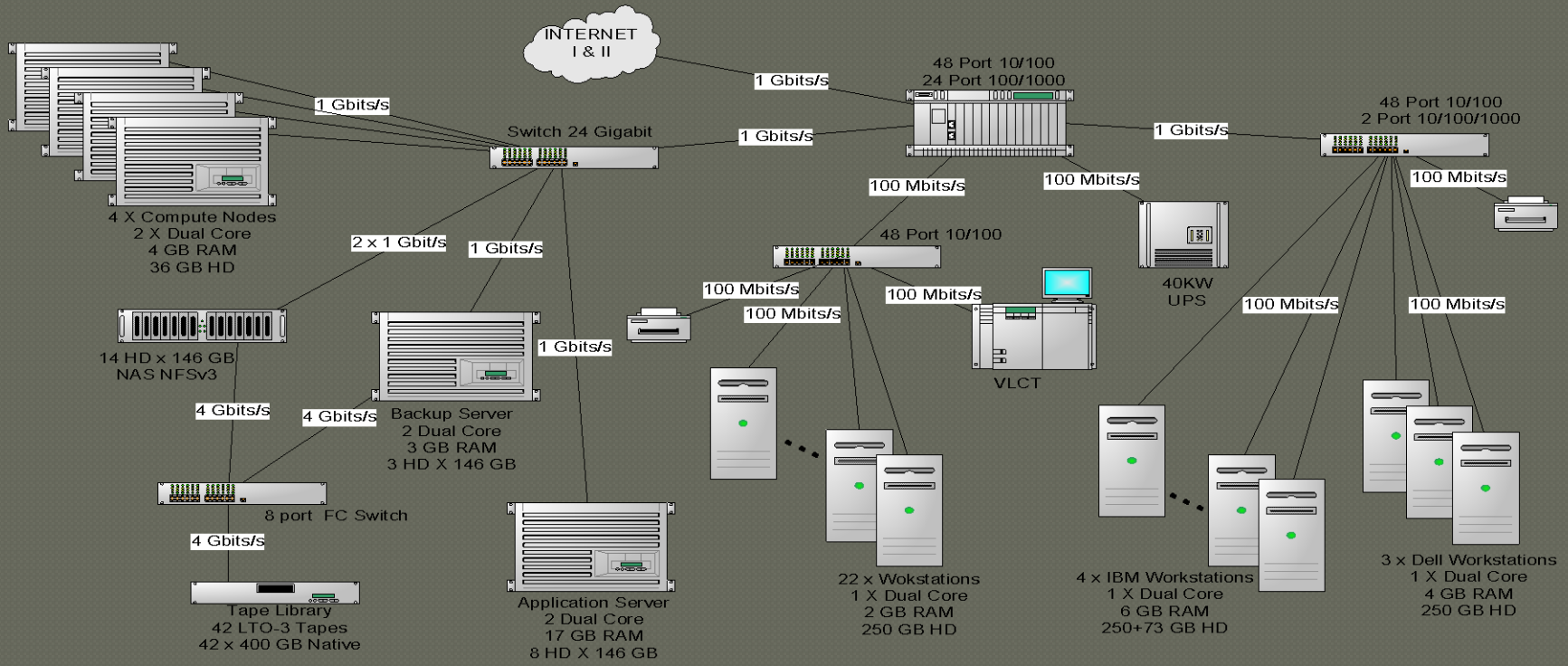
- Contacts: Dr. Manuel Jiménez, Dr. Rogelio Palomera, Dr. Gladys Ducoudray, Dr. Guillermo Serrano
- The Integrated Circuits Design Laboratory (ICDL) is located in Room 210B, Stefani Building in the UPRM campus. The facility provides 800sq. ft. devoted to the tasks of designing and testing analog, digital, and mixed-signal integrated circuits and systems. The facility was established in 1999 with the sponsorship of Texas Instruments (TI) under the UPRM-TI Collaborative Program. It provides 16 design workstations running industry-grade software tools for the design entry and design validation in bipolar and MOS technologies. In addition the lab provides four testing stations with state-of-the- art test and measurement tools used by senior and graduate students, in advanced and graduate course projects in electronics as well as graduate research students for their projects.
- http://ece.uprm.edu/icdl/Page/


1,500

ICDL Equipment

- Agilent 34401A 6½ Digits Multimeter
- Agilent E3634A DC Power Supply
- Dual Output DC Power Supply
- Agilent 54622D Mixed-Signal Oscilloscope
- PCB Router Quick Circuit 5000
- Agilent 6063B System DC Electronic Load
- Agilent E3631A Triple Output DC Power Supply
- Agilent53131AUniversal Counter 225 MHz
- Agilent 33120A Waveform Generator
- Xilinx Spartan-3 XC3S200-FT256 FPGA
- Windows workstations

