EE5940-2: VLSI Data Converter Design Spring 2016

Course Project

PROJECT PROPOSAL DUE: Tuesday, February 16th

FINAL PROJECT REPORT DUE: Thursday, May 5th, 5 pm

There will be no extensions for the final project reports. Note, this is the last class of the semester not the last day of classes. If you are going to be out of town you can hand in your reports early. Late reports will not be accepted.

Sequence of steps while working on the project:

a) *Select a project.* All along the quarter students are expected to work on a project of significant size. You are expected to work on a single project. As these projects make up a significant proportion of your final grade, students are advised to start thinking of topics for their final project immediately. All students have to design a data converter as their project. You can choose either an ADC or a DAC. You will have to complete circuit design. In general the power supply voltages for CMOS is rapidly decreasing and low power is always import. So, circuits that use low power and low supply voltages will be given highest credit.

Choose specs for the project. Next your will have to select a set of specifications for the data converter. **I suggest everyone (UNITE students included) discuss their projects with me before the project proposal due date.** Telephone discussions are not effective. So, please see me during office hours. If you are unsure of what the various projects mean, please, feel free to discuss it with me. Please restrict yourself to my office hours. I do not expect you to have a complete idea as to what you want to build. However, I want you to start thinking at this time and I want you to choose a general direction NOW. You can provide me with more complete details for the second part of the project during the interim project report. Mathematica, Mathcad, Switcap, Mathlab and Simulink are most usefully for this part of the project.

Project proposal: A short (4 pages in conference paper or journal format, i.e., 2 column) proposal describing what you want to do in the project. I want to see a list of references, ideas, circuit concepts, abstract, conclusions, etc. **10 points**

c) *Complete your project.* Please, take the time to analyze your circuit. Perform hand calculations and confirm using circuit simulation. It is not sufficient to choose device parameter values out of the blue and show through circuit simulation that the circuit meets specifications. If questioned you need to be able to defend your choices. You need to understand how the circuit works. This is the most important part of the project spend -- time on it. The project is equally, if not more, important than the examinations. Analog circuit design cannot be learned by just taking a test. You have to do it to learn it. The difficulty of the project should be about as much or more than a final examination. I expect a complete design, simulations to confirm your design, layout, simulations after layout. Make sure you understand the impact of temperature variations, power supply variations and fabrication process variations on your design.

Write your final project report. As with the interim project report do a good job at writing. Include everything you did in your interim project report in this final report. Final Project report: (6 pages in conference paper or journal format, i.e., 2 column. I know it is going to be hard to condense all the work you have done into 6 pages but figuring what is important to include is critical.) **20 points**

References

Use the references provided in the class notes, class website and books. In particular, the best place to start is "web.stanford.edu/~**murmann/adcsurvey**.html".Next take a look at some additional references provided below. Make sure you use IEEExplore and read the latest papers from JSSC, TCAS, ISSCC, VLSI Symposium, CICC, etc.

1. R. H. Walden, "Analog-to-Digital Converter Survey and Analysis," in IEEE J. on Selected Areas in Communications, Vol. 17, No. 4, April 1999, pp. 539-550.
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3. Kuboki, S.; Kato, K.; Miyakawa, N.; Matsubara, K., "Nonlinearity analysis of resistor string A/D converters," IEEE Transactions on Circuits and Systems, vol.CAS-29, (no.6), June 1982. p.383-9. 12 references.
4. G.T. Uehara and P.R. Gray, "A 100MHz Output Rate Analog-to-Digital Interface," ISSCC, 1994.
5. N. Kumazawa, et al, "An 8bit 150MHz CMOS D/A Converter," VLSI Symp, pp. 55-56, 1990.
6. D.W. Groeneveld, et al, "A Self-Calibration Technique for Monolithic High-Resolution D/A Converters," IEEE J. Solid-State Circuits, pp. 1517-1522, Dec. 1989.
7. M.J. Pelgrom, "A 10-b 50-MHz CMOS D/A Converter," IEEE J. Solid-State Circuits, pp. 1347-1352, Dec. 1990.
8. M. deWit, et al., "A Low-Power 12-b Analog-to-Digital Converter", IEEE JSSC, pp. 455-461, Apr. 1993.
9. T. Matsuura, et al., "An 8b 20MHz CMOS Half-Flash A/D Converter," ISSCC, pp. 220-221 & 376, 1988.
10. K. Kusumoto, et al., "A 10-b 20-MHz 30mW Pipelined Interpolating CMOS ADC," ISSCC, pp. 62-63 & 264, 1993.
11. Y.-M. Lin, et al., "A 13-b 2.5-MHz Self-Calibrated Pipelined A/D Converter," IEEE J. Solid-State Circuits, pp. 628-636, Apr. 1991.
12. T. Cho, et al., "A 10-bit, 20-MS/s, 35-mW Pipeline A/D Converter," IEEE J. Solid-State Circuits, pp. 166-172, Mar. 95.
13. D.W. Cline and P.R. Gray, "A Power Optimized 13-Bit 5MS/s Pipelined ADC in 1.2mm CMOS," IEEE J. Solid-State Circuits, pp. 294-303, Mar. 96.
14. P.R. Gray et al., "Design Considerations for High-Speed Low-Power Low-Voltage CMOS, Symp. Adv. Analog Int. Circ., 1994.
15. A.N. Karanicolas, et al., "A 15-b 1-MS/s Digitally Self-Calibrated Pipeline ADC," IEEE J. Solid-State Circuits, pp. 1207-1215, Dec. 1993.
16. J.C. Candy and G.C. Temes, "Oversampling Methods for A/D and D/A Conversion," in *Oversampling Delta-Sigma Converters*, J.C. Candy and G.C. Temes, eds., pp. 1-29, IEEE Press, 1992.
17. B.E. Boser and B.A. Wooley, "The Design of Sigma-Delta Modulation A/D Converters," IEEE J. Solid-State Circuits, pp. 1298-1308, Dec. 1988.
18. K.C.-H. Chao et al., "A High-Order Topology for Interpolative Modulators for Oversampling A/D," IEEE Trans. Circ. and Syst., pp. 309-318, Mar. 1990.
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21. P.C. Yu and H.-S. Lee, "A 2.5-V 12-b 5MS/s Pipelined CMOS ADC," IEEE J. Solid-State Circuits, pp. 1854-1861, Dec. 1996.
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