University of Puerto Rico at Mayagüez

Electrical and Computer Engineering Department

The TI-UPRM Program:
A Model for Industry-Academia Collaboration

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Outline

- TI-UPRM Program Structure
- The TI-UPRM Research/Co-op Model
- Program Highlights
- Sample Projects
- The IAP
- Contact Info

Undergraduate ECE Program Highlights

- A five year program
  - Comprehensive curriculum: 168+ credit-hours
  - Heavy design component across curriculum
  - Capstone design experience
  - Research opportunities
  - Hands on experience
- Bilingual Program (Spanish /English)
  - All Puerto Rican students are US citizens
- Flexible and up to date curriculum
- Strong faculty-student interaction
  - Mentoring
 - Small class sizes

The TI-UPRM Program

- **Objective:**
  Strengthening the academic and research programs in Electronics

- **Methodology:**
  Creation of an educational model that combines research and Co-op education

- **Outcomes:**
  Full fledged industrial-academic partnership with benefits for all involved parties
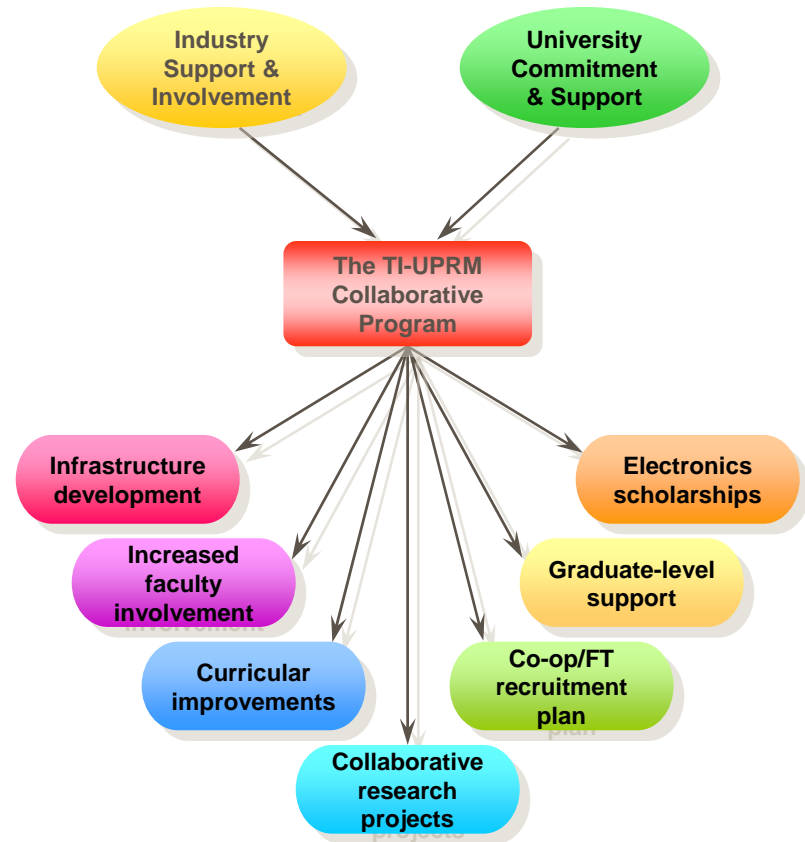
The Research/Co-op Model

