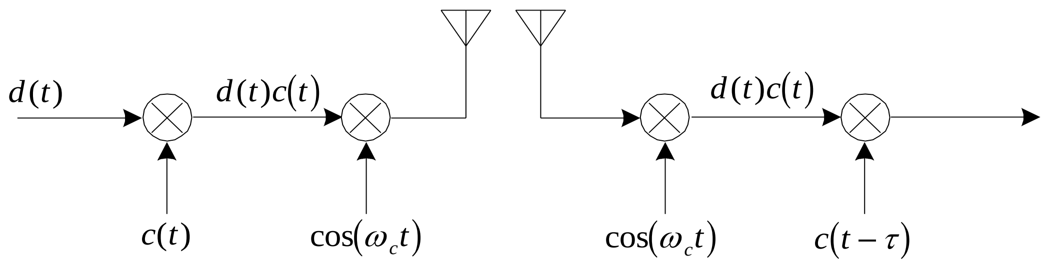
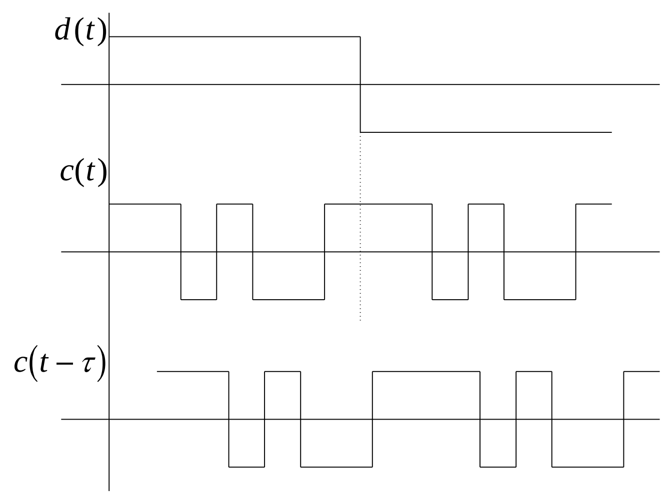
Synchronization

