

X

DECODING OF CONVOLUTIONAL CODE

Principle Involved.

$$\begin{array}{rccccccc}
 & \overline{F}_0 & \overline{F}_1 & \overline{F}_2 & \overline{F}_3 & \overline{F}_4 & \overline{F}_5 & \overline{F}_6 \\
 F = & 11 & 11 & 10 & 01 & 10 & 10 & 11 \\
 \overline{C} = & \overline{C}_0 & \overline{C}_1 & \overline{C}_2 & \overline{C}_3 & \overline{C}_4 & \overline{C}_5 & \overline{C}_6
 \end{array}$$

Decode $\Rightarrow$ Find a valid codeword.

Received codeword.

Might NOT be a valid codeword — Due to errors over channel.

Corresponding to
Path in Trellis.

Decode as accurately
as possible.

The most probable
codeword that has
been transmitted.

Most likely
codeword
to have been
transmitted.

Transmitted codeword
with maximum
likelihood.

Hamming Distance :

$\hookrightarrow$ = # bits of Dissimilarity
between two codewords.

Ex:

$$\begin{array}{cccccc} 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 0 \end{array} = \begin{array}{l} \overline{F} \\ \overline{C} \end{array}$$

Two dissimilar Bits
 $\Rightarrow$ Hamming Distance
 $= d_H = 2$

Decoding Principle:

$\min d_H(\overline{F}, \overline{C})$

Hamming Distance

codeword.

received word.

Maximum Likelihood Decoder

$\hat{c}$ So found from this decoder is the maximum likelihood estimate.

Further observe,

$$\begin{aligned} d_H(\bar{c}, \bar{r}) &= d(\bar{c}_0, \bar{r}_0) + \underbrace{d(\bar{c}_1, \bar{r}_1)}_{\text{Branch metric}} \\ &\quad + \dots + \\ &= \sum_{i=0}^{N-1} d(\bar{c}_i, \bar{r}_i). \end{aligned}$$

Sum of Branch metrics.

Hamming Distance metric is additive in $\bar{c}_i, \bar{r}_i$.

Observe: $\bar{c}_i$ corresponds to a branch in trellis at i th stage.

$\Rightarrow d_H(\bar{c}_i, \bar{r}_i)$ can be designated as a Branch Metric
Hamming Distance.

Therefore,

Optimal Minimum Distance code word.

} Find a path through trellis such that sum of Branch metrics is minimum.