

Lecture 2: Signals & Communications

- **Announcements:**
- Lecture 1 pdfs and video already posted on the course website in the "Lecture" link
- HW#1 online
- Discussions start next week
- Labs start the week after next
 - ↳ Monday, Sept. 7 is a holiday, so the Monday lab will start one week later
 - ↳ The Tuesday lab starts Sept. 8
- David Au will release the google form for lab kit sending information today
- We will send Zoom links for lecture, discussions, and office hours before next week
- We will send new ones for the week after next, which will then become permanent ones
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- **Lecture Topics:**
 - ↳ More on Labs (that I didn't get to last time)
 - ↳ Review of Signal Types
 - ↳ Motivation: Digital Communications
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1

How Labs Will Run:

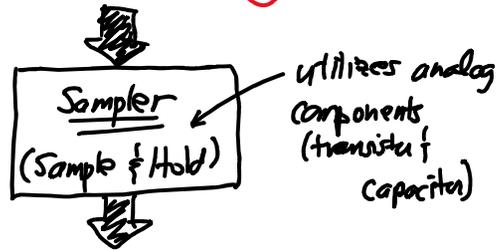
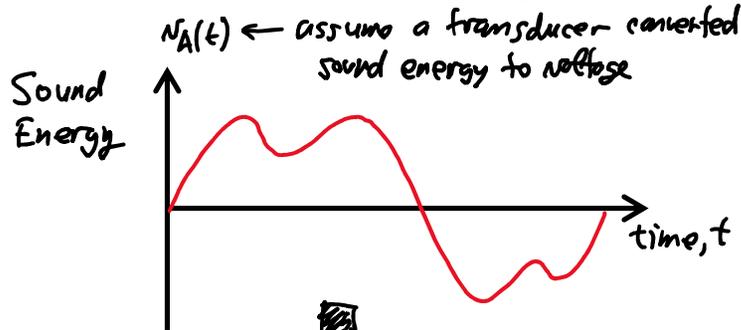
- At the beginning of the lab, your TA will say a few things about it
 - ↳ TA might go through some of the prelab that you turned in via Gradescope before the lab
 - ↳ TA might give some pointers on how to use equipment
 - ↳ TA might demonstrate via zoom how to hook something up and test it
- After this, the lab period becomes like a Zoom lab office hours period during which you can ask questions and get help hooking up a circuit, debugging, etc.
- You don't need to stay; i.e., if you prefer, you can do the lab completely on your own on your own time
- **Note:** Debugging via Zoom will probably prove very difficult
 - ↳ Be patient with the process
 - ↳ We will probably need to make adjustments on how we do things as we learn what works and what doesn't
- Because of difficulties associate with remote offering and the lack of some nice equipment that cannot be shipped, e.g, Semiconductor Parameter Analyzer, there are some things that we just won't be able to do - this is fine
 - ↳ We will do the best we can, but we should understand that not all of the original lab is possible
 - ↳ Keep in mind that even if we can only do 50% of the original lab, that's still a lot!

2

• Signal Types:

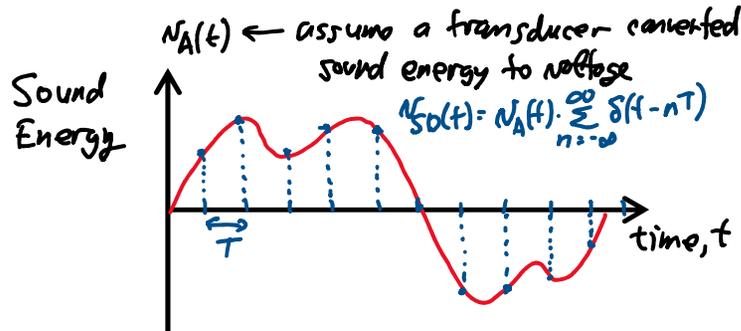
1) Analog Signal:

- ↪ The majority of physical signals are analog
- ↪ "analog" comes from the fact that analog electronic signals and the physical signals they represent are analogous
- ↪ Continuous time, continuous amplitude

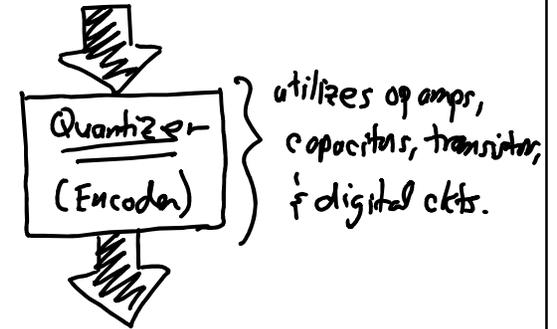


2) Sampled-Data Signal:

- ↪ Discrete time, continuous amplitude

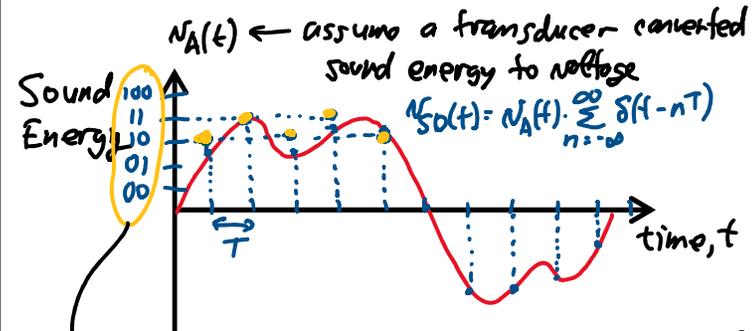


- ↪ If sample fast enough (i.e., at the Nyquist rate = 2 x the highest frequency), then can retain all the original information in the original analog signal
- ↪ If you cannot do this, then you lose information!



3) Digital Signal

- ↪ Discrete time, discrete amplitude



These values now encoded in a binary representation
 ⇒ can be processed by digital electronics

⇒ Problem: Lose information through quantization

Lost Info $\propto \frac{1}{\# \text{ of levels}}$

- **Advantages of Digital:**
 - ↳ **More complex processing possible due to higher density of electronics (i.e., VLSI)**
 - ↳ **Easier to store, e.g., mp3's more reliable than analog records**
 - ↳ **Easier to interpret, e.g., digital vs. analog clock (with hands)**
- **Disadvantages of Digital:**
 - ↳ **Loss of information through quantization and sampling**
 - ↳ **In many cases, not as fast as analog (smaller bandwidth)**
 - ↳ **The speed disadvantage is easy to see in wireless communications, which is why analog is so important for wireless**
- **Go to Digital Communications Example**