Undergraduate Research at the UPRM ECE Department

A Short Historical Personal Perspective

Miguel Velez-Reyes
January 8, 2009
Outline

• Background
• History
• Some Examples
• Final Remarks
ECE Timeline

1928
BSEE

‘60
EE ABET

‘67
MSEE

‘80
CpE

‘94 ‘95
CpE ABET
MSCpE

2001
PhD CISE

2009
PhD EE
ECE Faculty

- 60 Faculty members
  - 34 Professors
  - 11 Associate Professors
  - 12 Assistant Professors
  - 3 Instructors

- 54 members of the faculty have a PhD
  - 39 professors involved in the graduate program and research
ECE Research

- Approximately $4-5M/year in sponsored research (ECE accounts for 4.2% of faculty members at UPRM and generates 24% of external funds)
- Among the top 2 departments in external funding.
  - NSF
  - NASA
  - DoD
  - DoE
  - PR Government
  - Industry
Location of ECE Research Laboratories

R&D Center
- LARSIP
- EEPSyL
- ICIS
- IRISE
- Power Quality
- PDC
- ADM
- AIP

Stefani Bldg
- Climmate
- Radiation
- ICDL
- HPC
- Biomedical
- RaSP
- CRL
Examples of Industry and Government Sponsors and Collaborators

Texas Instruments

hp

NOAA

NASA

National Oceanic and Atmospheric Administration

U.S. Department of Commerce

NGSA

Air Force Research Laboratory

ARL

Lockheed Martin

NIST

NSF

CCRI

ITT

Engineered for life
Graduate Programs @ ECE

• Electrical Engineering: MSEE & MEEE (Ph.D. in 2009)
• Computer Engineering: MSCpE & MECpE
• Computing and Information Sciences and Engineering: Ph.D. (joint with Mathematics Department)
  – administered outside ECE: Program director Dr. Néstor Rodríguez
UG Research a Key Component of our Research Programs

• Just in the numbers
  – ~1,300 undergraduate students
  – ~140 graduate students
  – $3-4M/yr in research

• Many benefits
  – Best students
  – Pipeline
  – Enhance our students educational experience
Before 1990

• Limited research infrastructure.
• Limited research funding
• Small graduate program
  – only MS in EE (est. in 1967)
• Development of critical mass of research oriented faculty
  – Ramon Vásquez, Domingo Rodriguez, Rogelio Palomera, Tom Noack, K. Venkatesan, B. Ray and others
Key Enablers

• Industrial Affiliates Program (IAP) 1988

• NSF CISE Research Infrastructure Seed Funding, 1988
  – Development of a Five Year Plan for the Enhancement of the Computer Engineering Program at UPRM, Ramon Vasquez, PI

• Laboratory for Applied Remote Sensing and Image Processing established in 1989
  – UPRM Puerto Rico Center of Excellence in Tropical and Caribbean Research sponsored by NSF MRCE, 1988
1990-2000

• CISE Research Infrastructure → CECOND
  – Enhancement of the Computer Engineering Academic and Research Program at UPRM, Ramon Vasquez, PI

• Establishment in 1994 of the Tropical Center for Earth and Space Studies
  – NASA University Research Centers Program

• The ERC era begins
  – CPES - 1998
2000-Current

• Two new ERCs
  – CenSSIS, 2000
  – CASA, 2003
• DHS CoE (2008)
  – CIMES, ALERT
• CISE Research Infrastructure
  – MII: A Program for Research in Computing and Information Sciences and Engineering (PRECISE), Domingo Rodriguez, PI
• Many individual grants and other types
Two Examples: IAP & TCESS
Welcome to the Industrial Affiliates Program (IAP) Home Page. IAP is an Industry sponsored undergraduate research program at the Universidad de Puerto Rico Mayaguez. The program is administered at the Department of Electrical & Computer Engineering. Professors and students from all departments in the Engineering School are invited to participate in the program.

Throughout these pages you will find more detailed information on IAP, sponsor companies, student projects, important dates, IAP's staff and other related information about our program. Industrial Affiliates Program (IAP) is an organization that is geared toward enriching and enhancing the educational experience of interested undergraduate students. IAP offers creative technical experience the educational experience to complement the University's strong Electrical and Computer Engineering curriculum.

