AV312 - Lecture 18

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Figures from "Communication Systems" by Haykin and "An Intro. to Analog and Digital Commn." by Haykin and Moher

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Review of last classes

- Intersymbol interference
- Nyquist bandwidth and channel
- Raised cosine pulse shaping
- Duobinary signalling

Today's class

- Zero-forcing equalization
- Today's scribes are T. Santhoshi and Shah Kunjan Amiya

Zero-forcing equalization

- Recall the digital transmission system block diagram
- A transmit filter $G(f)$, a channel $H(f)$, and a receive filter $Q(f)$
- Let us assume that transmit filtering is not done
- We have $P(f) = H(f)Q(f)$
- We will consider a special form for $Q(f)$ - a linear transversal filter
- The impulse response of $Q(f)$ is $q(t) = \sum_{k=-N}^{N} w_k \delta(t - kT_b)$
- Then $p(t) = h(t) \star q(t)$

Zero-forcing equalization

- $p(t) = h(t) \star q(t)$
- Or $p(t) = \sum_{k=-N}^{N} w_k h(t - kT_b)$
- At the sampling instants $p_n = p(nT_b) = \sum_{k=-N}^{N} w_k h((n-k)T_b)$
- Let $h_n = h(nT_b)$
- Our requirement is

$$p_n = \begin{cases} \sqrt{E}, & \text{for } n = 0, \\ 0, & \text{otherwise.} \end{cases}$$

- Can we adjust w_k to satisfy these requirements?

Zero-forcing equalization

- Our requirement is

$$p_n = \begin{cases} \sqrt{E}, & \text{for } n = 0, \\ 0, & \text{otherwise.} \end{cases}$$

- We can adjust w_k so that

$$p_n = \sum_{k=-N}^{N} w_k h_{n-k} = \begin{cases} \sqrt{E}, & \text{for } n = 0, \\ 0, & \text{for } n = \pm 1, \pm 2, \ldots, \pm N. \end{cases}$$

- The receiver determines h_{n-k} via pilot sequence assisted training