Lecture - 03

Tuesday, 30 November 2021 8:25 AM

★ Signals & systems

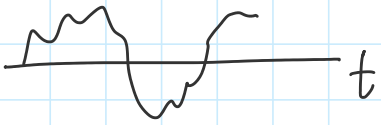
★ Signal is a function of some independent variable
- ↳ 1D signals in this course
- ↳ typically time

$x(t) : t \longrightarrow x(t)$

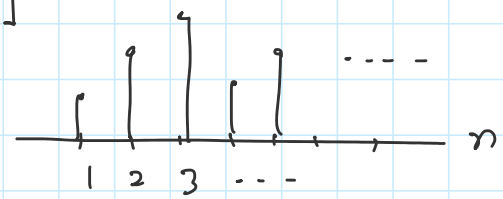
★ Classification of signals

(1) Continuous-time Vs Discrete-time

$x(t)$



$x[n]$



(2) Analog vs Digital

(3) Deterministic Vs Random

(4) Periodic Vs Aperiodic

↓

repeats after some interval. i.e $x(t+T) = x(t)$ $\forall$ t & for some T

★ Sinusoids (real)

$$x(t) = A \sin(2\pi f_0 t + \phi)$$

parameters

A - amplitude

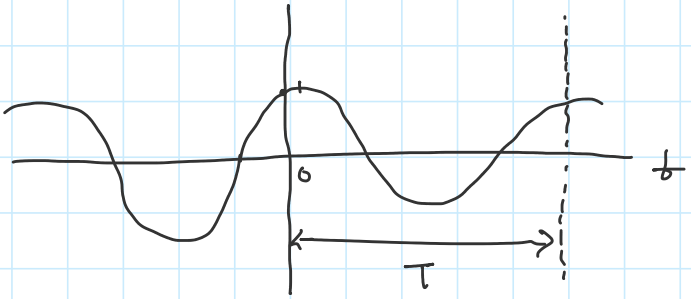
f_0 - Frequency

ϕ - initial phase

frequency : f_0

time-period : $T = \frac{1}{f_0}$

sketch



importance of sinusoids in signals & systems

↳ term for both sin( ) or cos( )

frequency : f_0 in Hz

radian frequency : $\omega_0 = 2\pi f_0$ rad/s

★ Fourier Series for periodic signals

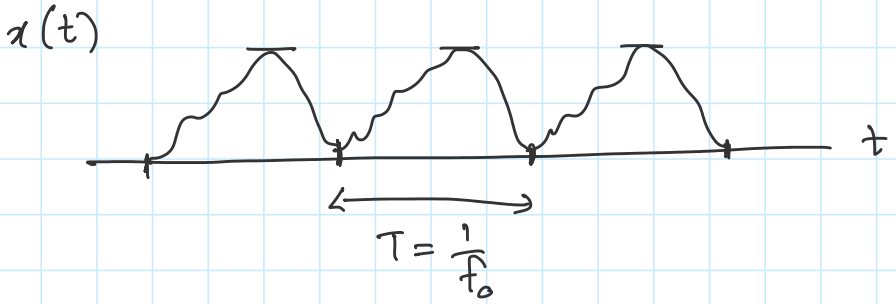
Let $x(t)$ be a periodic signal with period (T)

i.e. $x(t+T) = x(t) \quad \forall\, t$

we can represent ANY* periodic signal using a (infinite) sum of sinusoids. Specifically:

$$x(t) = a_0 + \sum_{k=1}^{\infty} a_k \cos(2\pi k f_0 t) + \sum_{k=1}^{\infty} b_k \sin(2\pi k f_0 t)$$

$x(t)$ has frequency $f_0 = \frac{1}{T}$



$$x(t) \xleftrightarrow{FS} \{a_k, b_k\}$$

↳ Fourier Series coefficients

FS coefficients

$\sin(2\pi k f_0 t)$ } k-th Harmonics

$\cos(2\pi k f_0 t)$ }