Welcome to DAT116
(Mixed-Signal System Design)

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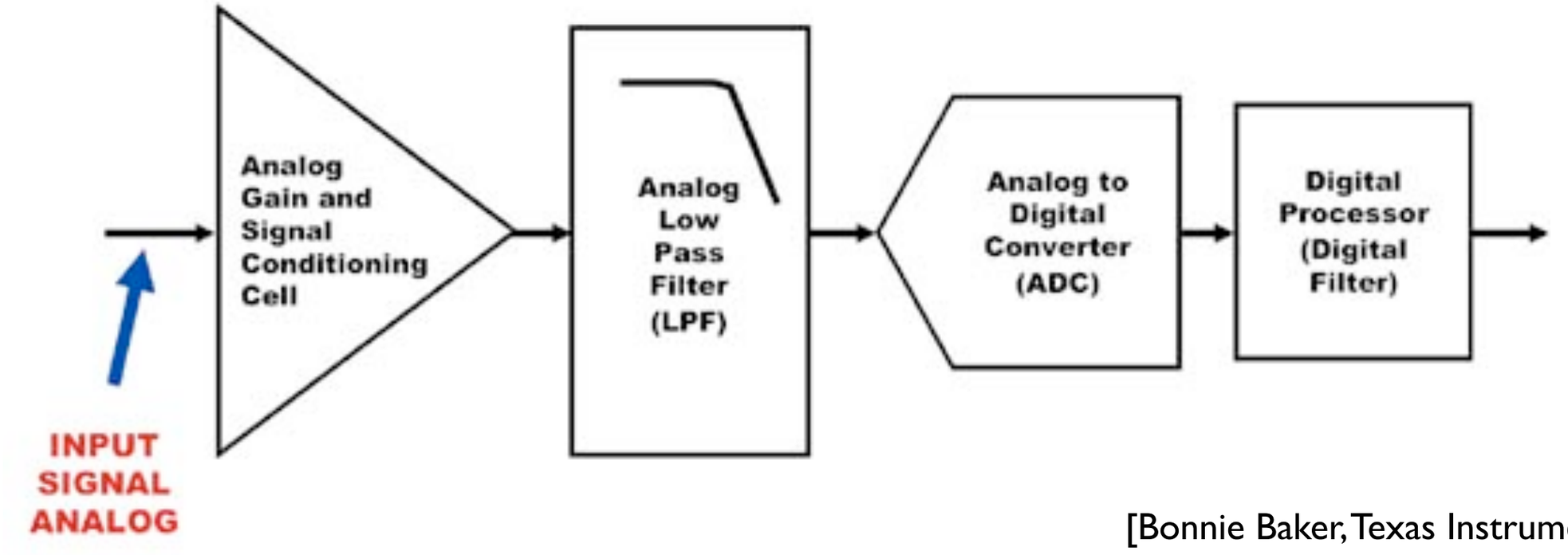
Why?

- In embedded systems, analog and mixed-signal circuits are mainly *interface* technologies
- Used to give the system information about its environment, and to affect same
  - Includes incoming / outgoing signals such as sound, light, voltages etc.
- Condition and convert signals to and from digital form

Why a course?

- Mixed-signal interface often determines achievable system performance!
  - Sets limits on accuracy, power, noise, etc.
- Embedded-system designer needs to understand MSSD limitations.

Classic signal acquisition



[Bonnie Baker, Texas Instruments]

- D/A conversion similar but backwards…
- What parameters to decide upon?

What?

- From syllabus: “The course is intended to give insight into how analog and mixed-mode subsystems (particularly A/D and D/A converters and surrounding circuitry) are specified and implemented, and how they affect the performance of the systems they are part of.”

How?

- Self-studies
- Lectures
  - Mon 13–15, Thu 10–12
- “Exercises”
  - Mon 15–17
- Labs
  - Tue 13–17, Wed 8–12

But note exceptions.

Who?




- Alexandra Angerd (lab TA)
- Lena Peterson (lecturer, examiner)
- Lars Svensson (lecturer, examiner, occasional lab TA)
- Victor Åberg (lab TA)

Organization

- Weekly “themes”
  - Introduce theme on Thursday in week n – 1
  - 2 lectures + self-studies in week n
  - Exercise + lab in week n + 1

Themes

1. Sampling
2. Variability
3. Quantization
4. Continuous-time filtering
5. Dynamic range
6. Discrete-time filtering
7. Digital assist

Learning outcomes

1. Sampling
2. Variability
3. Quantization
4. Continuous-time filtering
5. Dynamic range
6. Discrete-time filtering
7. Digital assist

- select sample rates and converter resolutions which make the required system performance attainable