Contents

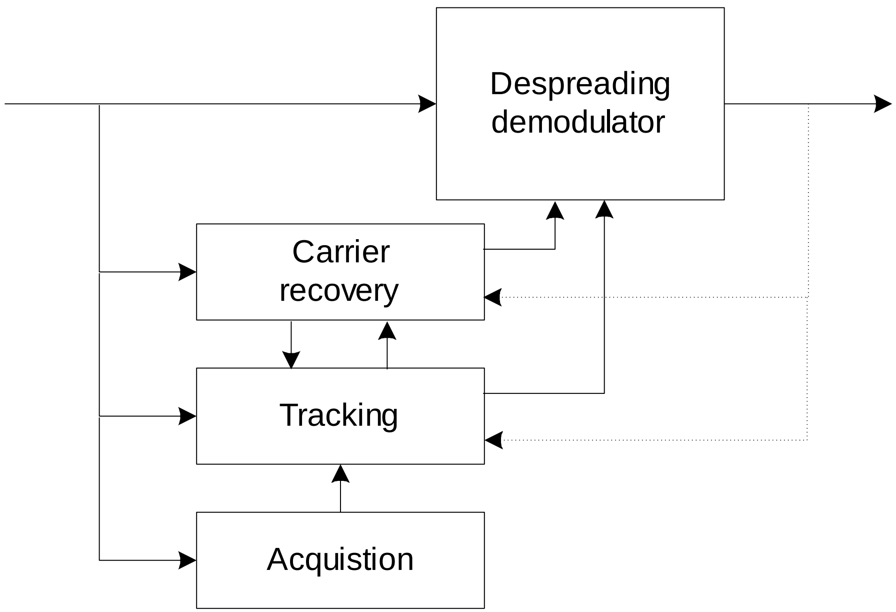
Introduction



< CDMA systems >



- Acquisition: Course synchronization
- Tracking: Fine synchronization

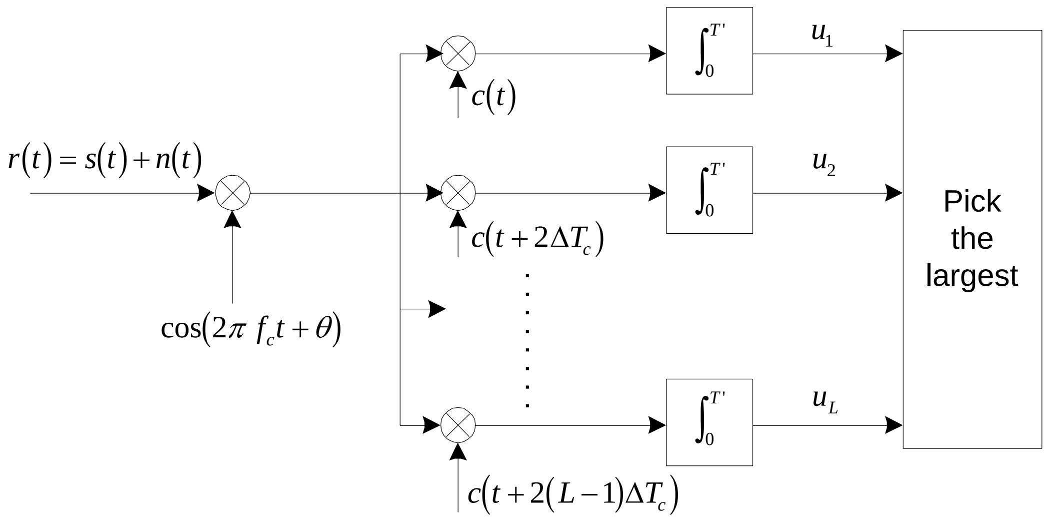


Acquisition

- Classification
  - Parallel search
  - Serial search
  - Hybrid search

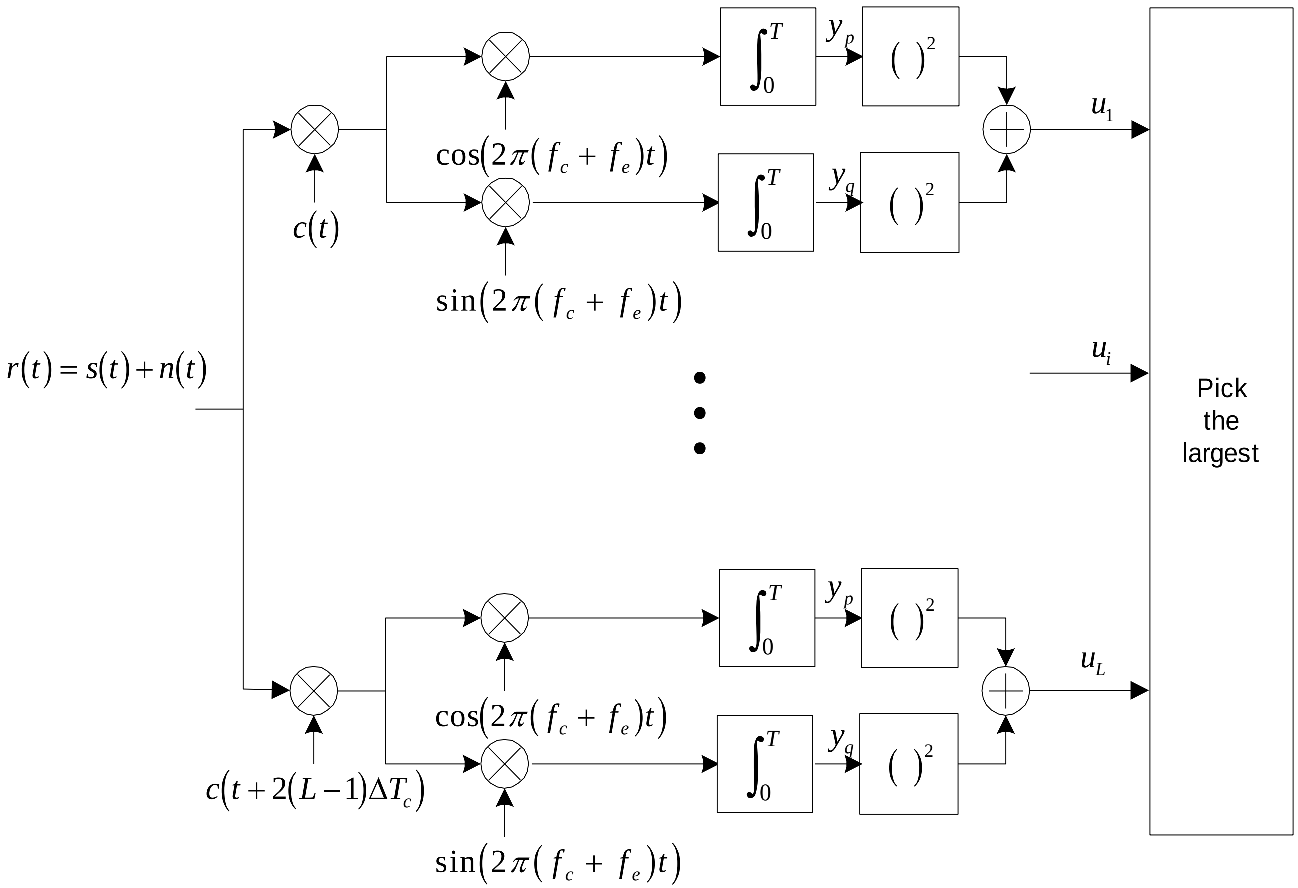
  - Single dwell
  - Multiple dwell

- Fixed dwell parallel scheme
  - Coherent version



- Input : $r(t)=\sqrt{2P}c(t+\tau_1)\cos(2\pi f_c t+\theta)+n(t)$
- Integration time T′
- Total $L(=NT_c/2\Delta T_c)$ phases are inspected
- Assumption : Coherent Scheme (f_c, θ is known)

