1 Theory, assumed state of knowledge

Lecture (CE II/Script): Chaper 6; MLSE, Viterbi Algorithm

2 What is shown?

A transmission with on-off keying over a channel with linear distortion is taken as a basis for this demo. It is simulated on symbol basis, i.e. kT_S. The linear distortion of the channel is characterized by the impulse response vector $\underline{h} = [h_1, h_2, h_3]$, which is initially $h = [1, 1, 1]$, but all three values can be modified. The corresponding trellis diagram is shown. With $NH = 3$ the number of states is $2^{NH-1} = 4$. If $\underline{h}$ is modified, the trellis diagram will not be changed. An ideal channel ($h = [1, 0, 0]$) e.g. then results in redundant states.

The calculation of the metrics in the trellis diagram is shown in detail in four steps:

1. old survivor paths
2. old survivor paths with new branches, all new metrics
3. all new paths (survivor and parallel paths with greater distance)
4. new survivor paths

For an automatic run (default setting) the speed can be modified by using the gui button “Rate”. The transmit sequence $x(k)$ can be modified by the gui button “0/1/random tx”: Only zeros, only ones or random 0/1. Default setting is random 0/1. At the output of the channel WGN can be added, with $SNR = E_b/N_0$ being displayed. An estimated value for the bit error probability is calculated and displayed with help of an internal error counter (presumed that errors occur).

3 What is demonstrated?

In this demo the Viterbi algorithm and it’s use for optimum equalization (MLSE) is considered. The on-off keying transmission over a three path channel (on symbol basis) results in a trellis diagram, which allows to follow the calculation of the metrics, at least in the noise-free case. Additionally it should become obvious that it is sufficient in practice to store the survivors over a length of less than $5NH$ symbols.