Learning outcomes

1. Sampling
2. Variability
3. Quantization
4. Continuous-time filtering
5. Dynamic range
6. Discrete-time filtering
7. Digital assist

- Estimate the influence of the converter imperfections on converter and system performance

Learning outcomes

1. Sampling
2. Variability
3. Quantization
4. Continuous-time filtering
5. Dynamic range
6. Discrete-time filtering
7. Digital assist

- Identify requirements on analog interface components for a given converter solution

Learning outcomes

1. Sampling
2. Variability
3. Quantization
4. Continuous-time filtering
5. Dynamic range
6. Discrete-time filtering
7. Digital assist

- Starting from process specifications, assess achievable cost and performance of analog subsystems, based on examples and calculations

Learning outcomes

1. Sampling
2. Variability
3. Quantization
4. Continuous-time filtering
5. Dynamic range
6. Discrete-time filtering
7. Digital assist

- Model a mixed-signal subsystem using software tools in order to verify assumptions and hand calculations

Schedule

<table>
<tr><td></td><td></td><td rowspan="2">Lab</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Lecture</td><td></td></tr>
<tr><td>L</td><td>U</td><td>N</td><td>C</td><td>H</td></tr>
<tr><td>Lecture</td><td rowspan="2">Lab</td><td></td><td></td><td></td></tr>
<tr><td>Exercise</td><td></td><td></td><td></td></tr>
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- Rooms: EF (Lecture + Exercise), ED4220 (lab)
- Exceptions in TimeEdit

Schedule

	Lecture					
	C	H	L	U	N	C	H	L	U
			Lecture	Lab				Lecture	Lab
			Exercise					Exercise	

- Themes overlap across weeks!

Self-studies

- Theme starts with video “teaser” to watch, e.g., on Thursday after lecture
  - Reading directions for self-studies on PP
  - Topics covered in lectures in following week
    - Come prepared to these “real” lectures!
  - Exercise on Monday in the week after that
  - Then, lab on Tuesday / Wednesday

Exercises

- Focused on practice rather than theory
  - Previous lab
  - Next lab
  - Problem solving
- … but also open discussion, Q + A
  - Bring problems and questions!

Labs

- Lab sessions based on software simulations
  - Come prepared!
- Several tools (MATLAB, Simulink, Cadence)
  - Note: Cadence runs on Linux only!
  - Note: need to hear CAD tool lecture
- Work in pairs (ad-hoc this week, then we assign pairs)
- Room 4220 (in most cases)

➡ *Compulsory (including Lab 0)*

Lab reports?

- Yes (except for Lab 0)
- Two <u>parts</u>:
  - Group/pair submission of report on lab work
  - Individual submission of response to *reflection question(s)* at end of lab PM
- Two <u>phases</u>:
  - *Voluntary* submission by midnight on Friday following the lab to get *feedback*
  - *Compulsory* handin of *omnibus* report at end of course

Lab reports, cont.

- During course: *Feedback*
  - Improve writing and understanding
  - Submit by deadline or don't bother
    - No resubmissions until…
- …end of course: *Assessment*
  - Check that you have understood the topic

Lab 0?

- Brush-up / primer on MATLAB / Simulink
- Compensate for varying backgrounds
- Easy if you are already familiar with tools
- Necessary for the rest of you
- No report

Examination

- To pass:
  - Attend labs and do the work.
  - Submit acceptable omnibus lab report at end of course; pass individual oral with teachers.
    - If report or oral *not* passed, then may pass by sitting for written exam.
- Grade:
  - 3 if you have passed.
  - Bonus points for omnibus + oral (may yield a 4).
  - Written exam needed for 5.

Exact rules in Course PM

Omnibus handin

- Deadline: Thursday Jan 11, 2018 (midnight)

- *Must submit on time!*

- Earned bonus points (if any) valid for one year

Timing at end of course

- Jan 11, midnight: lab report handin
- Jan 14 – 17: individual oral w/ teachers (book timeslot w/ Doodle!)
- Jan 18: Sit-down exam
  - Signup by Dec 20 (info will be forthcoming)
  - Open-book