- Combines traditional Co-op education with undergraduate and graduate research experiences
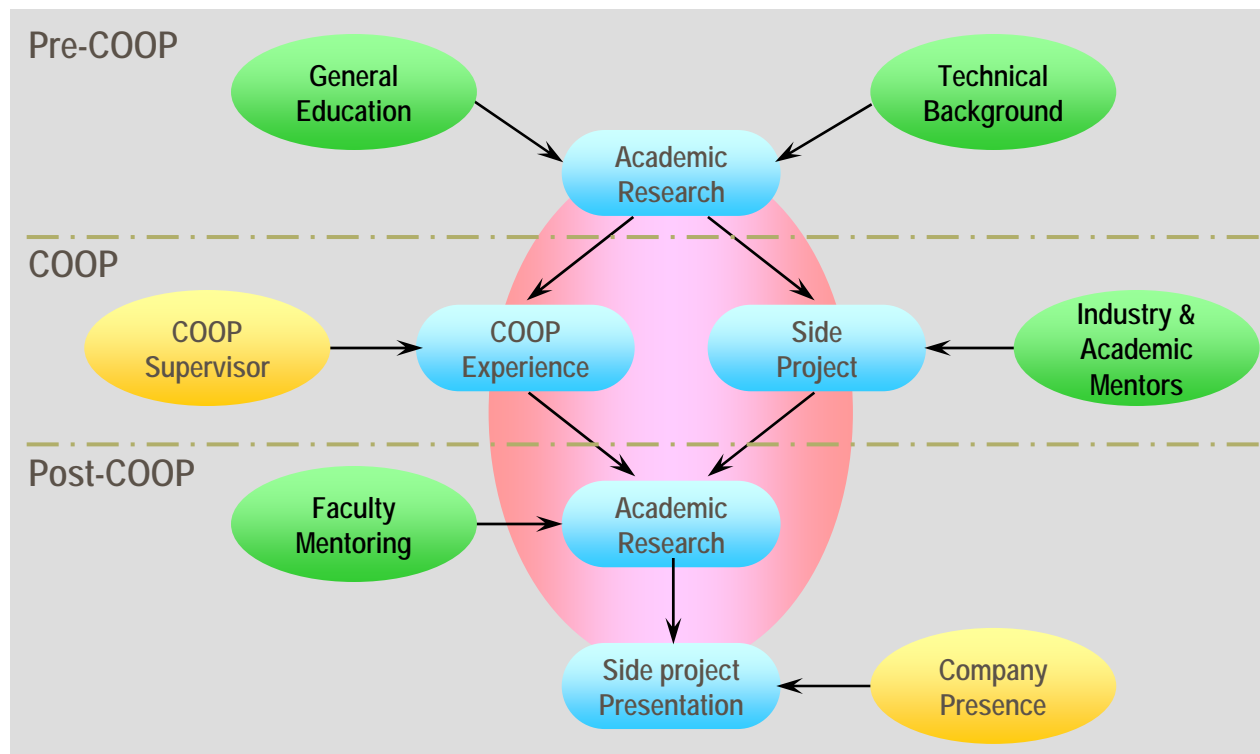
Participant Professors and Collaborators

- Lead
  - Manuel Jiménez
  - Rogelio Palomera
  - Gladys O. Ducoudray
- Collaborators
  - Domingo Rodriguez (DSP)
  - Shawn Hunt (DSP)
  - Nelson Sepulveda (Materials)
  - Nayda Santiago (Computing)
  - Raúl Torres (Control)
  - Jaime Arbona (Electronics)
  - Guillermo Serrano (Electronics)
  - Manuel Toledo (Electronics)

Infrastructure & Program Support

- **Integrated Circuits Design Laboratory (ICDL):**
  - Undergraduate and Graduate Teaching/Research Lab. for Analog and Mixed-signal Systems
- **Electronic Testing and Characterization Lab. (ETC)**
  - Wafer- and IC-level electronic testing and characterization
- **Rapid Systems Prototyping Laboratory (RASP):**
  - Graduate research in system-level hardware implementations
- **Digital Signal Processing Laboratory (DSP-Lab):**
  - Support to DSP Laboratory. Extensive use of TMS320
- **Microprocessor Development Systems Lab. (MDS):**
  - Support through donations for teaching and undergraduate research. Extensive use of MSP430

Academic Outcomes

- **Electronics Courses at UPRM**
    - Seven New Courses Created
    - Five Re-activated & Improved Courses
    - Two supported Courses
- **Twenty Technical Workshops**
    - Testing, VHDL/Verilog, MEMs, etc…
- **28 Professional Advancement Workshops**
    - Focused on soft skills sharpening
- **Six Distinguished Lecturers**

# Some UPRM/TI Program Outcomes

- Over 125 students in twelve years
  - 112 Co-op students (undergrad & grad)
- Over 27 TI patents by program students
- Development of modeling and testing methods now adopted by TI worldwide
- Application Notes used by TI worldwide
- Over 70 refereed papers in last eight years
  - 54 student co-authored publications
  - Thirty-one master theses

