

6.E Perspectives on Narrowband MUD

6.E.1

- Two final observations regarding MUD for narrowband detection:
 - it's a lot like intersymbol interference and equalisers;
 - asynch systems have an equivalent synchronous description.
- It's a lot like ISI and equalisers. Consider single source transmitting through channel with impulse response $h(t)$.

$$\text{send } s(t) = \sum_n b(n) p(t - nT)$$

$$\text{receive } r(t) = s(t) \otimes h(t) + n_w(t)$$

where we'll take the imp resp to be symbol spaced for simpler presentation

$$h(t) = h_0 \delta(t) + h_1 \delta(t - T) + h_2 \delta(t - 2T)$$

The matched filter output is then

$$y(i) = \sum_{j=0}^2 h_j b(i-j) + n(i)$$

• Expressed as arrays

$$\underline{y} = H \underline{b} + \underline{n}$$

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_{N+2} \end{bmatrix} = \begin{bmatrix} h_0 & & & & \\ h_1 & h_0 & & & \\ h_2 & h_1 & h_0 & & \\ & 0 & h_2 & h_1 & h_0 \\ & & & \ddots & \\ & & & & 0 & h_2 \end{bmatrix} \begin{bmatrix} b_1 \\ \vdots \\ b_N \end{bmatrix} + \begin{bmatrix} n_1 \\ \vdots \\ n_N \\ n_{N+1} \\ n_{N+2} \end{bmatrix}$$

A finite number of discrete variables (b 's) affect measurements linearly.

Compare $\underline{y} = F \underline{b} + \underline{n}$ multiuser

$$= \begin{bmatrix} F_{11} & F_{k1} \\ \vdots & \vdots \\ F_{M1} & F_{Mk} \end{bmatrix} \underline{b} + \underline{n}$$

A similar situation.

Many of the same approaches (ZF, MMSE, Viterbi, DFE) are used.

— The full vector of sufficient stats stacks the vectors per symbol G.E.5

$$y = \begin{bmatrix} y(0) \\ y(1) \\ \vdots \\ y(N-1) \end{bmatrix} = \begin{bmatrix} \text{[Block Matrix]} \\ \text{[Block Matrix]} \\ \text{[Block Matrix]} \\ \text{[Block Matrix]} \end{bmatrix} \begin{bmatrix} b(0) \\ \vdots \\ b(N-1) \end{bmatrix} + \underline{\text{noise}}$$

Block structured, small number of block bands on either side of block diagonal.

• We can still write

$$y = H \underline{b} + \underline{n}$$

equiv. synch. system.

A finite number of discrete variables (b 's) affect measurements linearly.