

Lecture 22

Thursday, February 04, 2010
12:53 PM

Two ways to generate H_N where N is 2^t \leftarrow
positive integer

Method 1: Sylvester's construction

(shortcut)

$$H_1 = [1] \equiv [0]$$

$$H_{2N} = \begin{bmatrix} H_N & H_N \\ H_N & \overline{H_N} \end{bmatrix}$$

$$= H_2 \otimes H_N$$

$H_{2 \times 1}$

$$H_2 = \begin{bmatrix} H_1 & H_1 \\ H_1 & \overline{H_1} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$H_4 = H_{2 \times 2} = \begin{bmatrix} H_2 & H_2 \\ H_2 & \overline{H_2} \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$$

Method 2: Special Multiplication
(Kronecker product)

$$H_{ab} = H_a \otimes H_b$$

$$H_8 = H_2 \otimes H_4 = H_4 \otimes H_2$$

$$\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$= \begin{bmatrix} H_4 & H_4 \\ H_4 & \overline{H_4} \end{bmatrix}$$

$$\begin{bmatrix} H_2 & \overline{H_2} & H_2 & \overline{H_2} \\ H_2 & H_2 & \overline{H_2} & \overline{H_2} \\ H_2 & H_2 & \overline{H_2} & H_2 \\ H_2 & \overline{H_2} & \overline{H_2} & H_2 \end{bmatrix}$$

GPS

m-Sequence

Walsh codes

m-Sequence
(auto-correlation)
one user.

→ Gold Code ←

Walsh codes
poor autocorr.
Excellent
cross correlation
(orthogonality)
Syn. CDMA

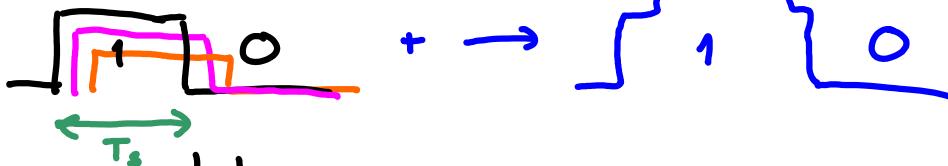
Wireless channel

Send : $x(t)$

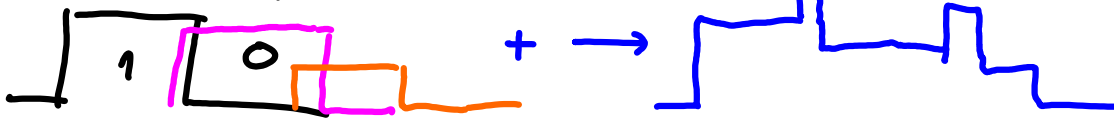
Receive : $\beta_1 x(t-\tau_1) + \beta_2 x(t-\tau_2) + \beta_3 x(t-\tau_3) + \dots$
multipath



Small delay



Large delay



Inter-symbol interference

" T_s (symbol period)" should be \gg delay.