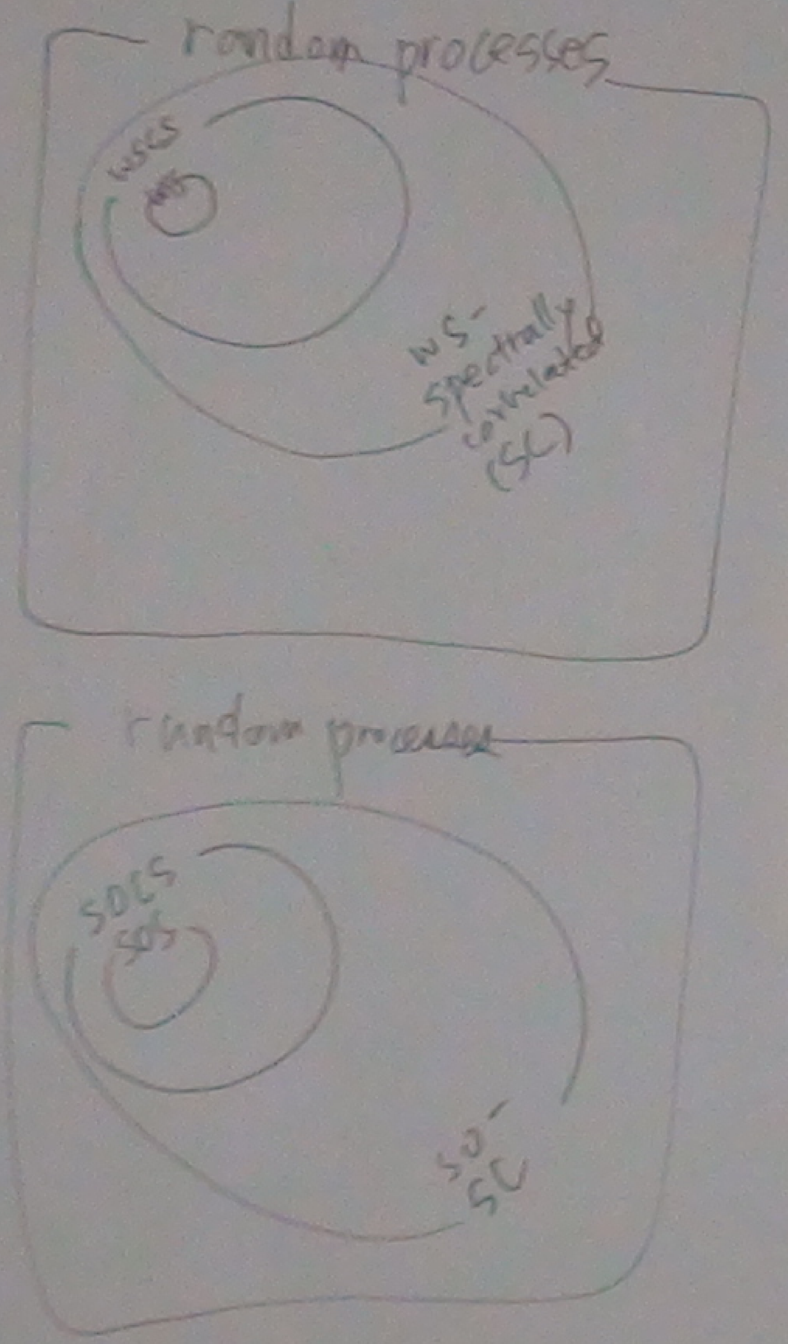
EECE695M CM#1a.

□ Cyclostationarity in Signal Processing & Communications

주기 정상성

□



< CT r.p.
DT r.p.

complex-valued random vectors

proper-complex r.vectors	improper-complex r.vectors

□ Commun.

PAM : improper-complex SOCS

QAM : proper-complex SOCS
improper-complex SOCS

OQAM : " " "

f-OFDM,

FBMC – OQAM
QAM

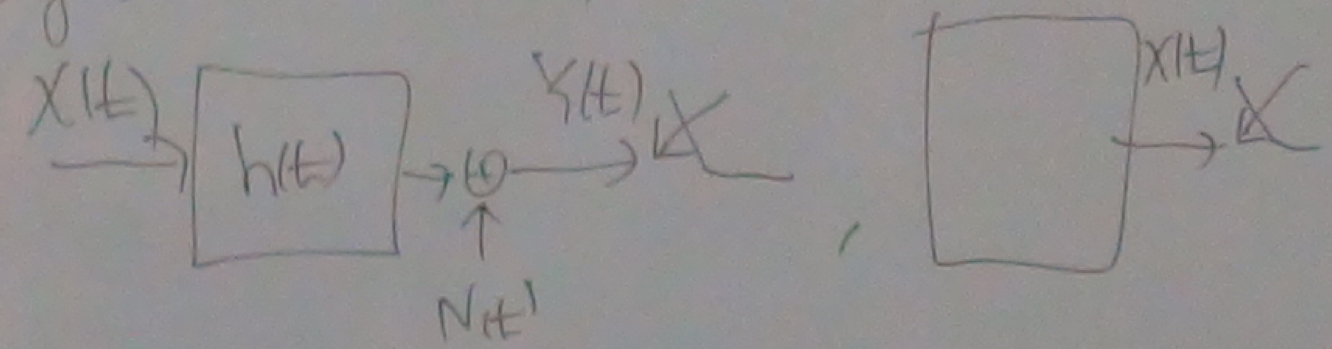
DFT-S-OFDM – QAM : proper-c SOCS

BPSK
$\frac{\pi}{2}$-BPSK : improper-c SOCS

⋮

* Capacity of LTI channel w/ SOCS noise

SOCS R(D)