IAP is a Unique Educational Experience

- **Smart move for a student**
  - Acquire knowledge, skills, and expertise not possible through the traditional classroom
  - Undergraduate Research and Development
  - State of the art technologies

- **Highly attractive for employers**
  - Enhanced Interview Process
  - Poster, Project Supervision, Oral Presentation, Lab Visit, Interview

- **Promote joint projects between ECE faculty and IAP companies**

- **Link Industry, ECE students, and Faculty**

IAP Impact

During the years IAP sponsored projects have evolved

- **TI, UPRM-TI Collaborative Program**
  - 10 years of Research collaboration
  - ICDL design infrastructure renovation

- **IBM, Shared University Research Program**
  - Electronics/computational infrastructure for complex automation circuits design
IAP Objectives

- Unique educational experience for students
- Acquire knowledge, skills, and expertise not possible through the traditional classroom
  - State of the art technologies
- Highly attractive for employment
- Link Industry, ECE students, and Faculty
- Enhance ECE Department Infrastructure
Participation in IAP

- Students
- Companies
- Professors

- 92-93: 20 Students, 10 Companies, 5 Professors
- 93-94: 30 Students, 20 Companies, 10 Professors
- 94-95: 40 Students, 30 Companies, 15 Professors
- 95-96: 50 Students, 40 Companies, 20 Professors
- 96-97: 60 Students, 50 Companies, 25 Professors
- 97-98: 70 Students, 60 Companies, 30 Professors
- 98-99: 80 Students, 70 Companies, 35 Professors
- 00-01: 90 Students, 80 Companies, 40 Professors
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>IAP is born</td>
<td>6 projects, 15 students, 8 professors, 3 companies (Kodak, Bellcore, Raytheon)</td>
</tr>
<tr>
<td>2008</td>
<td>In Summary</td>
<td>15 projects, 48 students, 14 professors, 5 companies</td>
</tr>
</tbody>
</table>

- Over 600 undergraduate students have participated
- Over $600,000 in cash donations
- Over $100,000 in equipment donation for projects
The Industrial Affiliates Program at the University of Puerto Rico Mayagüez

Miguel Vélez-Reyes (mvelez@ece.uprm.edu)
Manuel A. Pérez-Quiñones (mperez@ece.uprm.edu)
José Luis Cruz-Rivera (jcruez@ece.uprm.edu)

Electrical and Computer Engineering Department
University of Puerto Rico – Mayagüez
PO Box 9042, Mayagüez, Puerto Rico 00681-9042
Phone (787) 832-4040 ext. 3031 FAX (787) 831-7564

Abstract - The Industrial Affiliates Program (IAP) is an Industry sponsored undergraduate research program at the University of Puerto Rico Mayagüez. The program is currently on its 10th year and has the support of more than 12 companies, many of them internationally recognized companies. IAP is administered by the Department of Electrical & Computer Engineering and has student and professor participation from all departments in the School of Engineering. The program seeks to provide undergraduate students with research experience, to work on problems relevant to industry, and to become organization that is geared towards enriching and enhancing the educational experience of interested undergraduate students. IAP offers a creative technical educational experience to complement the University's strong Engineering curriculum.

The importance of undergraduate research has been widely documented in the engineering education literature [1-11]. IAP differs from many of these programs providing research experiences for undergraduate (REU) students in several respects. Some REU programs take place during the summer months [12-17].
Tropical Center for Earth and Space Studies
A NASA University Research Center

Dr. Miguel Vélez-Reyes
Director
TCESS was a Group 2 NASA URC established in 1995.
- 10 yrs of NASA support
  $10.8M

Prof. Rafael Fernández-Sein was the project director until August 2003.
- Continued his participation in TCESS as director of the Space Information Laboratory until June 2005.

