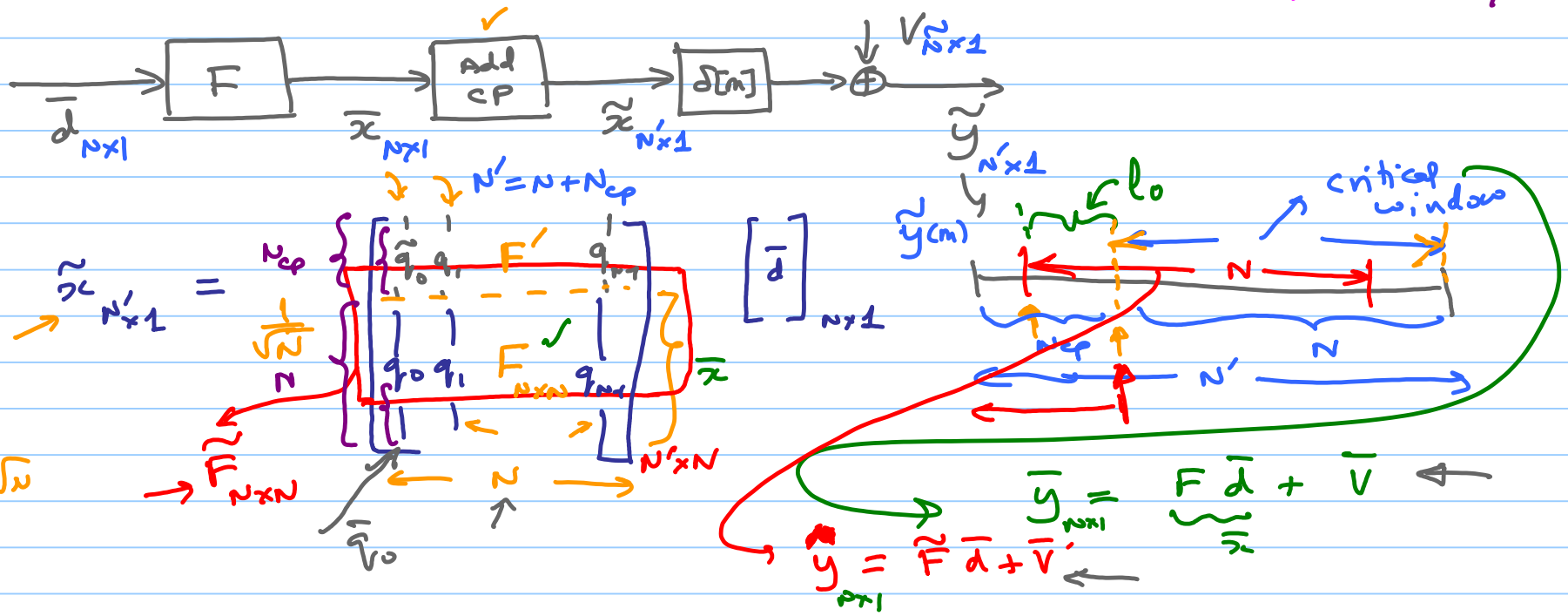
EE6323 Feb-May, 2021

Class #9 (Apr. 13, 2021)

Note Title 27-03-2020

Best Wishes for Ugadi / Vishu / Puththaandu / Navaratri



(*) $F^H \bar{y} = F^H F \bar{d} + F^H \bar{v} = \bar{d} + \bar{v}'$

$I_{N\times N}$ — v' — "B, th are acceptable"

(*) $F^H \hat{y} = F^H \tilde{F} \bar{d} + F^H \bar{v}$

$\tilde{F}$ — $\hat{}$ — $N\times N$

$= \begin{bmatrix} 1 & & \\ & e^{-j\frac{2\pi}{N}1\cdot l_0} & \\ & & \ddots \\ & & e^{-j\frac{2\pi}{N}(N-1)l_0} \end{bmatrix}$

$N_{cp}+1$ — Timing recovery. — $N+N_{cp}=N'$

(*) Properties (Revisit)

Prop #0: $\sum_{n=0}^{N-1} q_n(m) = \begin{cases} 0, & n=1,2\cdots N-1 \\ \sqrt{N}, & n=0 \end{cases}$

Prop #1: $\bar{q}_n^H \bar{q}_n = 1$

Prop #2: $\bar{q}_n^H \bar{q}_{n'} = 0, \quad n' \neq n \in \{0,\cdots N-1\}$

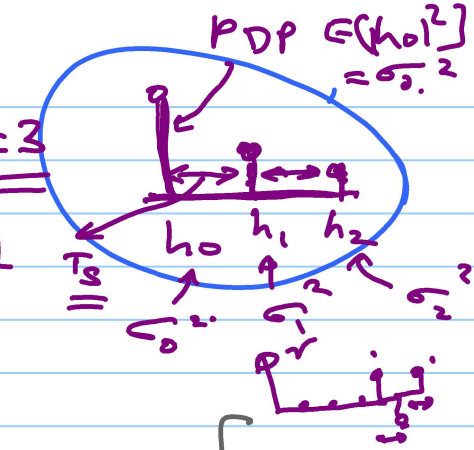
Prop #3: $\bar{q}_n^H \bar{q}_{n,l} = e^{-j\frac{2\pi}{N} n l}$

$\bar{x}$ — F — $[q_0\ q_1 \cdots q_{N-1}]$ — $q_{N/2}$ — $[\bar{d}]$ — $I(0)=0$

$[q_{N/2+1} \cdots q_{-1}\ \bar{q}_0\ \bar{q}_1 \cdots \bar{q}_{N/2}]$

prop # 4 $\bar{q}_n^{H} \bar{q}_{n',l} = 0$ ✓ , $n \neq n' \rightarrow l \in \{0 \text{ to } N_{cp}\}$

Recall : $h[n] \rightarrow$ multi tap channel $\{h_l\}$, $l = 0, 1, 2$ ↖ $L-1$



$L-1$ samples will have $|B|$

$N' = N + N_{cp}$, $L-1 < |B|$ $\tilde{y}(n)$

$\tilde{y}_{N\times 1}$ $\bar{y}_{N\times 1}$

$h_l * \tilde{x}(n)$ → CP removal → h_l (x) $x(n)$ ✓

$$F^H \bar{y} = F^H (h_l \circledast x(m))$$

$$= F^H h_l \odot F^H \bar{x} \leftarrow \bar{F}\bar{d}$$

$\odot$ → Schur / Hadamard product.

$|\mathcal{B}|$

$$N_{cp} - (L-1) + 1$$

$$N_{cp} - L + 2$$

(*) $N_{cp} - (L-1) = 0$, we are still kept with critical window

$L \leq N_{cp} + 1$ ⟶ $1 \leq L \leq N_{cp} + 1$

Block Modulation ⟶ OFDM / OFDMA → sync. → Timing sync. / Carrier sync.

→ C-E.

CFO

$\langle \bar{q}_n \bar{q}_n \rangle \rightarrow \pm 1$

$\langle \bar{q}_n, \bar{q}_m \rangle \neq 0$