□ SP

Widely linear receiver — LMMSE

cf) linear receiver — WL-MMSE

FRESH filtering

* Pre-processor : 前처리기

EECE695M CM#1b

□ DT periodic signals

$x[n]$ $\exists N \in \mathbb{N}$, s.t.

$x[n] = x[n+N]$, $\forall n$

□ period 4 → period 8

$x[0] = x[4] = x[8] = x[16]$

$x[1] = x[5] = x[9]$

$\vdots$

$x[0] = x[0]$

$x[1] = x[1]$

□ fundamental period

the smallest period of the periods of a periodic signal, N_0.

kN_0, $k \in \mathbb{N}$.

fundamental freq.

□ $x[n] = \sum_{k=\langle N_0 \rangle} C_k e^{j\frac{2\pi}{N_0}kn}$ Harmonically related complex exponential functions

— — $\frac{2\pi}{N_0}$, $\frac{2\pi}{N_0}2$, $\frac{2\pi}{N_0}3$, ...

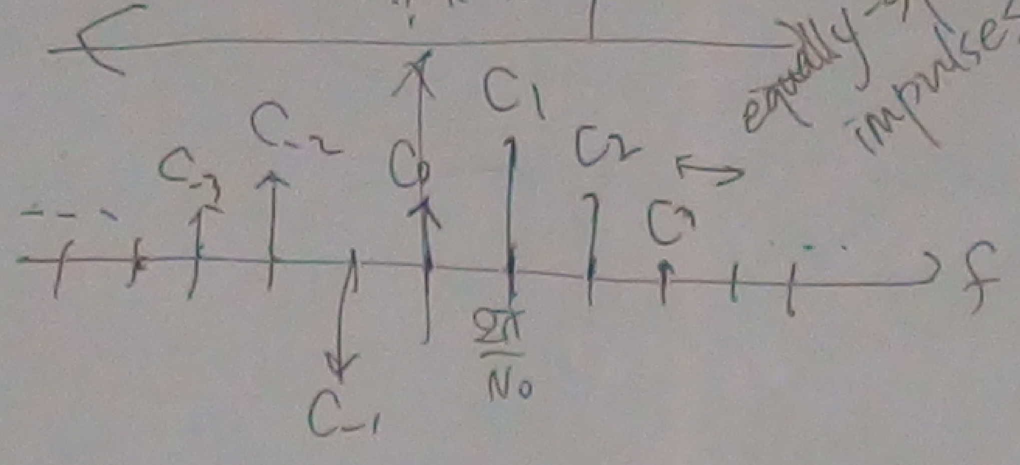
$0 \cos\left(\frac{2\pi}{N_0} \cdot 0 \cdot n\right)$

$+ 2 \cos\left(\frac{2\pi}{N_0} 2n\right)$

$+ 3 \cos\left(\frac{2\pi}{N_0} \cdot 3n\right)$

$+ 7 \cos\left(\frac{2\pi}{N_0} \cdot 7n\right)$

$X(e^{j2\pi f}) = \frac{1}{N_0} \sum_{k=-\infty}^{\infty} C_k \delta\left(f - \frac{2\pi}{N_0}k\right)$



□ Two periodic Signals

$x_1[n] = x_1[n+N_1]$, $\forall n \in \mathbb{Z}$

$x_2[n] = x_2[n+N_2]$, $\forall n \in \mathbb{Z}$

$x[n] = x_1[n] + x_2[n]$

$= x[n+N_0]$, $\forall n$

where $N_0 = \mathrm{lcm}(N_1, N_2)$

□ More than one periodic signals. finite # of

□ CT periodic signals

$x(t)$, $\exists T \in \mathbb{R}_+$ s.t.

$x(t) = x(t+T)$, $\forall t$

□ If T is a period, then kT, $\forall k \in \mathbb{N}$, is a period.

□ fundamental period T_0

the smallest period of ...

□ $x(t) = \sum_{k=-\infty}^{\infty} C_k e^{j\frac{2\pi}{T_0}kt}$ harmonically related.

$\frac{2\pi}{T_0}$: fundamental frequency.

