EELE 477
Digital Signal Processing

1

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

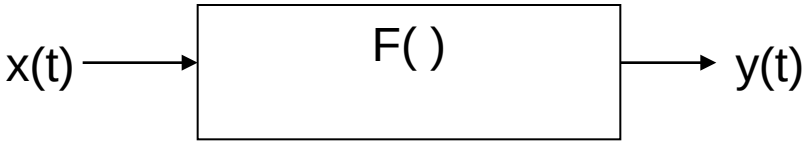
Signals

- 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: $y(t) = 2*x(t)$
  $y(t) = [x(t)]^2$
  $y(t) = x(t-2)$

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

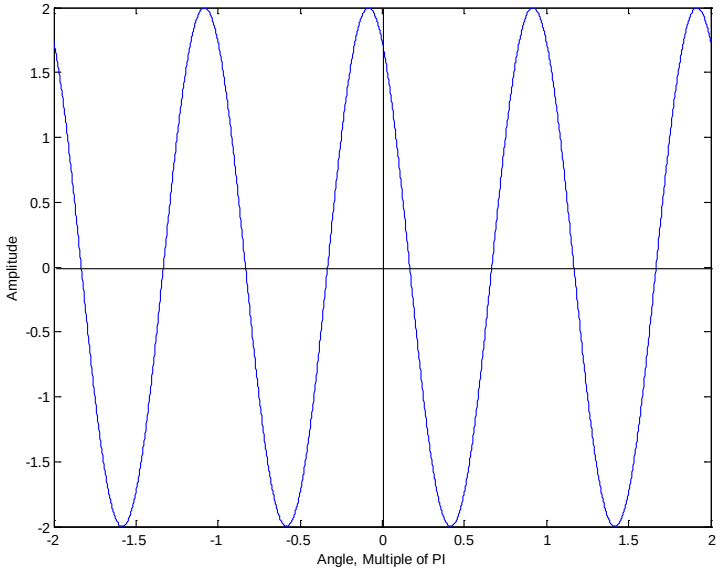
- $x(t) = A\cos(\omega_0 t + \phi)$

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

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

Matlab sinusoids (cont.)

- $y[n]=127*\cos(2\pi f n T_s)$

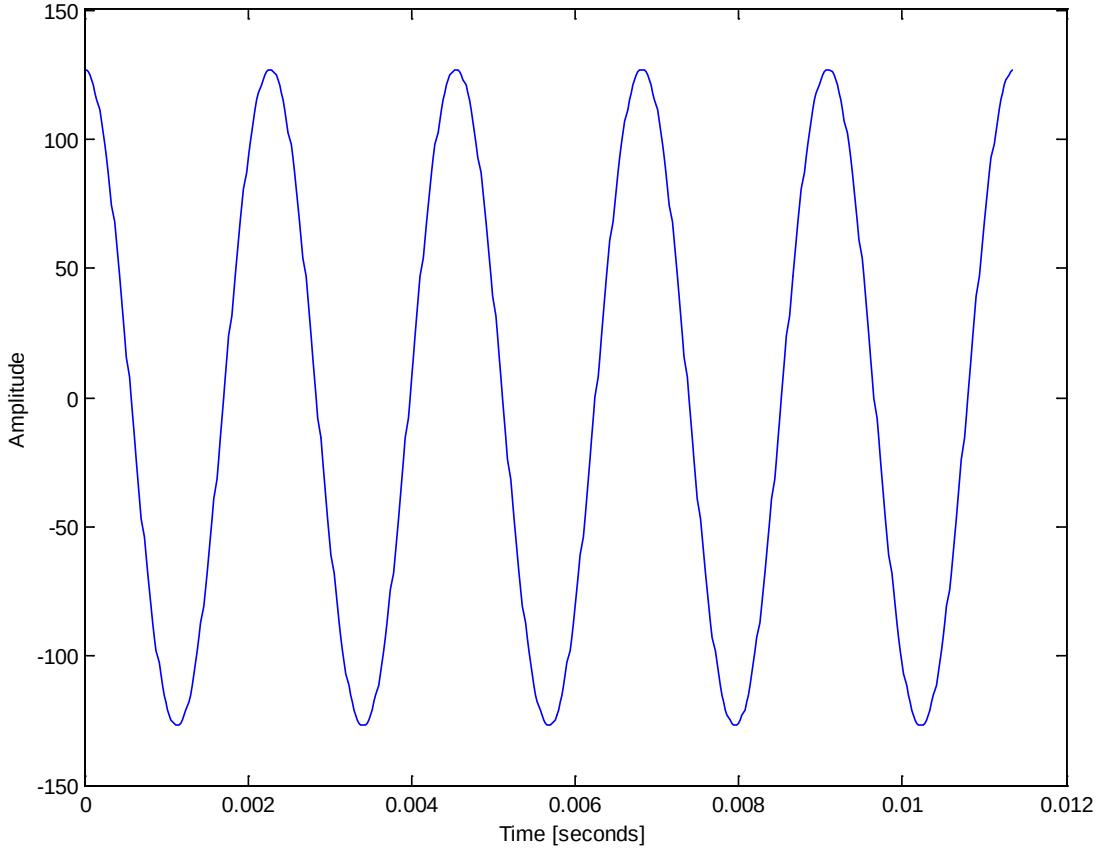
  for 5 cycles, the range of n is

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 );
```

Matlab sinusoids (cont.)



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?