Samples of Research Outcomes

- Behavioral Macromodels for Sigma-Delta Modulators in Oversampled Data Converters (TI Wireless)
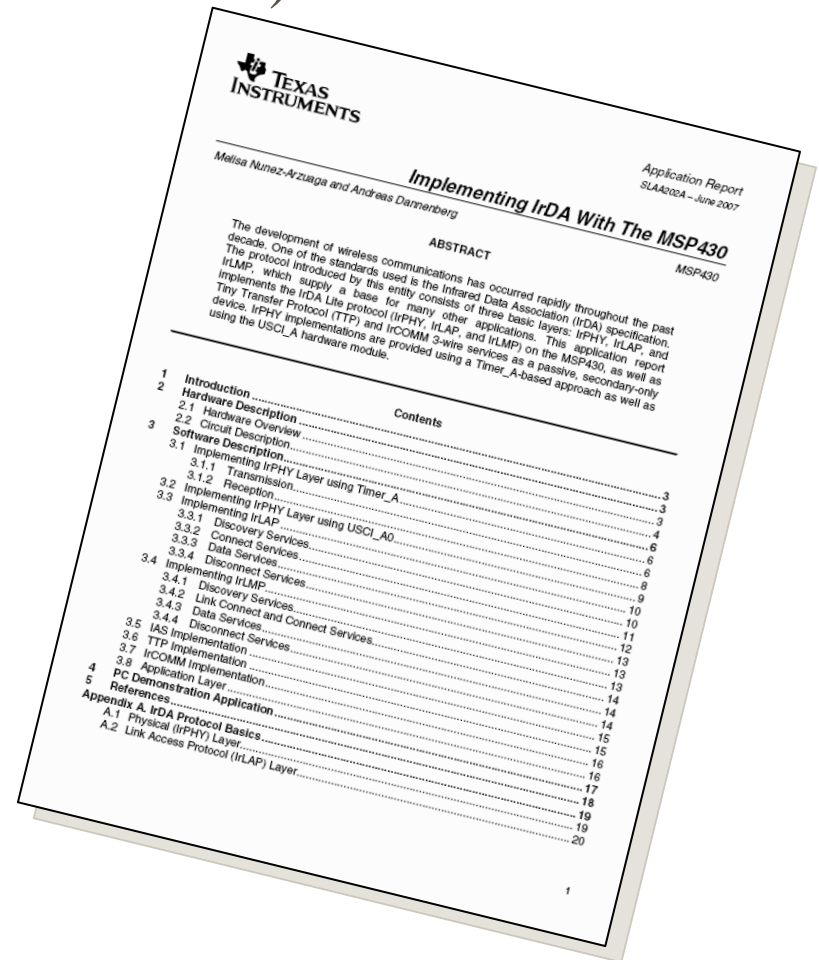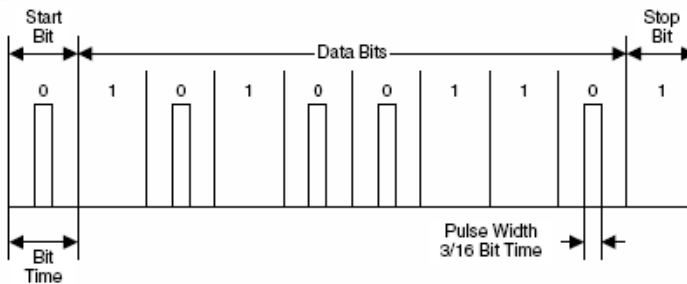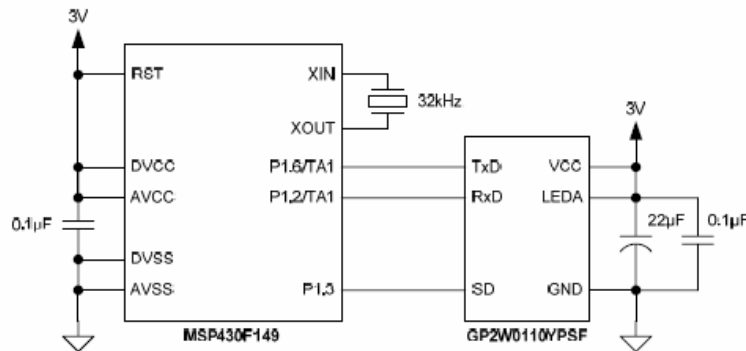

