EE2019: Analog Systems and Lab

Introduction

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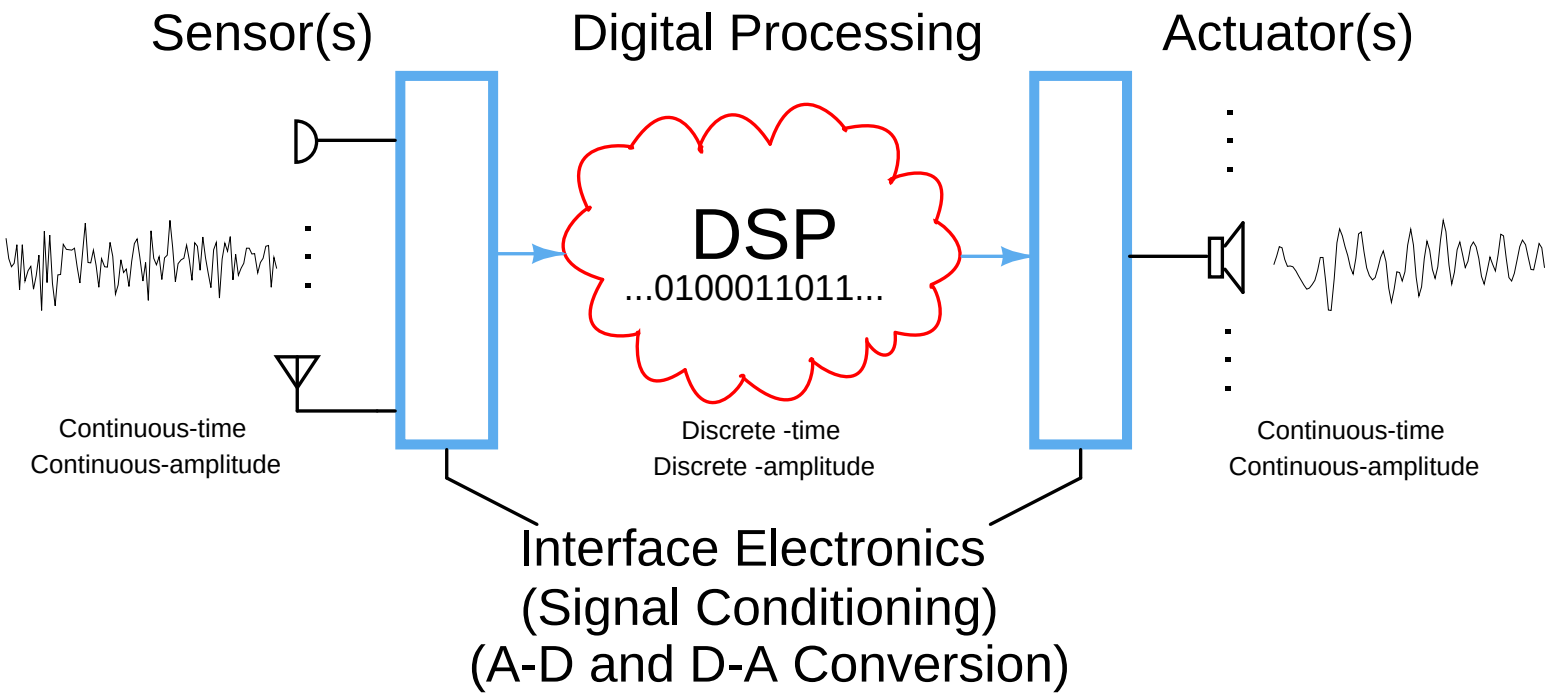
Outline



Picture: courtesy Shanthi Pavan

Analog circuits in modern systems on VLSI chips

- Analog to digital conversion
- Digital to analog conversion
- Amplification
- Signal processing circuits at high frequencies
- **Power management-voltage references, voltage regulators**
- **Oscillators**

