EE 201C

Modeling of VLSI Circuits and Systems

Instructor: ***Lei He***

Email: ***LHE@ee.ucla.edu***

Who should and can take this course

Those want to learn timing, signal and power integrity, stochastic power/thermal for both SoC and SiP

Those want to learn modeling for cyber-physical systems (such as smart grid and electric vehicle), or any systems

Background required

- Basics of IC and systems
- Matlab and SPICE (both could be learned in this class)

201C Course Outline and Schedule

Deterministic modeling (3 weeks)

- Parasitic (RLC and thermal RC) extraction
- Delay modeling and model order reduction
- Static timing and noise analysis for logic and on-chip interconnects
- 1 hw (e.g., model order reduction in Matlab)

Stochastic modeling (3 weeks)

- Process variation, and stochastic timing
- Circuit reliability (defects, soft errors and aging)
- Stochastic power and thermal integrity
- 1 hw (e.g., SPICE-based stochastic modeling of SRAM cells or analog circuits)

Beyond-die signal and power integrity (3 weeks)

- High-speed signaling
- Chip-package co-design with signal and power integrity
- Modeling of TSV for 3D IC
- 1 hw (e.g., Matlab-based modeling for high-speed signaling)

Some Details on hws

Example 1: Matlab coding of PRIMA

- Extend single-point model order reduction to multi-point MOR
- Majority of program is given

Example 2: SPICE-based stochastic modeling of SRAM cells

- Reduce the number of SPICE runs for required accuracy
  - Monte Carlo vs Pesudo Monte Carlo vs non Monte Carlo

Example 3: off-chip signal and power integrity

- ISI (inter symbol interference) reduction for high-speed signaling
- Power noise reduction via off-chip decap

Requirement and Schedule for Final Project

Programming project to be done by a single student, or a team of two students

- Reports use ACM style
  - http://www.acm.org/sigs/pubs/proceed/template.htm
- Reports uploaded to class wiki

One week to discuss projects, examples include:

- Equivalent circuit based modeling for battery or solar cells (details discussed on week 4)
- Stochastic modeling of SRAM arrays or analog circuits (details discussed on week 6)

These projects may be expanded to be projects for MS degrees, or for publications

Grading Policy

3 Homeworks (mini-projects) 60

each hw 8 pts for correctness, 2pts for optimality

Programming project 40

30 pts for solution quality

10 pts for clarity of presentations

A $\Leftrightarrow$ score > 85