EEL 5934- Fundamentals of Data Converters

This course explores fundamentals of data converter systems and circuits. Most of the commonly used ADC architectures such as flash, two-step, pipelined, algorithmic, successive-approximation and integrating ADCs as well as oversampling delta-sigma modulators are discussed in details. The effects of circuit non-idealities are analyzed and various system and circuit techniques will be discussed to enhance the performance of these converters. The course objective is to provide a thorough background of data converter systems and circuits, discuss the real world applications, IC design challenges and prepares students for other areas of analog and digital IC design.

Course Outline

- Overview of data converters
  - Sampling in ADC & DAC
  - Merits of data conversion
  - Switched-Capacitor circuits
  - Circuit non-idealities in ADCs
    - INL & DNL error
    - Gain error
    - Linear and non-linear error corrections
- Nyquist ADCs
  - Single step converter(Flash)
  - Two-step converters
  - Multi-step converters
    - Pipeline
    - Algorithmic and SAR
  - Folding and Interpolating ADCs
  - Integrating converters (single-slope and dual-slope)
- Nyquist DACs
  - Resistor Ladder based
  - R-2R
  - Binary scaled DACs
- Limitation in ADCs & DACs
  - Non deterministic Noise limitations
  - Deterministic Noise limitations
  - Where is the technology going?
- Oversampling ADCs
  - Concept
  - First-order modulators
    - Gain error
    - Quantizer
  - Second-order modulators
    - Stability
Software
   Matlab R8 and above
   Cadence

What you should know
   Analog IC Design (Opamps, frequency response, settling, slew rate ...)
   Introduction to Switched Capacitor Circuits (will be studied in details in this course)
   Probability and stochastic signals (WSS, Gaussian, PDF, PSD ..)

A set of extra lecture notes is prepared and will be given to students who want to review the background knowledge prior to this course, such as Opamp design tradeoffs, settling and slewing, transistor noise and etc. (optional)