The last two are found even on many “digital” ICs

Analog IC design in India

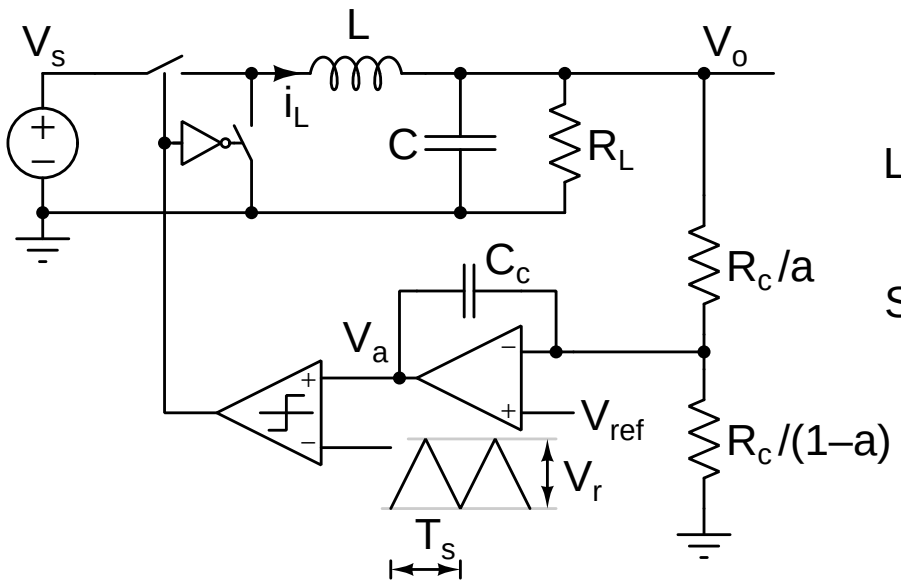
- Many companies starting analog centers
- Multinationals and Indian start ups
- Big demand for skilled designers
- Interesting and profitable activity ☺

Course goals

Theory and Lab

- Negative feedback systems and their building blocks
- Stabilization of feedback circuits
- Applications

Course goals



$$L(s) = \frac{a}{sC_cR_c}\,\frac{V_s}{V_r}\,\frac{1}{s^2LC + sL/R + 1}$$

Steady state $V_o = V_{ref}/a$

Course prerequisites

- Circuit analysis
  - Mesh, nodal analyses
  - RLC, linear dependent sources
- Laplace transforms, frequency response
- Differential equations
- Basic digital logic gates

EE1101: Signals and Systems
EE2015: Electric Circuits and Networks
EE2001: Digital Systems and Lab

Course contents

- Controlled sources
- Realizing accurate transfer characteristics using negative feedback
- Stabilization of negative feedback systems
- Negative feedback amplifiers
- DC-DC converters
- Filters
- Oscillators
- Track-and-hold, ADC, DAC
- . . .

Follow up

- EE3002: Analog circuits
- EE3703: Analog circuits lab
- EE5390: Analog IC design

- EE5323: Advanced Electrical Networks
- EE534: Active Filter Design
- EE6320: RF Integrated Circuits
- EE6321: VLSI Data Conversion Circuits
- EE6322: VLSI Broadband Communication Circuits
- EE6323: Wireless System Design
- EE6324: Phase-Locked Loops
- EE5325: VLSI Power Management Circuits

Resources

Course homepage

- IITM moodle: https://courses.iitm.ac.in/
- http://www.ee.iitm.ac.in/vlsi/ee2019_2022/start

Recorded lectures

- http://www.ee.iitm.ac.in/∼nagendra/videolectures/

Text book

- None

Resources

References

- A. S. Sedra, K. C. Smith and Arun N. Chandorkar *Microelectronic Circuits: Theory And Applications*, 7ed, Oxford University Press, 2017.
- Sergio Franco, *Design with operational amplifiers and analog ICs*, Tata McGraw Hill.
- Hayt and Kemmerly, *Engineering Circuit Analysis*, McGraw Hill, 6/e.
- B. P. Lathi, *Linear Systems and Signals*, Oxford University Press, 2 edition, 2004.

Logistics

- Hybrid mode this semester (but, online for now)
- E slot
  Odd roll numbers: Prof. Aniruddhan
  Even roll numbers: Prof. Saurabh
- Extended tutorial: Thursday, 9am-12pm (tentative)
- Lab: T slot, Friday, 2pm-445pm, IE labs

Etiquette and expectations

- Mobile phones off
- 85% attendance (includes tutorial sessions, excludes quizzes)
- **Must** solve problems given in classes

Must know or refresh

- Basic circuit analysis (nodal/mesh analysis)
- Bode plots
- Two port parameters
- Differential equations and time domain solutions
- Circuit analysis with Laplace transforms

(Links to recorded lectures on the webpage)

Evaluation

- 4 quizzes-40%
- End sem-25%
- Lab-25%
- Tutorials-10%
  - Must attend. Marks only if evaluated problem is solved completely.

Teaching assistants

Post any questions related to the course on the moodle forum

TAs will hold tutorial evaluation hours on weekends

TA office hours will be announced soon

For more advanced students

Simulate the circuits you see in class

- http://www.ee.iitm.ac.in/∼nagendra/cadinfo.html
- Online spice simulator at http://www.ngspice.com/index.php

Build the circuits

- Breadboad, components, IE lab