– Noncoherent version



$$y_p = \sqrt{2P}\int_0^{T'} c(t+\tau_1)c\big(t+2(i-1)\Delta T_c\big)\cos(2\pi f_c t+\theta)\cos\big(2\pi(f_c+f_e)t\big)dt$$

$$= \sqrt{\frac{P}{2}}\int_0^{T'} c(t+\tau_1)c\big(t+2(i-1)\Delta T_c\big)\cos(2\pi f_e t-\theta)dt$$

$$y_q = \sqrt{\frac{P}{2}}\int_0^{T'} c(t+\tau_1)c\big(t+2(i-1)\Delta T_c\big)\sin(2\pi f_e t-\theta)dt$$

$$f_e << 1/T' \quad , \; 2\pi f_e t-\theta \approx \text{constant}$$

$$\therefore\; y_p = \sqrt{\frac{P}{2}}\cos(2\pi f_e t-\theta)\int_0^{T'} c(t+\tau_1)c\big(t+2(i-1)\Delta T_c\big)dt$$

$$y_q = \sqrt{\frac{P}{2}}\sin(2\pi f_e t-\theta)\int_0^{T'} c(t+\tau_1)c\big(t+2(i-1)\Delta T_c\big)dt$$

$$\therefore\; u_i = y_p^2+y_q^2 = \frac{P}{2}\left[\int_0^{T'} c(t+\tau_1)c\big(t+2(i-1)\Delta T_c\big)dt\right]^2$$

– Mean Acquisition Time

- Penalty time: T_p

  1,2... , (n−1)th detection incorrect,

  nth detection correct: $(n-1)T_p + nT'$

- Detection prob in each attempt : P_d

  1,2... , (n−1)th detection incorrect,

  nth detection correct: $(1-P_d)^{n-1}P_d$

- Mean acquisition time

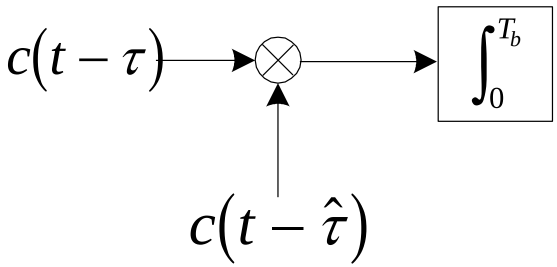
$$T_{acq} = T^{'} P_d + \left(T_p + 2T^{'}\right)(1 - P_d) P_d +$$

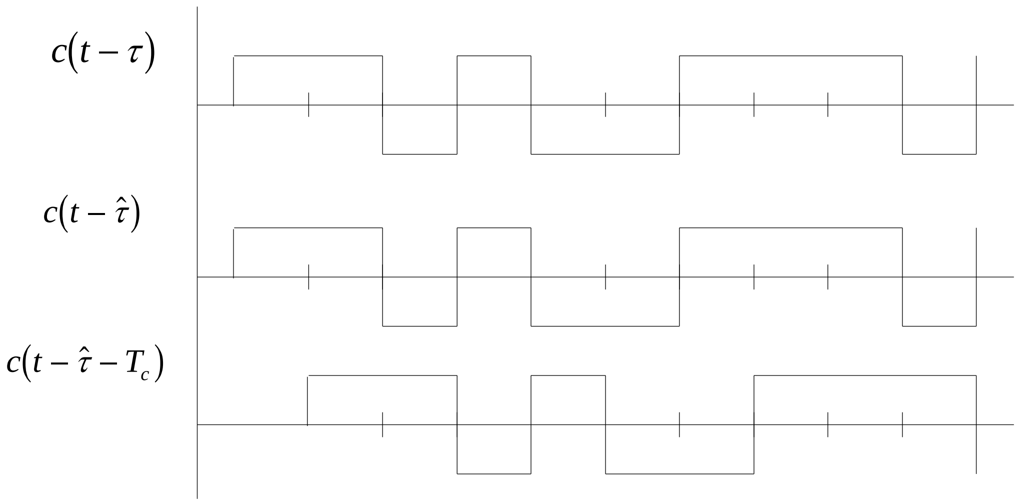
$$\cdots \quad + \left((n-1)T_p + T^{'} n\right)(1 - P_d)^{n-1} P_d \cdots$$