Thermal noise

Jitter noise

Op-amp noise

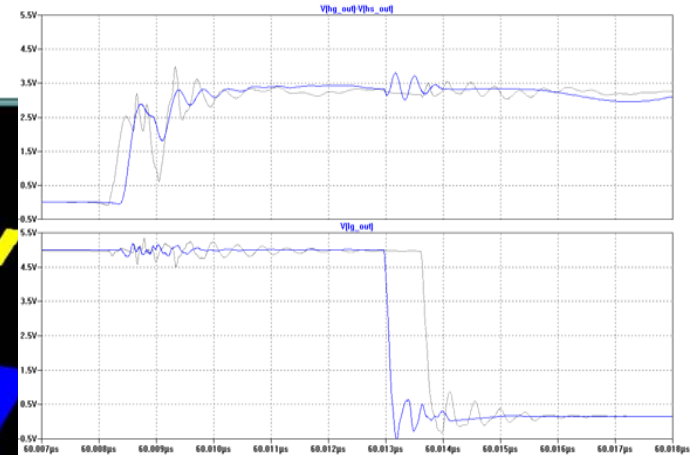Thermal noise
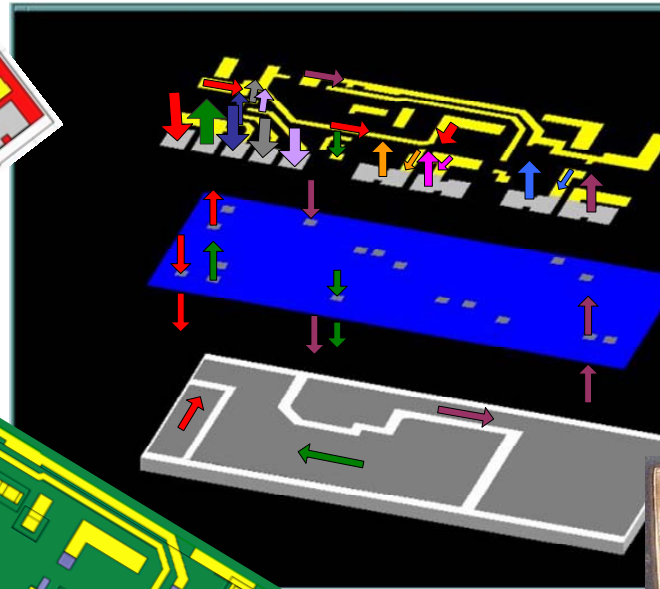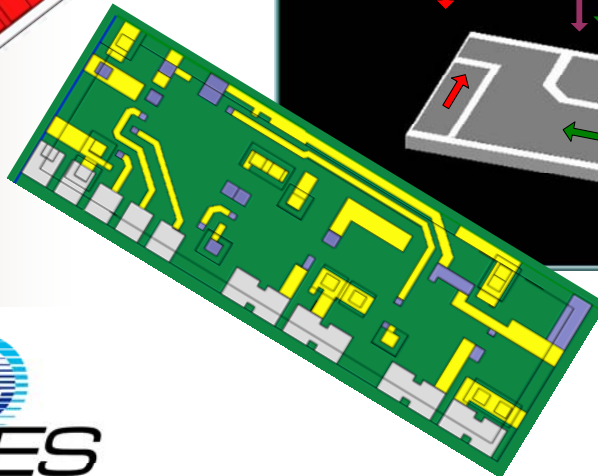