TCESS was the largest NASA project at UPRM.
TCESS: Program

NASA-TRC
Dr. Darrell Williams
GSFC

External Advisory Board

M. Velez-Reyes

Administrative and Technical Staff

Bio-Optical Oceanography
R. Armstrong

Carbon Sequestration
L. Perez-Alegria

Laboratory for Applied Remote Sensing & Image Processing
M. Velez-Reyes

Space Information Laboratory
M. Velez-Reyes

Materials and Electronics for Space Applications
F. Fernandez

Globe Outreach Program
J. Lopez
Student Participation

1st PhD in the UPRM Computer and Information Science and Engineering Program Graduated in 2004!

3 TCESS Female Students now Faculty/Researchers at UPRM
- V. Manian (F)
- Y. Detres (R)
- G.O. Ducoudray (F)
127 Degrees Awarded

- 81 Undergraduate Degrees
- 43 Master Degrees
- 4 Ph.D.
- Infrastructure and student support made UPRM a competitive option for graduate studies
  - 17 continued MS or PhD studies at UPRM
Multidisciplinary Research

Jeannette Arce
Geology

Eladio Rodriguez
Electrical Engineering

Elias Beauchamp
Computer Engineering

Jose Torres
Marine Sciences
Student Follow Up

Student Employment Status after Graduation

- NASA: 2
- Other Govt. Agency: 9
- Academia: 8
- Post Doc: 2
- Industry: 37
- Graduate School: 45
- Self-Employed: 1
- Unknown: 19

Number of Students
Over 20,000 school students and 1000 school teachers
Impact on Attracting Students to UPRM Sci & Eng Programs

Comparison between number of students which entered UPRM to study science from 324 and 90 non-visited and visited school, respectively by SOW.

Comparison between number of students which entered UPRM to study engineering from 324 and 90 non-visited and visited school, respectively by SOW.
Final Remarks

- UG is an important component in our research/education work
- Different models are used by researchers
- Collaboration in developing soft skills
  - Workshops and seminars
- Publications with UG students as authors are important
- Models that facilitate interaction are needed as ECE graduate programs grow
Sample Publications with UG Co-Authors

A Computer-Based System for Validation of Thermal Models for Multichip Power Modules

Zarate, J. Rodriguez, J. A. Henfer, Miguel Velazquez-Reyes, and Dave Berning

"National Institute of Standards and Technology Room B-116, Technology Bldg.
100 Bureau Drive, Stop 8120
Gaithersburg, MD 20899-0120
Tel. (202) 575-2571, FAX (202) 586-4031
E-mail: [henfer, david.berning]@nist.gov

Abstract—This paper presents a computer-based system for experimental validation and calibration of thermal models for multichip power electronic modules. The thermal models under study are based on the thermal component network. The paper describes the basic system features and experimental setup as well as experimental results. Calibration results show good performance for the proposed models.

Self-Reconfigurable Electric Power Distribution System using Multi-Agent Systems

Janeth G. Gómez-Gualdrón, Graduate Student Member, IEEE, Miguel Vélez-Reyes, Senior Member, IEEE, and Luis J. Collazo, Student Member, IEEE

Abstract—Electric power distribution systems (EPDS) can be found almost everywhere, from ship power systems to data centers. In many critical applications, there is need to maintain minimal operating capability under fault conditions. Therefore, it is necessary to develop energy distribution control techniques which allow the implementation of a self-reconfigurable EPDS. This research project focuses on the application of MultiAgent System (MAS) to develop a self-reconfigurable EPDS. MAS are composed of multiple interacting software elements, known as

- A new functional network topology is chosen.
- The EPDS has to be reconfigured.

All these decisions must be made by a self-reconfigurable controller system that incorporates not only simple regulatory loops and supervisory control logic, but also a set of components that detect, isolate, and manage faults, in coordination with the control functions. The goal is to increase survivability, eliminate human mistakes, make intelligent reconfiguration decisions more quickly, reduce the manpower
The Power of Undergraduate Research

Implementing an undergraduate research program to help ensure availability of qualified professionals to face today’s energy challenges

Efraín O’Neill-Carrillo, Miguel Vélez-Reyes, Agustín Irizarry-Rivera, and Eddie Marrero
Questions?

- Suggestions, Advice, ...

mvelez@ece.uprm.edu