$$= \sum_{n=1}^{\infty} \left(nT^{'} + (n-1)T_p\right)(1 - P_d)^{n-1} P_d$$

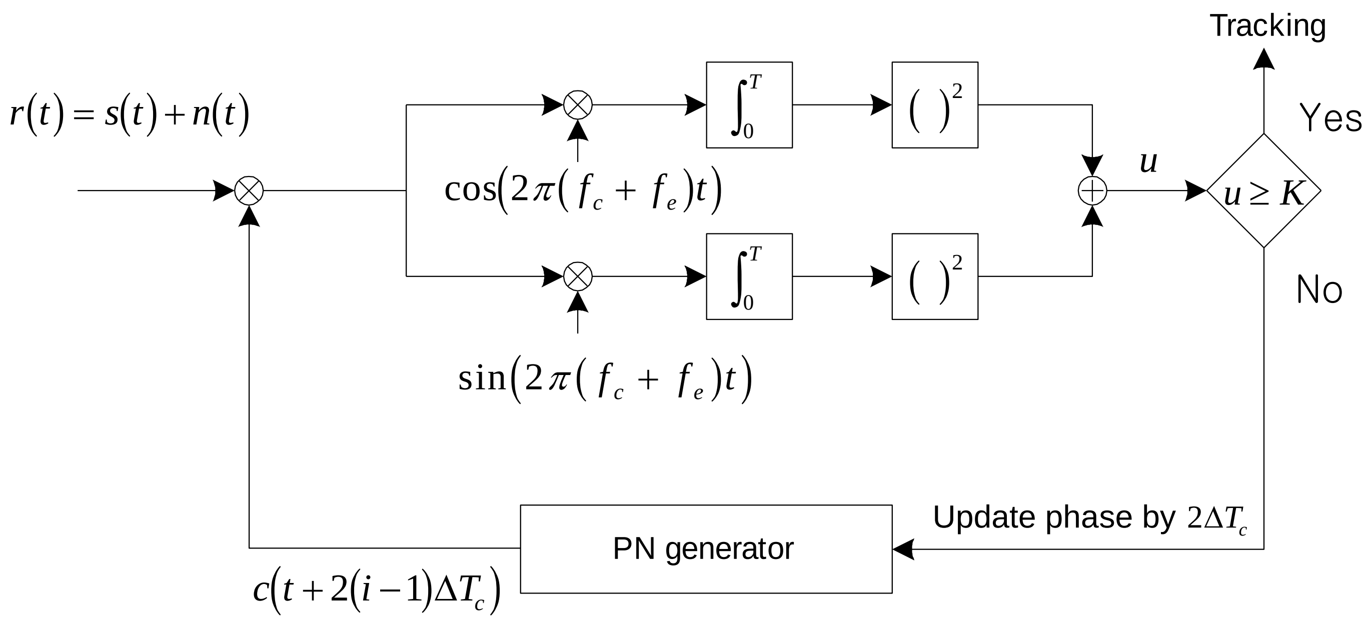
$$= \frac{T^{'} + T_p}{P_d} - T_p$$

• Serial Search example

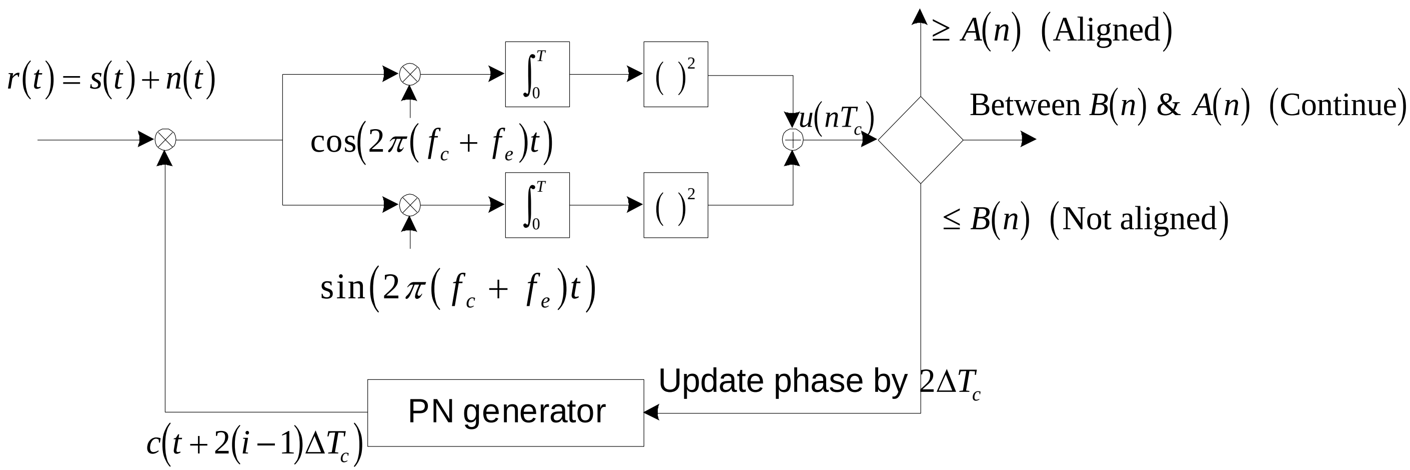




- Fixed dwell Serial Scheme



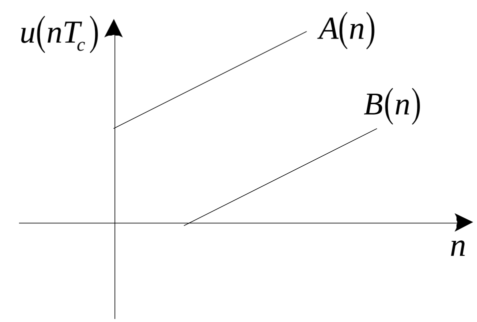
- # Sequential detection



