ELEC 5970/6970, Section 0007, Fall 2007
Broun Hall 0235, Tuesday and Thursday 3:30-4:45pm

Integrated Circuit Design for Frequency Synthesis

Objectives:

Get hands-on expertise in the design of frequency synthesizers in high-speed integrated circuits. The course delivers an introduction to system architecture and behavioral analysis followed by detailed circuit implementation for state-of-the-art synthesizer designs, emphasizing phase-locked loop-based analog synthesizers and direct digital synthesizers and their applications in CMOS and BiCMOS technologies. You will get details on transistor-level circuit design for each functional block, and tested solutions for problems raised by circuit level constraints and other issues associated with synthesizer implementations. The latest advances in all-digital phase locked loop implementation, phase noise reduction techniques, injection locking, and quadrature oscillators are explained, and details on new techniques like ultra-high speed direct digital synthesis take you to the cutting edge of next-generation wireless and radar applications. You also get an in-depth look at ΣΔ modulators and a discussion on PLL and DDS hybrid frequency synthesis and direct modulations.

This course is designed for senior and graduate levels with prerequisite of ELEC 6970 Introduction to Digital and Analog IC designs.

Instructor:

Foster Dai
404 Broun Hall. Office Hour: 4:50 ~ 6:30 pm, TU, TH
Tel. 334-844-1863, Email: fosterdai@auburn.edu
Assistant: Xuefeng Yu, B361, 844-1867, yuxuefe@auburn.edu

Topics:

- Introduction to Frequency Synthesizers and Synthesizer Architectures
- System Level Overview of PLL-Based Frequency Synthesis
- CMOS Logic and Current Mode Logic
- Dividers and Phase-Frequency Detectors
- Charge Pumps and Loop Filters
- Voltage-Controlled Oscillators
- Delta-Sigma Modulators
- All-digital Phase Looked Loops
- Direct Digital Frequency Synthesis

Grading: (5970 and 6970 will have different project assignments.)

- Project I (10%), Selected Synthesizer Design Study and Presentation
- Project II (10%), Selected Synthesizer Design Study and Presentation
- Project III (20%), Selected Synthesizer Building Block Design
- Final Project & Presentation (30%)
- Final Exam (30%)

Reference Books:

- *Integrated Circuit Design for High-Speed Frequency Synthesis* by John Rogers, Calvin Plett, and Foster Dai
- *Radio Frequency Integrated Circuit Design* by John Rogers and Calvin Plett
- *RF Microelectronics* by Behzad Razavi
- *The Verilog Hardware Description Language* by Philip R. Moorby and Donald E. Thomas