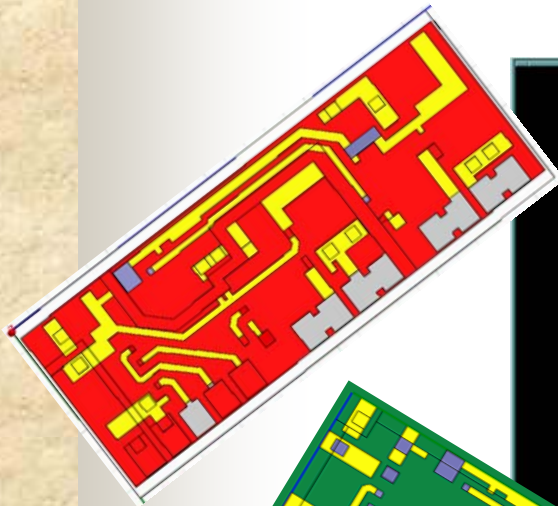
TEXAS INSTRUMENTS
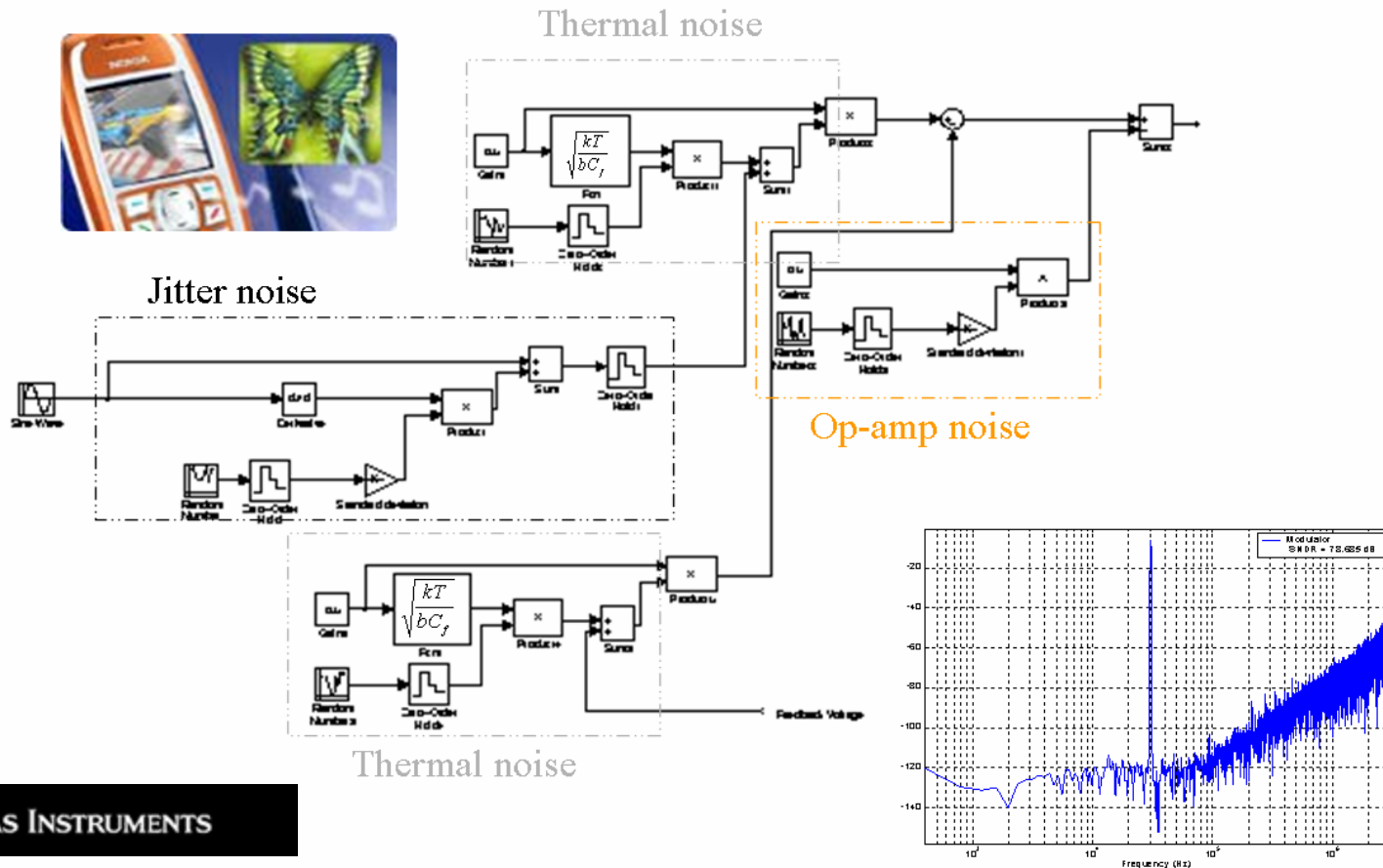
LDMOS Characterization (ATD)
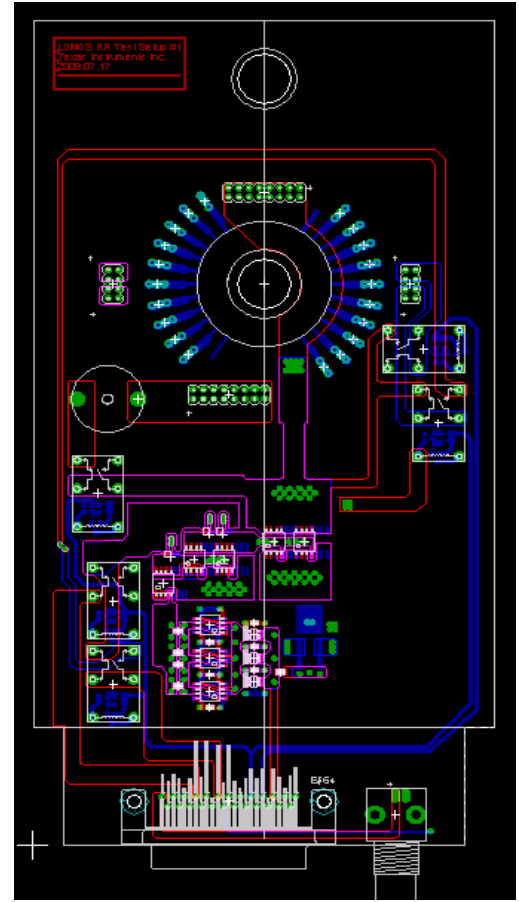