Create fundamental analog, mixed signal and RF design innovations in integrated circuits and systems that improve energy efficiency, healthcare, and public safety and security.

http://ecs.utdallas.edu/TxACE
“Do we need to train more Analog/Mixed Signal designers?”

October 18, 2021
Panel Organizer: Prof. Ali Niknejad
UC Berkeley

https://www.facebook.com/spicemonkeyuk/
Panel Overview

- Enrollment trends at universities show less interest in “EE” and more interest in “CS”
- Even among “EE” topics, the physical side (devices, circuits) is growing less rapidly
- Are we training enough people to meet the demands of the US industry?
  - US meets its needs by sponsoring many VISAs for international students … some jobs require US citizens (government, defense)
What drives analog/RF innovation?

• New constraints imposed by technology node advancements:
  – Lower supply voltages
  – More “digital” transistors with less gain / higher flicker noise
  – Extreme channel shrinking down to ~5nm

• Communication circuits:
  – 5G and “6G”, high-speed links (> 200 Gb/s)
  – Higher resolution / bandwidth ADCs and DACs
  – Lower power ADCs and DACs
More “Analog” Drivers

• Medical Devices / Sens
  – Many more body worn devices (acceleration, SpO2, pulse, ECG)
  – Patches and implants revolutionizing medicine

• Power Management (Always needed !)
  – EV, more devices, solar
Radar and Imaging (autonomous driving)

https://www.zendar.io/dataset.html
Machine Learning / AI

• Artificial Intelligence / Machine Learning?
• Is this an analog problem or a digital problem?

Task 2810.078, Murmann, Stanford University
Analog IC Engineering is “hard”:

– Strong Math and Physics Background (chemistry)
  • Linear Algebra, Differential Equations, Laplace/Fourier, etc.
– Circuit designers must be aware of device physics, device models, device fabrication and layout
– Firm grasp of linear system theory (convolutions, step/ impulse response, s-domain, frequency domain)
– Discrete time system design (z-domain), random processes and stochastic systems (noise)
– Electrostatics (analog) and electromagnetics (RF, PMU)
  • PCB Design, Package Design, EMC
– DC circuits, AC circuits and power, analog IC circuits (several semesters), RF circuits …

Can we rely on more undergraduates?

• Typically undergraduates are not prepared for jobs in design and most companies hire MS or PhD students

• Can we teach design to undergraduates?
  – Berkeley experiment shows that we can tapeout a Bluetooth / IoT chip using a mix of undergrads and grads in the course of a semester!
Path at UC Berkeley

Core EECS (5-6 semesters)  

Math / Physics

Year 1

Year 2

Digital IC / Arch  
Intro Microelectronics

Device Physics  
Linear Systems

Years 3-4

Tapeout Class  
Analog IC  
RF / Comm

Device Fabrication  
DSP
Process Access

• How do we teach the next generation of IC designers about IC design without access to PDK’s?
• Access to advanced technology nodes increasingly difficult.
• Export licensing and restrictions make life very difficult for educational institutions
Analog CAD

• Is “Analog CAD” going to really happen?
• In the past, analog design is high manual and specialized and requires hand drawn layout, slow cycles of layout / post layout simulation, and then re-design over PVT corners
• Digital is completely tool chain driven and automated yet analog is still “manual”
• Is that about to change? Is ML/AI going to play a role?

https://www.rutenbar.pitt.edu/analog-cad
Berkeley Analog Generator

- Today a design is described by database containing at best schematic, layout, and some constraints, and hopefully some easy to run testbenches.
- There's no information on the design process itself.
- Goal:
  - Capture a designer's process through equations and optimization loops and put these into code.
  - Design description is process independent.
  - Layout should be described at a high level.
Microelectronics Resurgence

• CHIPS act and other investments by US government to reinvigorate research and innovation in microelectronics
• Is it too late?
• Do we need to make sure we also train more analog/mixed-signal designers?
Industry Pain Points

• Is it easy to hire Analog/Mixed-Signal IC Designers?
• Some companies are hiring aggressively and cannot quench the demand. How about others?
• Are we paying analog designers enough?
  – Will I make more money as an AI software engineer or an analog circuit designer?
Panelist:

Matthew Casto
Division Chief, Aerospace Components and Subsystems
Air Force Research Laboratory

Bill Deal
Consulting Engineer
Northrop Grumman Space Systems

Frank O'Mahony
Senior Principal Engineer
Intel

Boris Murmann
Professor
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