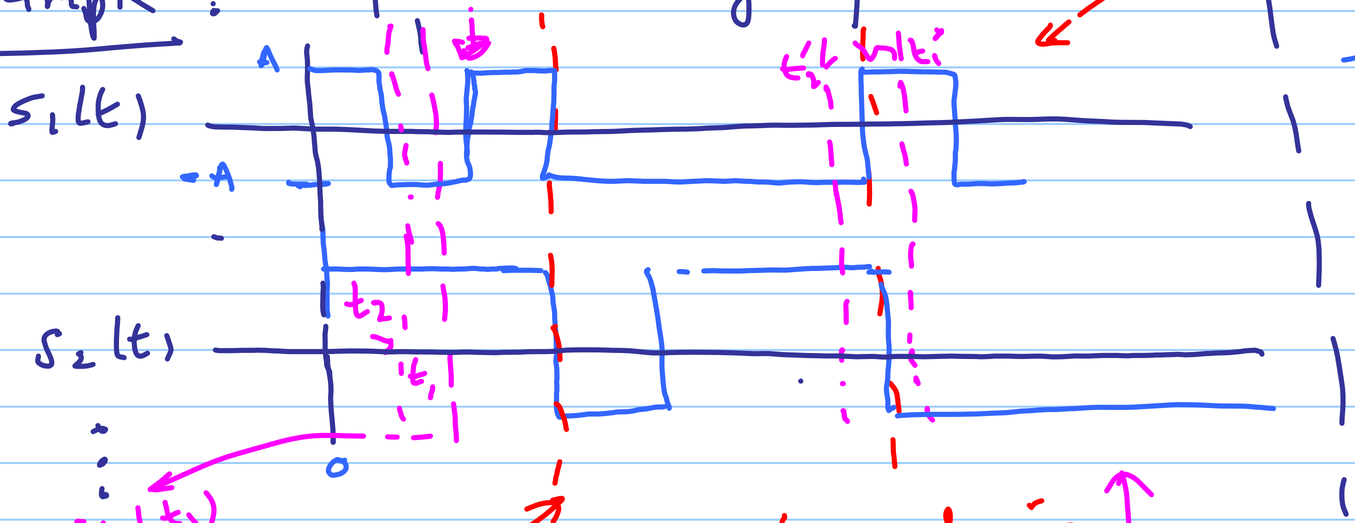
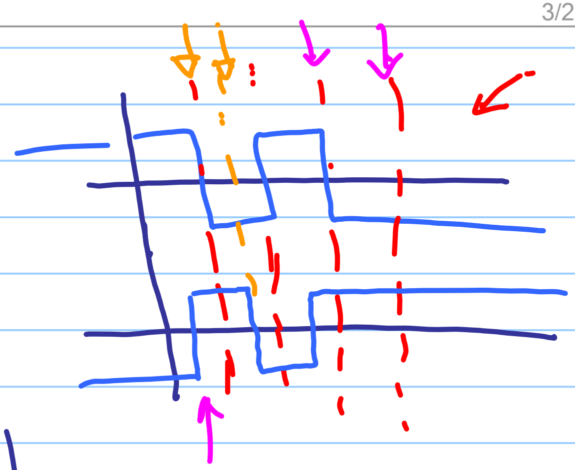
DSL LTE R→D→R

Example: Cyclostationary r.p.

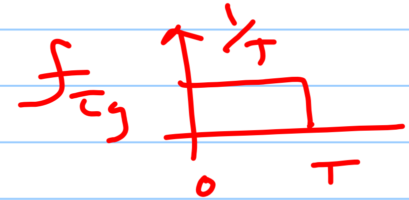


time-aligned bit_boundaries ($\tau_g = 0$)

$$\rightarrow x(t) = \sum_{n=-\infty}^{+\infty} A_n g(t-nT)$$ WSCS



$$x(t) = \sum A_n g(t-nT-\tau_g)$$



WSS

Show that:

(a) $E[X(t_1)] = 0$; $P(A) = P(-A) = 1/2$

(b) $R_X(t_1, t_2) \longrightarrow E[X(t_1)X(t_2)]$

$X(t_1)$: A, $-A$ $X(t_2)$: A, $-A$

t_1, t_2 are in different bit periods.

- $|t_1 - t_2| > T$ → "0"
- $|t_1 - t_2| < T$
  - $nT < t_1, t_2 < (n+1)T$ → A^2
  - straddle bit boundary → "0"

$$R_X(t_1, t_2) = \begin{cases} A^2, & \text{iff } nT \le t_1, t_2 \le (n+1)T \\ 0, & \text{otherwise} \end{cases}$$

$$R_X(t_1, t_2) = R_X(t_1 + nT, t_2 + nT)$$

bit-period

→ WSS

$s_+(t) = s(t) + j\,\hat{s}(t)$

$s(t) \longleftrightarrow s_+(t) \longleftrightarrow \tilde{s}(t)$

Pre-envelope — complex envelope

1. Introduction (Chap-1 in book) to digital communications, and review of sampling theorem and representation of band-pass signals (Chap-2).

2. Overview of random processes – Random variable and random process, Gaussian, white, stationary processes, circular Gaussian random variable, auto-correlation and power spectral density, WSS random signal transmitted through LTI system, band-pass processes (Chap-4), the random binary wave process.

3. Digital communications thro (band-unlimited) AWGN channels – Signal representation, PAM, PSK, and QAM signals, multi-dimensional signals, optimum receiver for AWGN measurement models, probability of error P_e for symbol detection (Sec. 7.1 thro 7.6 in Chap-7), approximate P_e using Union bound, Chernoff bound, P_e for fading channels

Alternate Proof — U. Madhow p.35 — $\frac{\sigma^2 |P(f)|^2}{T}$

N bits ⟵ 2^N, $N \to \infty$

$E[X(t_1)X(t_2)]$

Time Averaging ⟶ Ergodic Assumptions

S, s_1, p_1, $s_1(t)$, nT, $\Sigma(\cdot)$