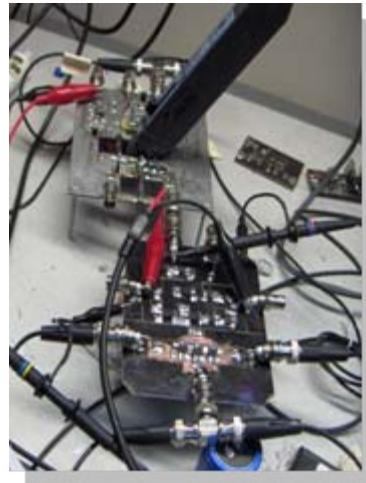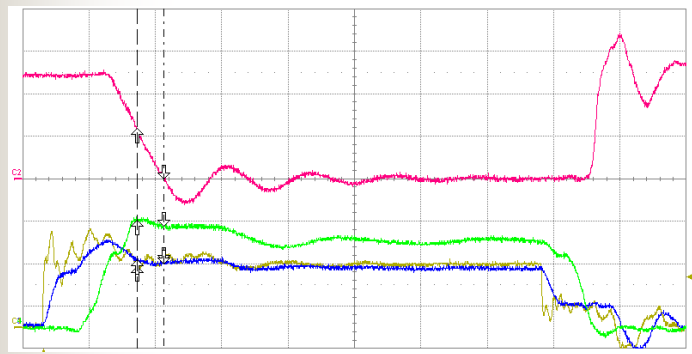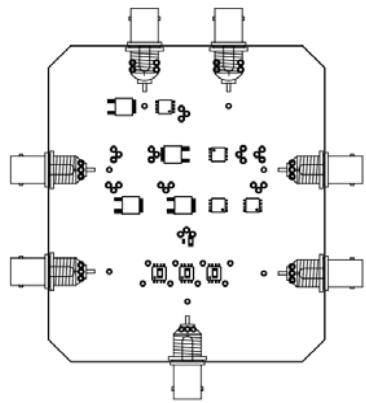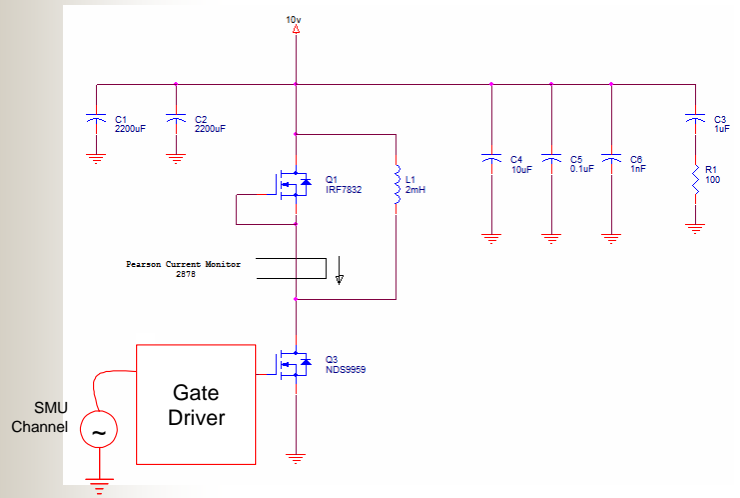
Samples of Project Outcomes