If $u(nT_c) \ge A(n) \rightarrow$ Aligned

$u(nT_c) \le B(n) \rightarrow$ Update phase

$A_n \le u(nT_c) \le B(n) \rightarrow$ Continue

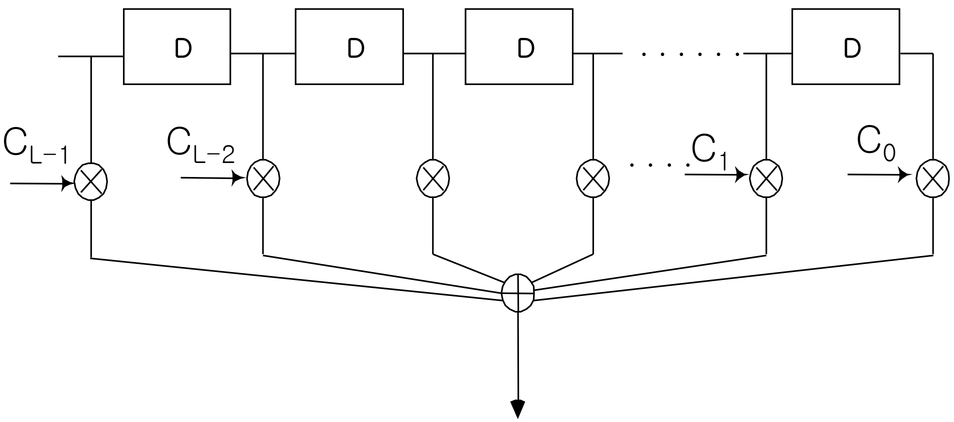


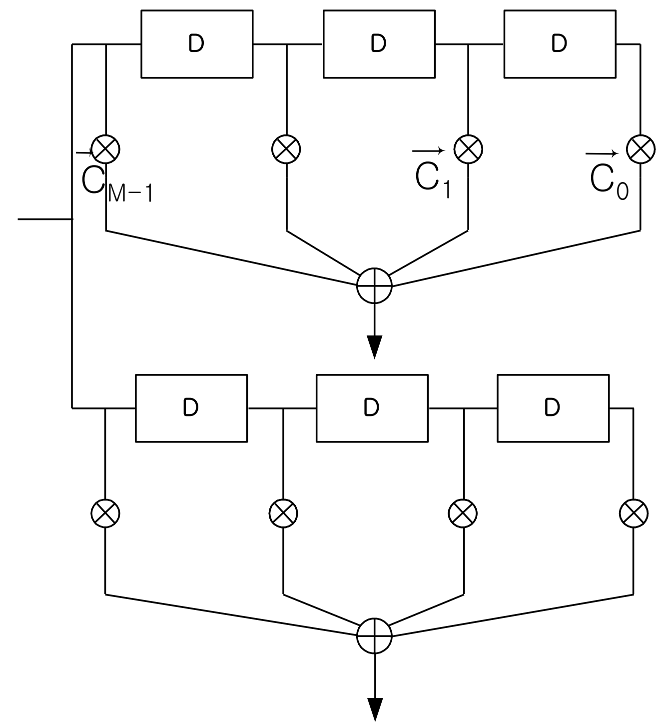
Straight – Serial Search Algorithm

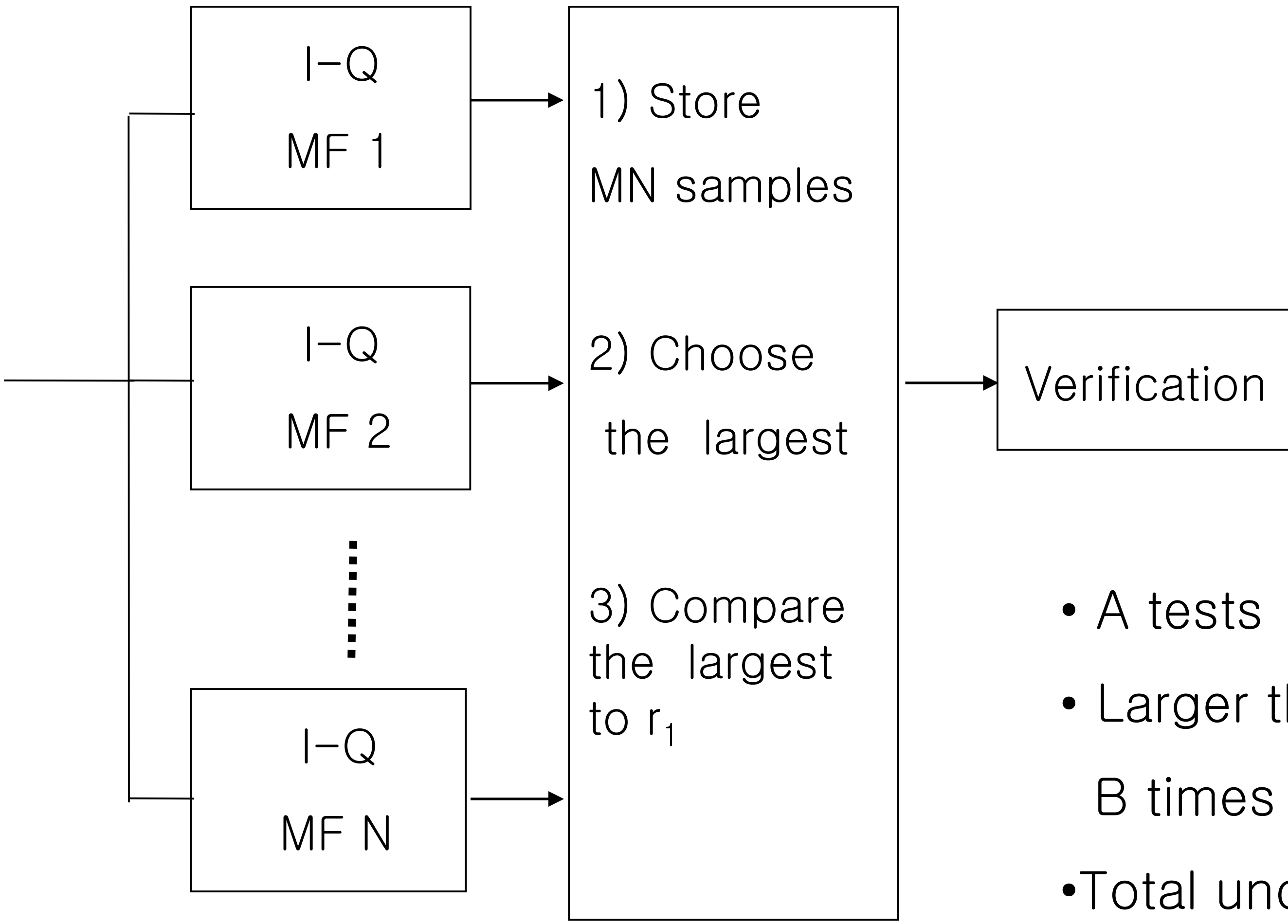
Reference: Andreas Polydoros, Charles L. Weber,
"A unified approach to serial search spreadcode acquisition – Part 1: General theory," *IEEE Trans. Commun.*, vol.COM-32, pp.542~549, May 1984

Parallel Acquisition

Ref : E.Sourour & S.Goupta
“DS/SS Parallel Acquisition in a Fading Mobile Channel,”
IEEE Trans.Commun., pp. 992~998, July 1990


