Course Outline & Information

Instructor

Professor Nairn,   ,   Nairn@uwaterloo.ca,   ext. 37294

Course Description

This course covers a broad range of topics in data conversion, from basic concepts to simulation and testing. The emphasis is on architectures and circuit techniques for digital-to-analog converters and analog-to-digital converters. Both Nyquist and over-sampling converters are discussed.

References

The course will not follow a specific textbook, but you are strongly encouraged to down-load (or purchase) reference [3].
1. F. Maloberti, *Data Converters*. Springer, 2007
2. R. Schreier and G.C. Temmes, *Understanding Delta-Sigma Data Converters*, John Wiley & Sons Inc., 2005.
3. W. Kester, *Analog-Digital Conversion Handbook*, Prentice Hall, 2004, available on-line at
   http://www.analog.com/library/analogDialogue/archives/39-06/data_conversion_handbook.html
4. R. van de Plassche, *Integrated Analog-to-Digital and Digital-to-Analog Converters*, Kluwer Academic Publishers, 1994.
5. MATLAB reference:
   http://www.mathworks.com/academia/student_center/tutorials/launchpad.html

Prerequisites

ECE 636 or permission of the instructor.

MATLAB will be used to model and simulate data converter behaviour. You should be familiar with the basics of MATLAB which can be found at reference [5]

Grading and Assignments

Best 5 of 6 equally weighted assignments[*]	30%
2 research reviews[**]	20%
Final exam	50%
Total	100%

[*] Due 2 weeks after the assignment is announced. Late penalty: Max. grade reduced by 3dB/day.
[**] Review 1 due June 13th, Review 2 due July 18th, Max grade reduced by 2dB/day.

Class Schedule

Tuesday & Thursday   10:00 - 11:20 am,   EIT 3141

Outline:

Topics:
1. Concepts
   - basic sampled data concepts
   - quantization effects
2. Specifications and Testing
   - ideal and practical data converter performance
   - static and dynamic performance metrics
   - testing and simulating common performance metrics
3. Circuit Techniques & Components
   - switched-capacitor and g_m-c circuits
   - comparators, sample and holds, references
4. Digital-to-Analog Converters (DACs)
   - architectural overview
   - Nyquist DACs (voltage, current & charge based)
   - over-sampling 1-bit & multi-bit
5. Analog-to-Digital Converters (ADCs)
   - architectural overview
   - Nyquist ADCs (integrating, successive approximation, pipelined, algorithmic, subranging, folding, flash and interleaving)
        - correction & calibration techniques
   - over-sampling
6. Limitations
   - fundamental limitations
   - practical limitations

The Fine Print:

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Plagiarism: For all assignments, students are welcome to consult with others. Nevertheless, each student is expected to add value beyond that of the work developed in conjunction with others and the submitted material must be in the student's own words.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances, (other than a petition) or Policy 71, Student Discipline, may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: The Accessability Services Office, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the Accessability Services Office at the beginning of each academic term.