Electronics Area Laboratories Computing Infrastructure



Development Tools

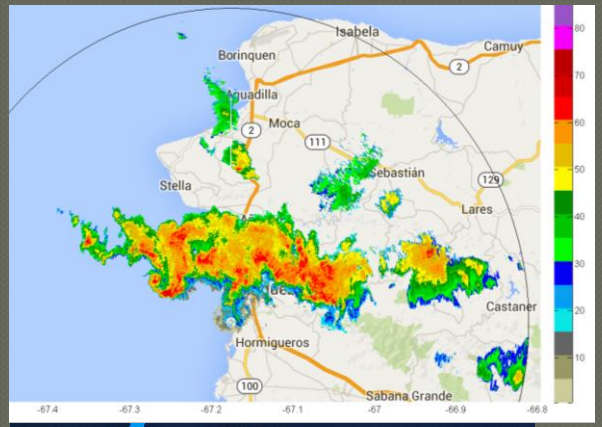
- Cadence University Program
  - Tools Analog, Digital, & Mixed-signal Design
- Mentor Graphics University Program
  - System Design & Modeling Tools
- Texas Instruments University Partner
  - DSP Hardware/Software Development Tools
- Hardware Prototyping Tools
  - Xilinx and Altera University Program Members
  - MOSIS and EUROCAD
- Mathematical Modeling and Prototyping
  - Matlab/Simulink, LabVIEW, ComSol, Altium