D
D
D
D
C_{L-1}
C_{L-2}
C_1
C_0


D
D
D
C_{M-1}
C_1
C_0
D
D
D

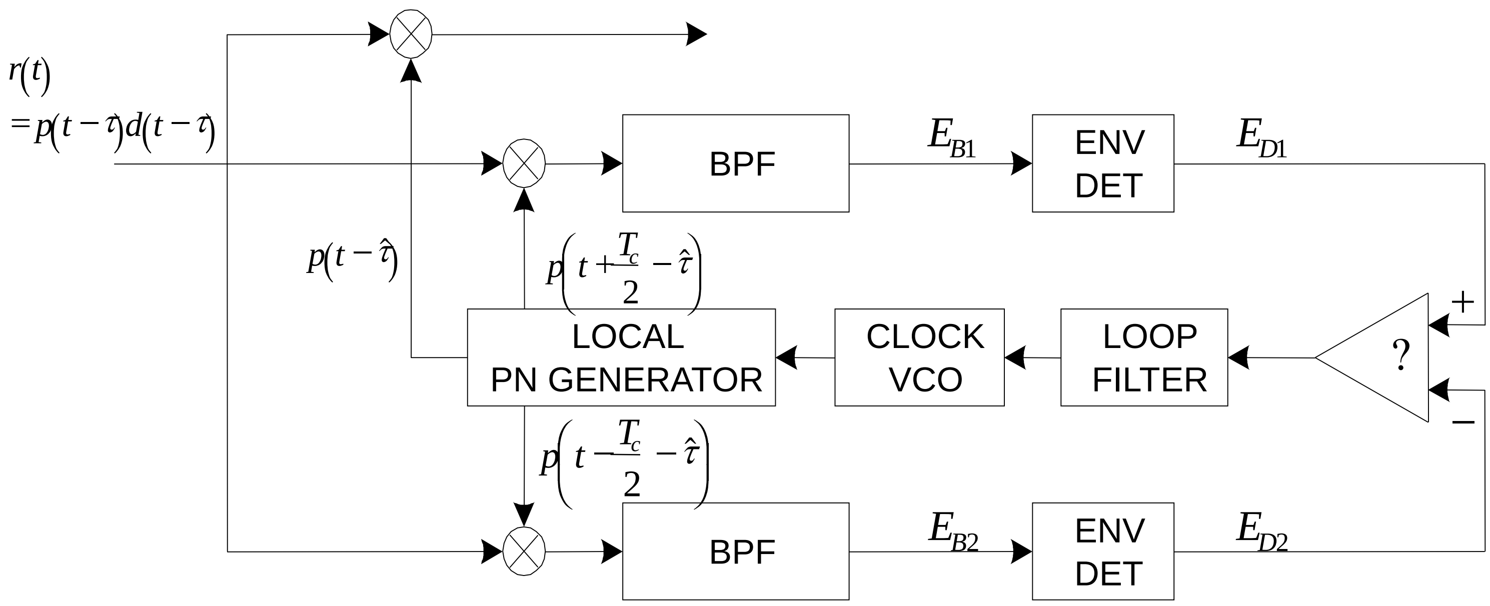


- A tests
- Larger than r_1

  B times => verified
- Total uncertainty region

  = period = L = MN

Tracking


r(t)
= p(t − τ)d(t − τ)
BPF
E_{B1}
ENV
DET
E_{D1}
$p(t-\hat{\tau})$
$p\left(t+\frac{T_c}{2}-\hat{\tau}\right)$
LOCAL
PN GENERATOR
CLOCK
VCO
LOOP
FILTER
?
+
−
$p\left(t-\frac{T_c}{2}-\hat{\tau}\right)$
BPF
E_{B2}
ENV
DET
E_{D2}

$$E_{B1} = \left\langle p(t-\tau)\, p\left(t-\hat{\tau}+\frac{T_c}{2}\right)\right\rangle d(t-\tau)\cos(\omega_o t+\phi)$$

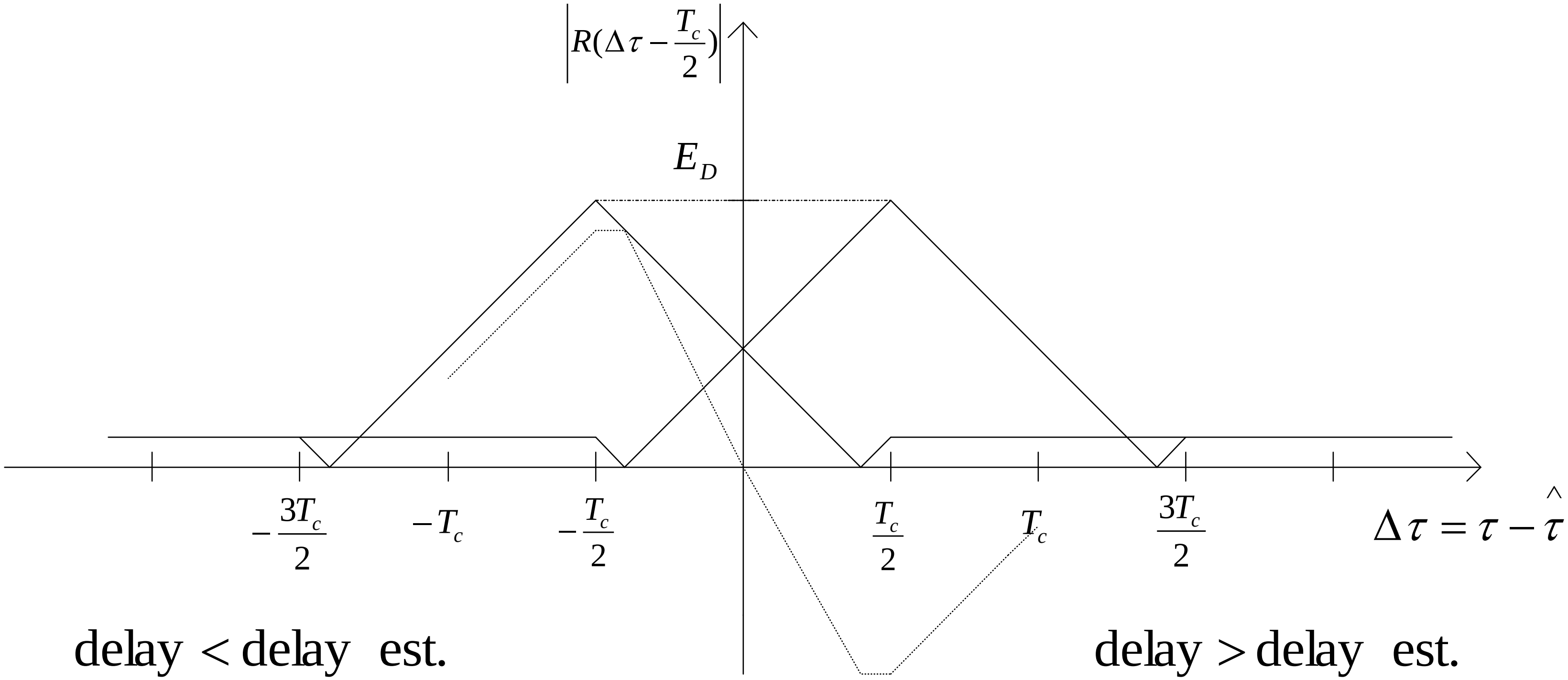
$$= R\left(\tau-\hat{\tau}+\frac{T_c}{2}\right) d(t-\tau)\cos(\omega_o t+\phi)$$

$$E_{D1} = \left| R\left(\tau-\hat{\tau}+\frac{T_c}{2}\right)\right| = \left| R\left(\Delta\tau+\frac{T_c}{2}\right)\right|$$

where $\Delta\tau = \tau - \hat{\tau}$

$$E_{D2} = \left| R\left(\Delta\tau-\frac{T_c}{2}\right)\right|$$

$$Y = E_{D2} - E_{D1} = \left| R\left(\Delta\tau-\frac{T_c}{2}\right)\right| - \left| R\left(\Delta\tau+\frac{T_c}{2}\right)\right|$$