□ $X(f) = \sum_{k=-\infty}^{\infty} a_k \delta\left(f - \frac{2\pi k}{T_0}\right)$

☑ Two

$x_1(t) = x_1(t+T_1)$, $\forall t$,

$x_2(t) = x_2(t+T_2)$, $\forall t$

$x(t) = x_1(t) + x_2(t)$, $\forall t$

Q. $x(t)$ is periodic?

A. No. In general.

$T_1 = 1$, $\sqrt{2}$ $\sqrt{2}$

$T_2 = \cancel{\pi}$ $\sqrt{2}$ $\sqrt{3}$ $\frac{2}{3}\sqrt{2}$

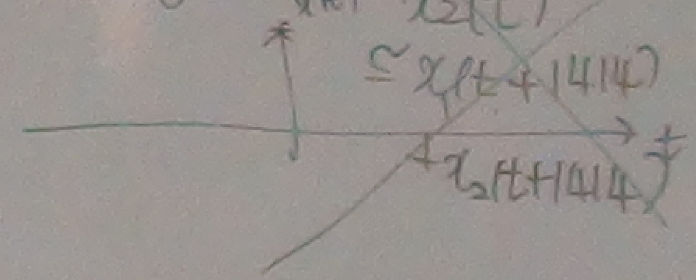
≈ 1.414

□ Almost Periodic Signals.

$x_1(t)$

$x_2(t)$

$\simeq x_1(t+1.414)$



EECE695M CM#1C

□ Signal

- scalar $x \in \mathbb{R}, \mathbb{C}$. $GF(2^q)$
- vector $\underline{x}$
- matrix X

sequence x_n, $x[n]$ DT signal

waveform $x(t)$ CT signal

$\underline{x}[n]$

$X[n]$

$\underline{x}(t)$

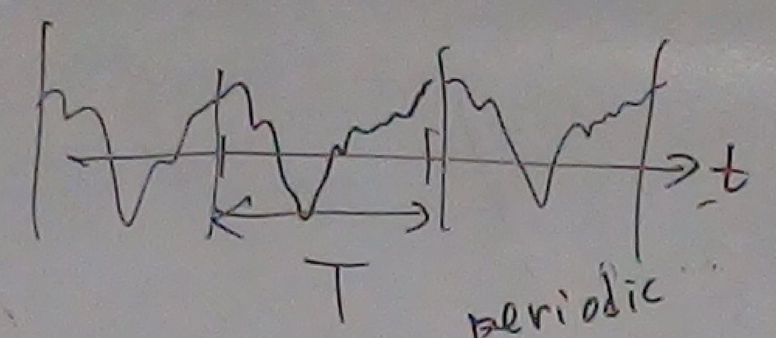
$X(t)$

field $V(x,y)$

$\underline{E}(x,y)$

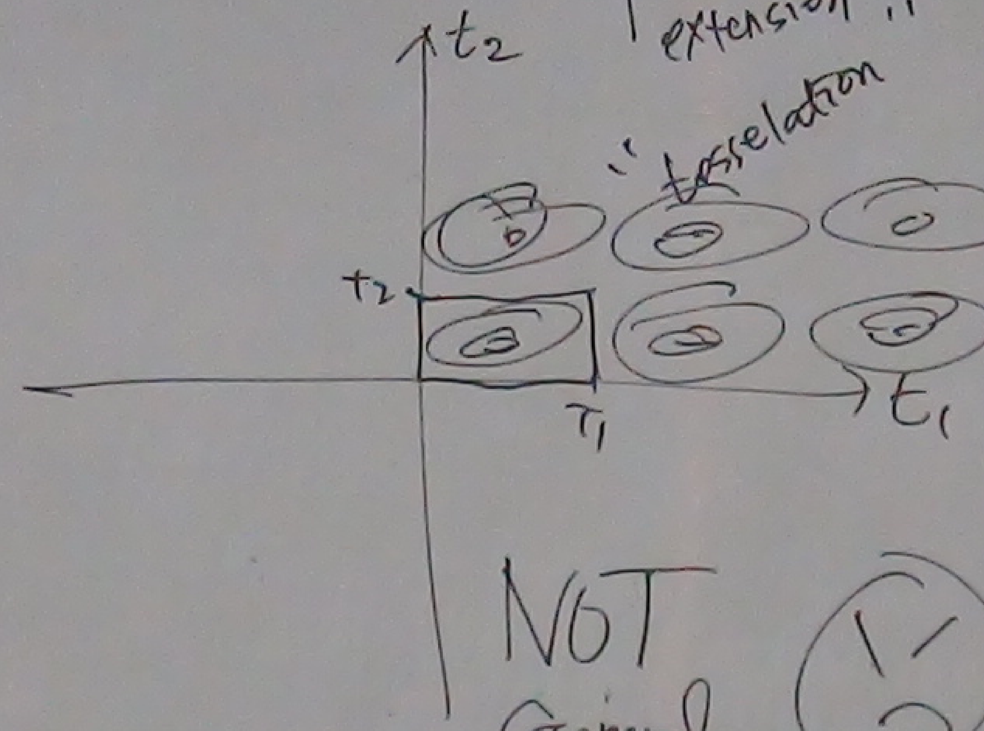
SV

□ $x(t) = x(t+T), \forall t$



"periodic extension"

"tesselation"



NOT General Enough!

□ $V(t_1,t_2) = V(t_1+T_1,\ t_2+T_2),\ \forall (t_1,t_2) \in \mathbb{R}^2$