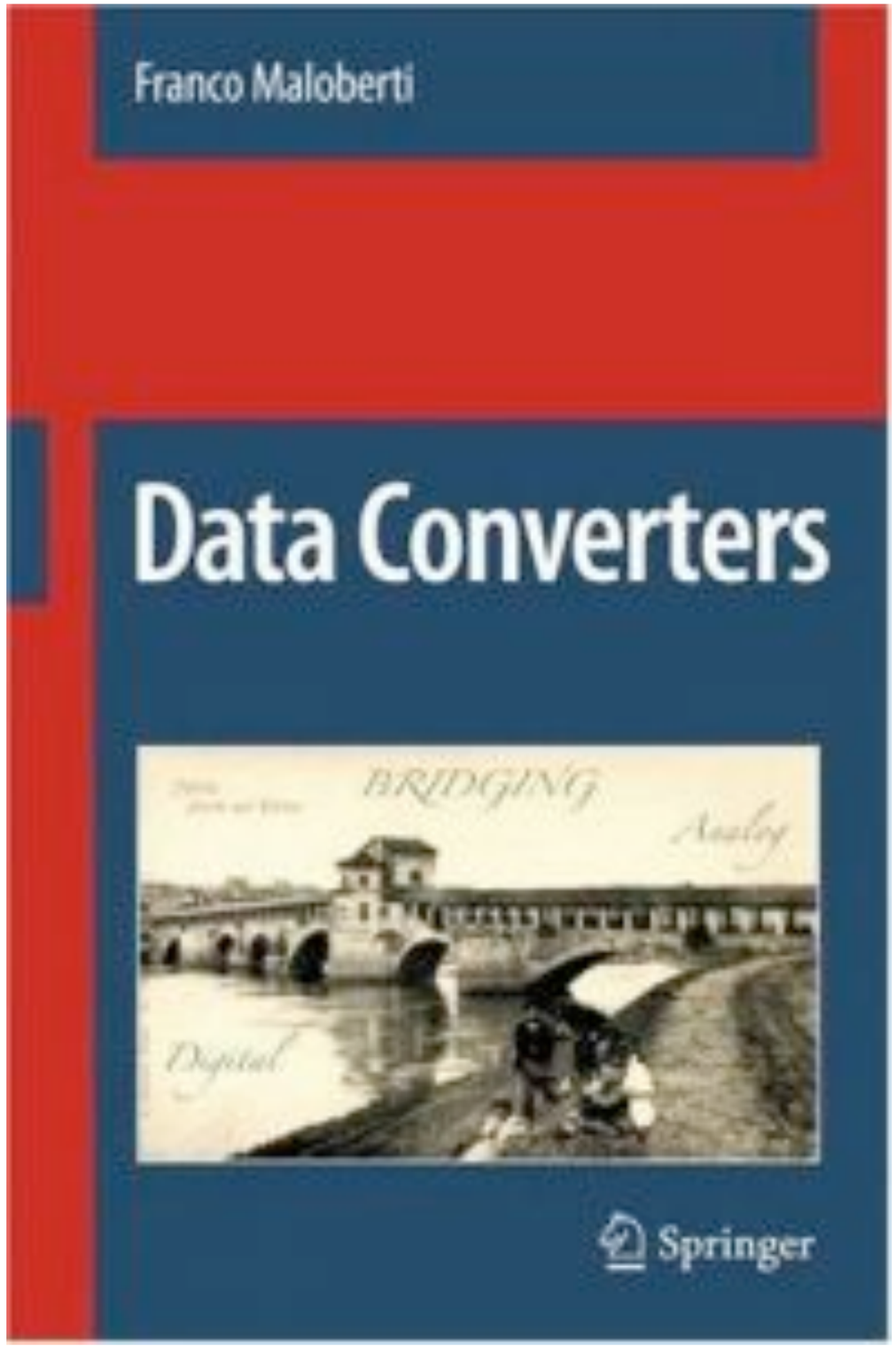
Literature

- Main textbook: Maloberti

  - Not at Cremona

  - In E-library

- Supplemented w/ research papers, book excerpts, E-library chapters



Homepage etc

- In PingPong
- If you have registered for the course, you should have access
  - Not registered? See me immediately
  - Also, if you have no lab room access by Monday, let us know
- For email: include “DAT116” in Subject:

Urkund

- We use the Urkund system to detect “borrowed” text in all submissions.

- Don’t do it.

Assumed background

- Feedback systems
  - Frequency dependent (RC feedback)
  - Poles, zeros in Laplace (s) plane
- Bode plots
- Signal spectra
  - Representation in time and frequency
  - Parseval’s theorem

Assumed background

- Signal statistics
  - Addition of uncorrelated signals
- Decibel calculations
  - Voltages, powers
- Basic circuit theory
  - Ohm, Kirchhoff, conductance, gain etc

Random course reps

- Snehal Manoj Chhapanimohan
- Wenqian Han
- Christian Krizan
- Nakul Raja Badarinath
- Ming Xu

Changes since last year

- Adjusted the reading directions
- Moved the Cadence labs to a central server
- Most changes based on student feedback
- Respond to poll after end of course!

Summary

- Check access to PingPong site!
- Brush up those old skills!
- Select Tuesday or Wednesday lab slot!
  - Doodle poll shown in PingPong.
- Go to the lab this Tuesday / Wednesday!