■ IrDA on the MSP430 (HPA/ASP)

Performance-driven Design

■ **Low-EMI PCB Layout Techniques for Power Electronics PCBs**
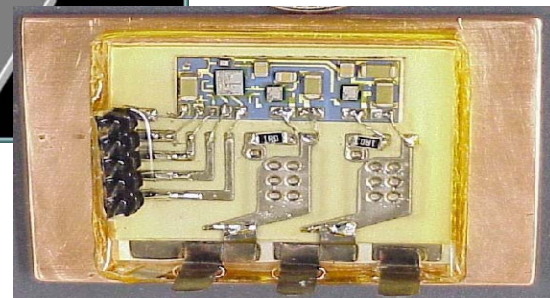
Actual IPEM & Gate Driver

Electronic Design Automation

■ **High-level Partitioning Methods for Discrete Signal Transforms on Distributed Hardware Architectures**

$$F_{4\times 4} = (F_4 \otimes I_4)(I_4 \otimes ((F_2 \otimes I_2)T_2^4(I_2 \otimes F_2)))P_4^{16}$$

Partitioned structure:

$$F_{obj} = \max_{p \in paths} \left(\sum_{i \in stages} Cost\,(c_{p,i}) \right) = 16$$

Scheduled partition requires a latency of 116 cycles.
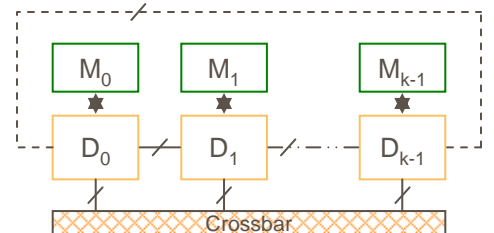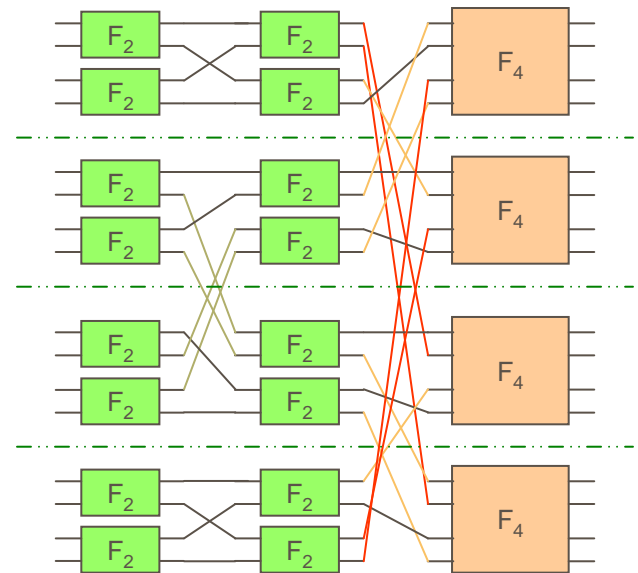
Partitioning Methodology
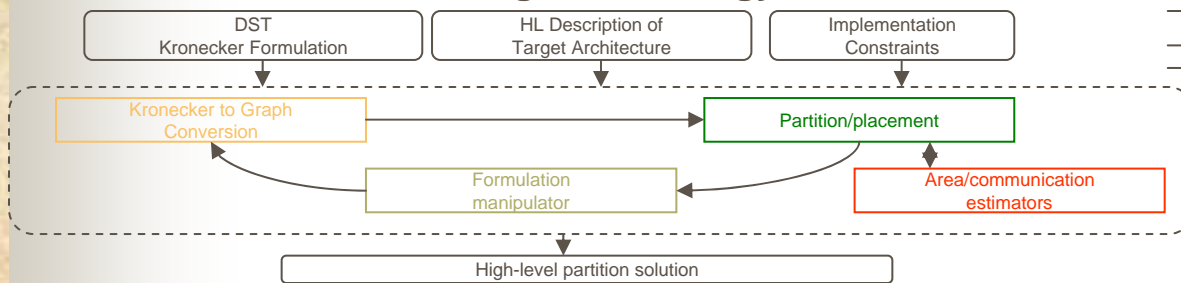
Rapid Prototyping Techniques

■ **Scalable Floating-point Pease FFT based on UPRM component library**
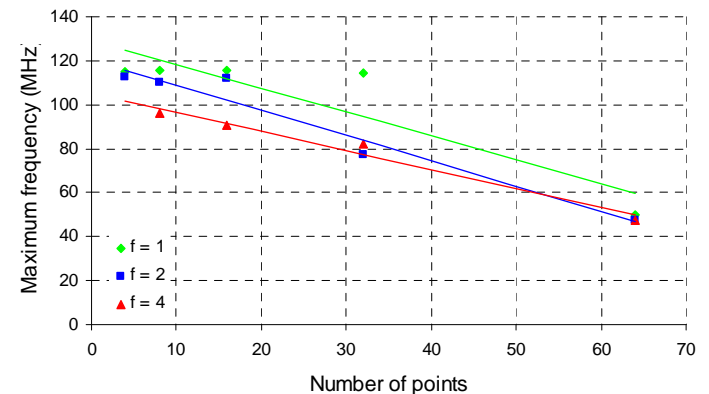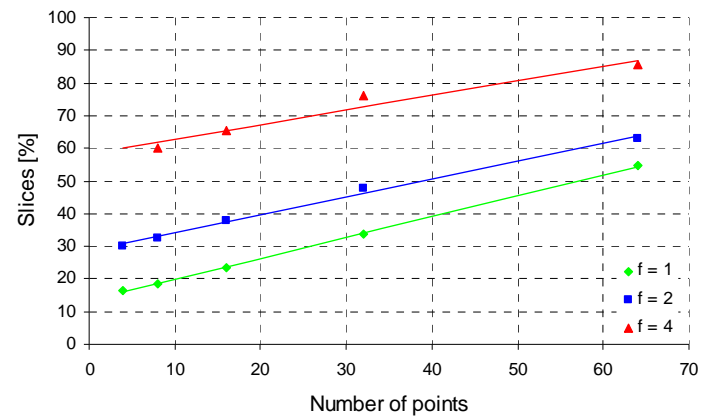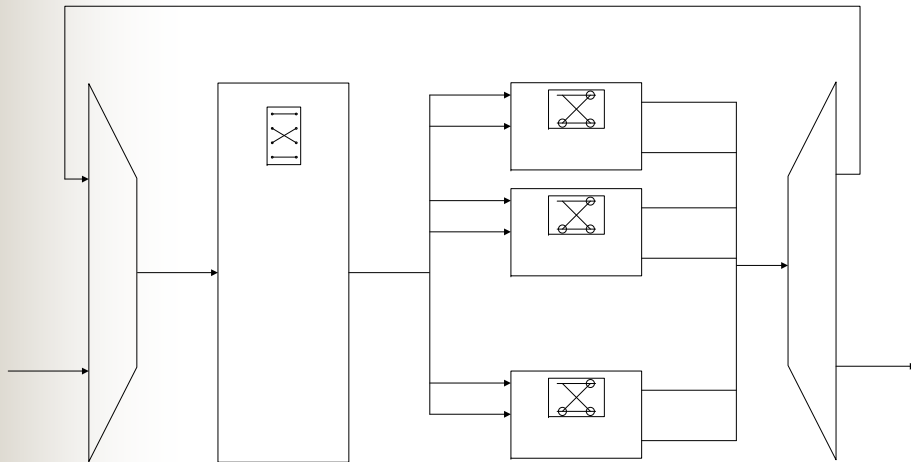
Industrial Affiliates Program (IAP)