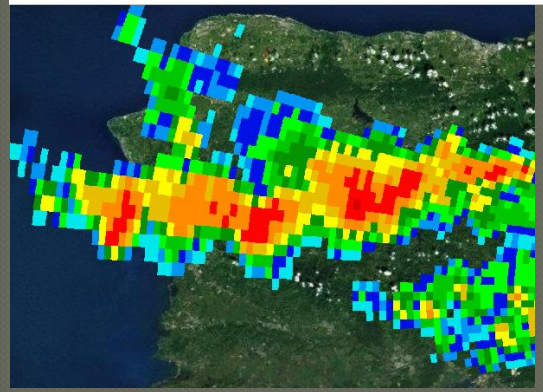
RF Systems and Microwave Remote Sensing

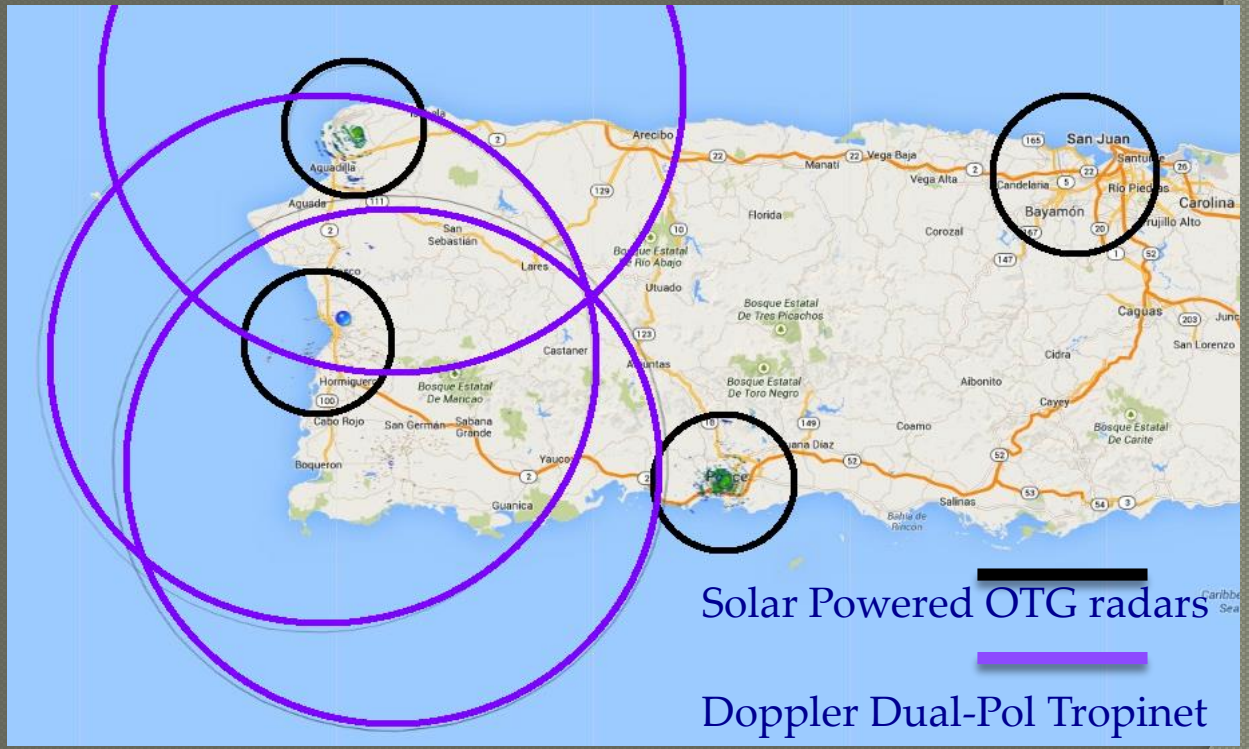
PR Weather Radar Network

- Contacts: Dr. José Colom, Dr. Sandra Cruz Pol, Dr. Rafael A. Rodríguez Solís, Dr. Leyda León
- The PRWRN has offices in CID F-211, and comprises three off-campus locations in Monte Cornelia (Cabo Rojo), Estación Experimental Agrícola de Lajas, and Estación Experimental Agrícola de Isabela. At each of these three locations a X-band, dual-polarized, Doppler weather radar provide coverage to Western Puerto Rico. The radars are used in atmospheric and meteorological research. The PRWRN collaborates with the National Weather Service office in San Juan.

Establishment of Dense Weather Radar Network







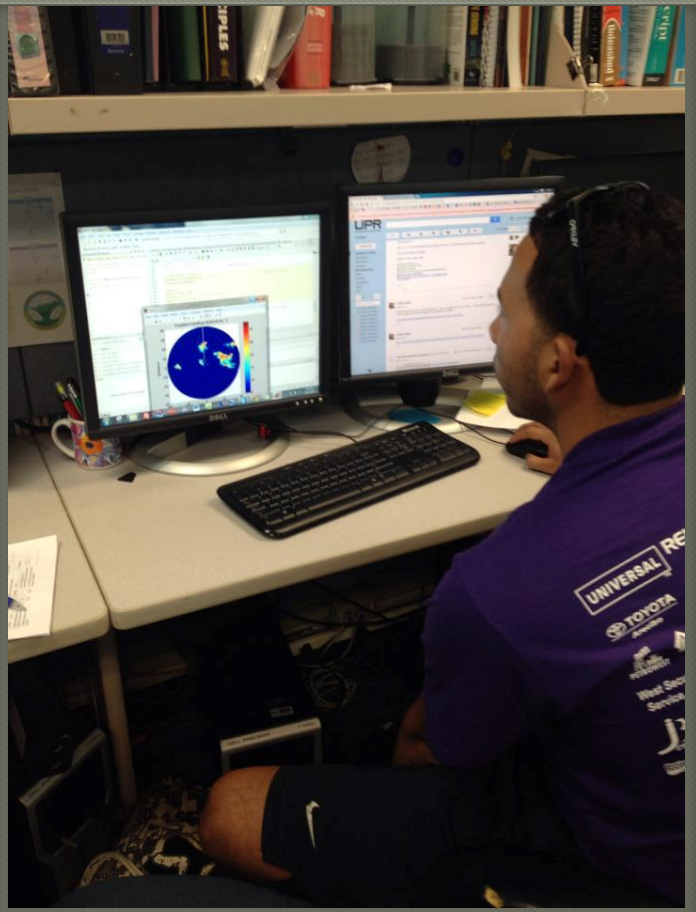
Radar Nodes

- **OTG Radar**
  - **X-band**
  - ***Single Polarized***
  - 3.8 deg beamwidth
  - 20 km range (150 m cross-range resolution)
  - Solar powered

- **TropiNet Radar**
  - **X-band**
  - ***Dual Polarized***
  - 1.4 deg beamwidth
  - 40 km range (150 m cross-range resolution)
  - Doppler

Cloud Microwave Measurements of Atmospheric Events (CliMMAtE)

- Contacts: Dr. Sandra Cruz Pol and Dr. Leyda León
- The Laboratory for CLiMMATE is located in Stefani Builing, S-201, and works with the development and calibration of atmospheric and cloud models using data from radar and radiometer measurements. It is currently working with models of atmospheric attenuation and precipitation measurements. Our work includes the development of algorithms for the calibration of the atmospheric models to better retrieve the physical and radiative characteristics of the atmosphere. This includes water vapor content, vertical air motion, turbulence, liquid water content, and raindrop distribution for clouds and/or precipitation. We also look at the atmospheric attenuation suffered by the radar signal as it travels through the clear atmosphere due to precipitation, water vapor and oxygen gases. This attenuation varies, among other factors, with frequency, radar scanning angle, air temperature and pressure.
- We currently employ data collected with CASA Off-the-Grid Single Polarized X-band Radars, TropiNet Dual-Polarized Doppler X-band radars, Parsivel Disdrometers, and NWS radiosondes.