$\left|R(\Delta\tau - \frac{T_c}{2})\right|$
E_D
$-\frac{3T_c}{2}$
$-T_c$
$-\frac{T_c}{2}$
$\frac{T_c}{2}$
T_c
$\frac{3T_c}{2}$
$\Delta\tau = \tau - \hat{\tau}$
delay < delay est.
delay > delay est.

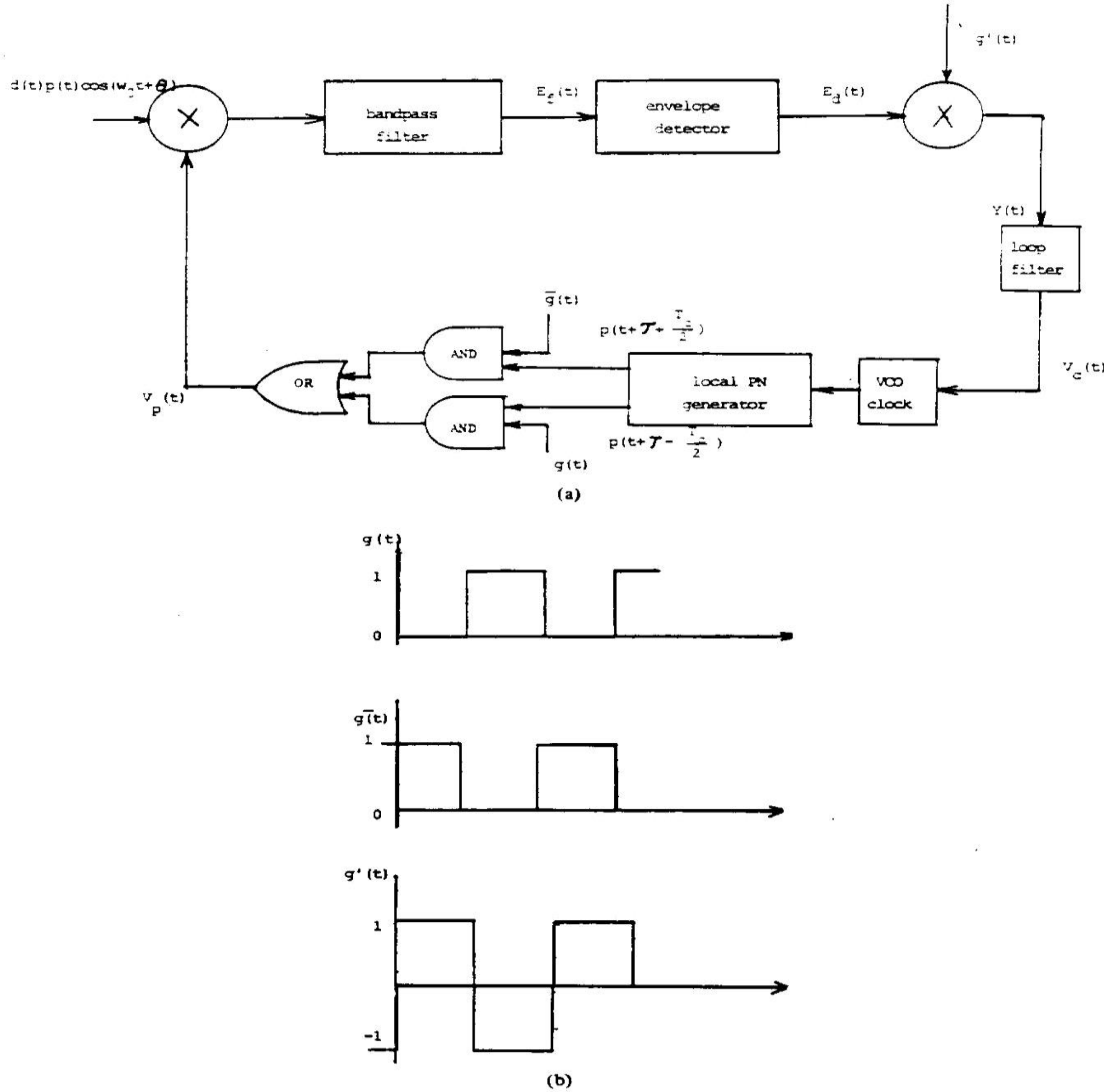


Fig. 23. The tau-dither loop. (a) Block diagram. (b) Control waveforms.