- Provides funds for undergraduate research
    - Funded by private industry donations
- Projects extend for eight months
    - Faculty supervision
    - Two yearly events:
        - April & October
- Managed by
    - IAP Coordinator
    - Faculty Committee
    - Industry Board

Gregg Lowe's keynote at IAP 20th anniversary

IAP Benefits to TI-UPRM Program

- TI participation for over 12 years
  - Over 70% of TI recruits at UPRM have been IAP's
- Project Incubator
  - Research projects with TIers
  - Master student thesis generator
  - Source for side projects for Co-Ops
- Student Trainer
  - Virtual one-year long technical interview
  - Specialized technical subject trainer
    - Topics and tools
  - Soft skill developer
    - Independent & team work, presentation, paper writing, etc.

Recent TI-related IAP Projects

2009 (From 19 projects)

- **Study of Transient Vt Shifts in MOSFETS**
  Students: Sonny Zamot, Yadriel Torres, Willie Gonzalez
- **Parametric DC Measurements in Circuit Components**
  Students: William Morales, Juan García
- **Design of a VLCT Interface (Part II)**
  Students: Jose Rivera, Jose J. Torrres, Jorge Mas
- **Fuzzy Compensation Scheme for an Analog IC Configuration (Part II)**
  Students: Pedro Escalona, Aldo Briano
- **Power Profile of an MSP430 (Part II)**
  Students: Bryant Mercado, David Couvertier
- **DA Converter with Offset Cancellation using Floating Gates**
  Jose A. Rivera, Marcelo Quiles

2008 (From 16 projects)

- **SMU Emulation on Keithley 26xx**
  Students: Rafael Vega, Jorge Moreno, Osvaldo Gonzalez
- **Fuzzy Compensation Scheme for an Analog IC Configuration (Part I)**
  Students: Pedro Escalona, Aldo Briano
- **Characterization of Ferroelectric Capacitors**
  Students: Eliud Torres, TBD
- **Design of a VLCT Interface (Part I)**
  Students: Jose Rivera, Jose J. Torrres, Jorge Mas
- **Power Profile of an MSP430 (Part I)**
  Students: Bryant Mercado, María T. Perez, Marinés Chaparro

2007 (From 21 projects)

- **Improvement of the Audio Fidelity, Weight and Output Power of a Class-D Amplifier System**
  Students: Omar Vicente, Javier Tafur
- **Programmable Active Filter Applications**
  Students: Joel Rosario, Gloria Pizzitola, Pedro Escalona, José Peguero
- **Automation of PCB Inspection Area**
  Students: Rubén Nieves, Javier Tafur, Alex Torres
- **Complex Floating Point Adder for Signal Processing Applications on FPGAs**
  Students: Jazmin Lantigua, Arnaldo Cruz

2006 (From 24 projects)

- **Design of an Operational Transconductance Amplifier for Oversampled Data converters**
  Students: Christian Medina, William Rivera
- **Low Power-Low Voltage Analog Building Block for Analog to Digital Converters**
  Jorge Arbona

2005 (From 19 projects)

- **Design of a Current Feedback Operational Amplifier**
  Students: Francisco Collazo, Marcos Lopez
- **Design and applications of a Microcontroller**
  Students: Ruben Nieves, Hector Irizarry, Wilfredo Bermudez, Jose Rodriguez
- **Automatic Generation of Equivalent Circuits Containing Nullors**
  Students: Abel Labour, Rafael Leavit, Obed Caban

Contact Information

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