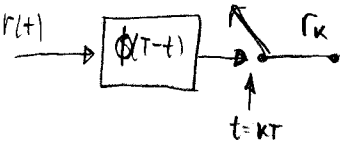
ML Sequence Detector

- Decode not symbols but a whole sequence
- PAM:



$\bar{r} = (r_1, r_2, \ldots, r_k)$

$s^{(m)}$ - transmitted sequence

$$p(\bar{r}|\bar{s}^{(m)}) = \prod_{k=1}^{K} p(r_k|s_k^{(m)})$$ - noise samples are independent

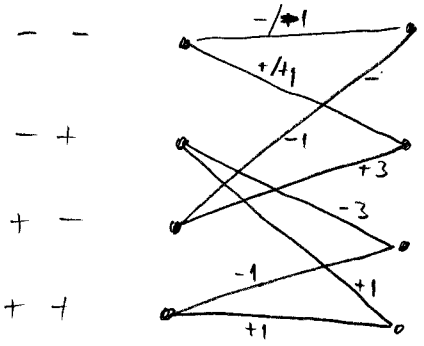
$$p(\bar{r}|\bar{s}^{(m)}) = \prod_{k=1}^{K} p(r_k|s_k^{(m)}) = \left(\frac{1}{\sqrt{2\pi\sigma^2}}\right)^K \cdot e^{-\frac{1}{2\sigma^2}\sum_{k=1}^{K}(r_k - s_k^{(m)})^2}$$

Example $y_k = x_0 + \sum_{j=1}^{L-1} h_j x_{k-j}$ - linear filter channel

$y_k = x_k - x_{k-1} + x_{k-2}$

x_{k-2}	x_{k-1}	x_k	y_k
−	−	−	−1
−	−	+	+1
−	+	−	−3
−	+	+	+1
+	−	−	−1
+	−	+	+3
+	+	−	−1
+	+	+	+1

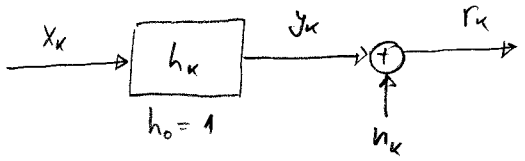
x_{k-2} x_{k-1} - state x_k - input y_k - output



Use Viterbi algorithm

Maximum Likelihood Detection for Channels with Memory

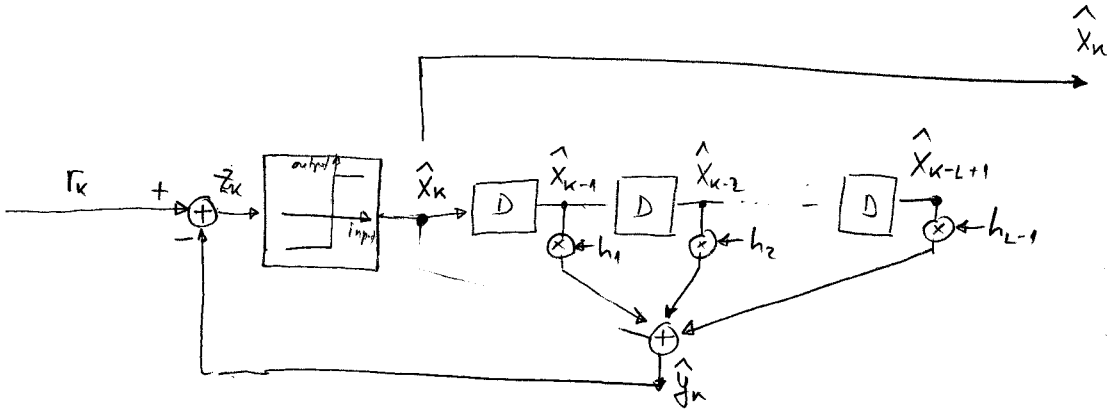
Linear filter channel



$$y_k = x_k * h_k = x_0 + \sum_{j=1}^{L-1} h_j x_{k-j}$$

↖ L−1 previous samples

A naive detector



$y_k = x_k - x_{k-1}$

x_k :	−1	−1	+1	+1	+1	+1	+1	−1	−1
y_k :	−1	0	+2	0	0	0	0	−2	0
r_k	−1.1	0.1	2.1	0.1	−1.1	−0.1	0.1	−2.1	0.1
$\hat{y}_k$	0	1	1	−1	−1	1			
z_k	−1.1	−0.9	1.1	1.1	−0.1	−1.1			
$\hat{x}_k$	−1	−1	+1	+1	−1	−1			