

EELE 477

Digital Signal Processing

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Introduction

Course Overview

- Summarize course format
- Review Syllabus
- Discuss lab and lab reports
- Describe course philosophy: learning via lecture, homework, hands-on lab, and reading assignments

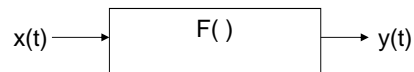
Signals

- Continuous time vs. discrete time
- 1-D signals and 2-D signals (images)
- Concept of *sampling*

- *Signals can be represented by mathematical functions*

Systems

- A *system* transforms a signal into a new signal or a different signal representation



- $y(t) = F(x(t))$
- Examples:
 - $y(t) = 2 \cdot x(t)$
 - $y(t) = [x(t)]^2$
 - $y(t) = x(t-2)$

Systems (cont.)

- A discrete-time system is the same concept:

$$y[n] = 2 * x[n]$$

$$y[n] = \{x[n]\}^2$$

$$y[n] = x[n-2]$$

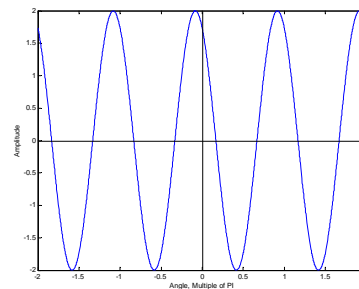
- Convert continuous-time signal to discrete-time signal:

$$y[n] = x(nT_s),$$

where T_s is the sampling period

Important Signals: Sinusoids

- $x(t) = A \cos(\omega_0 t + \phi)$
 - A = amplitude
 - ω_0 = radian frequency
 - ϕ = phase shift
- Example: $2 \cos(4\pi t + \pi/6)$
- $\sin(\theta) = \cos(\theta - \pi/2)$
 $\cos(\theta) = \sin(\theta + \pi/2)$



Sinusoids (cont.)

- Periodic: $x(t+T_0) = x(t)$
 $\cos(\omega_0 t + 2\pi k) = \cos(\omega_0 t)$
- $\cos(\omega_0(t+T_0)) = \cos(\omega_0 t)$ iff $\omega_0 T_0 = 2\pi k$
- Period vs. Frequency $T_0 = 1/f_0$
- Consider waveform effect of changing f_0

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Practical: Sinusoids in Matlab

- Example: create a 5 cycle segment of a 440Hz sinusoid with amplitude=127
- Step 1: Matlab is *discrete-time*, so choose sample rate. For example, pick 100 samples per waveform cycle:

100 samples	x 440 cycles =	44000 samples
cycle	second	second

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Matlab sinusoids (cont.)

- $y[n]=127*\cos(2\pi fnT_s)$
for 5 cycles, the range of n is

5 cycles	second	44000 samples	= 500 samples
	440 cycles	second	

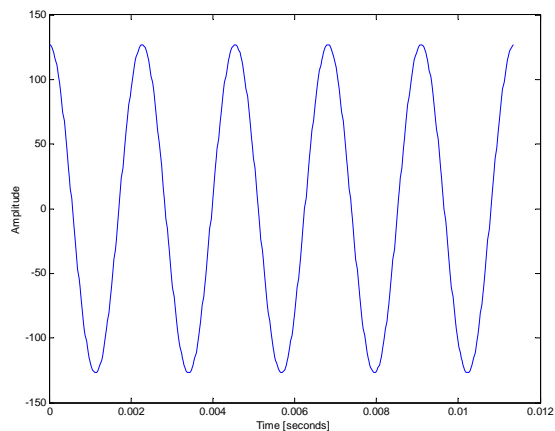
- For Matlab:

```
y=127*cos(2*pi*440*(0:499)/44000);  
plot((0:499)/44000 , y );
```

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Matlab sinusoids (cont.)



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Matlab sinusoids (cont.)

- What if we chose a lower sampling rate (longer sample period)?
- How does Matlab “connect the dots” when plotting?
- What other plotting options?