UNIVERSAL
TOYOTA

CliMMAtE Equipment

- 6 computer workstations
- 1 workstation with two monitors for weather surveillance
- 4 Parsivel Disdrometers

Microwave and Millimeter-wave Antennas and Remote Sensing Systems Laboratory (MAReS)

- Contact: Rafael A. Rodríguez Solís
- The Microwave and Millimeter-wave Systems Laboratory is located in Stefani Building, S-120/120A, and is a design, characterization and testing facility for RF, microwave and millimeter-wave circuits and antennas. It has microwave instrumentation operating up to 67 GHz, including a spherical near-field antenna measurement systems operating up to 40 GHz. The laboratory has computer workstations with access to commercial electromagnetic design software, including Keysight Advanced Design System, Ansys Electronics Testbench, and Remcom XFDTD. A LPKF milling machine is used to produce antennas and circuits prototypes, that are tested with the network analyzers, power meters, and spectrum analyzers in the laboratory.

MMWS Laboratory Instrumentation

- Agilent N5227A PNA Network Analyzer 10 MHz – 67 GHz
- Agilent E5071 ENA Series Network Analyzer 10kHz – 4.5 GHz
- Agilent 8565EC Spectrum Analyzer 30 Hz – 50 GHz
- Agilent 4395A Network/Spectrum/Analyzer 10 Hz – 500 MHz
- Agilent E4418B EPM-Series Power Meter
  - Power sensors for testing up to 50 GHz
- Agilent 8719ES S-Parameters Network Analyzer 50MHz-13.5GHz
- Agilent 53150A Power Meter/Frequency Counter 20 GHz
- 500 MHz Oscilloscope
- Windows workstations
- Agilent 8530A Microwave Receiver/8510C Vector Network Analyzer 10 MHz – 50 GHz
- Agilent Synthesized Sweeper 83651B 10 MHz – 50 GHz
- Agilent LO/ IF Distribution Unit 85309A 300 MHz – 18 GHz
- NSI Spherical Near-field Antenna Measurement System 2-40 GHz, in 12'x16' anechoic chamber.
- LPKF Laser & Electronics H-100 Milling Machine
- Probe station for on-wafer testing
  - Cascade Microtech probes for testing up to 67 GHz

RF Systems Laboratory

- Contact: Rafael A. Rodríguez Solís
- The RF Systems Laboratory is located in Stefani Building, S-202, and is used for undergraduate research, the Capstone Design course, and supports graduate research and courses. It has microwave instrumentation up to 6.7 GHz and computer workstations with access to commercial electromagnetic design software, including Keysight Advanced Design System and Ansys Electronics Testbench.

RF Systems Laboratory Instrumentation

- Agilent E5062A ENA Series Network Analyzer 300 kHz- 3 GHz
- Agilent 33220A Function/Arbitrary Waveform Generator 20 MHz
- Agilent E4418B EPM Series Power Meter
- Agilent E4419B EPM Series Power Meter
  - Power sensors for testing up to 50 GHz
- Agilent E4402B ESA-E Series Spectrum Analyzer 9 kHz-3 GHz.
- Agilent E4428C ESG Analog Signal Generator 250 kHz- 3 GHz
- Agilent 8648C Signal Generator 9 kHz-3200 MHz (2 of them)
- Agilent E4404B ESA-E Series Spectrum Analyzer 9 kHz - 6.7 GHz
- Agilent E4433B ESG-D Series Signal Generator 250 kHz- 4 GHz
- Agilent N9310A RF Signal Generator 9 kHz- 3 GHz
- Agilent 33120A Function/Arbitrary Waveform Generator 15 MHz
- Agilent 8714ET RF Network Analyzer 300 kHz- 3 GHz
- HP 5347A Counter/Power Meter 10 Hz- 20 GHz
- HP 8712ET RF Network Analyzer 300 kHz-1300 MHz