

The noise and interference channel, which degrade the communication signals transmitted, causing detection errors in reception. For a given level of noise and interference given, the probability of error can be reduced by increasing the transmission power. However, this increase in power is not always desirable. Another solution is the channel coding, which comprises adding to the binary message redundancy bits, so that the encoded message has a particular structure. In reception, the channel decoder checks whether this structure is well respected. Otherwise, an error is detected and corrected if necessary. We present in the following the principle of convolutional coding.

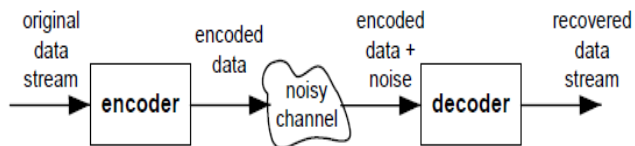


Figure 5: Diagram of an encoder and decoder.

3. Convolutional coding

Coding techniques for error control play an important role in digital communications systems. Convolutional codes or convolutional constitute a large family of error correcting codes [10]. The principle of convolutional coding is the combination of the input bit to transmit more bits previously transmitted by a logical operation, in order to regain its value Incident transmission. So this way to introduce redundancy in the information to be transmitted code gives the ability to detect and correct errors.

The convolutional codes add some redundancy to the bits of the information sequence to be transmitted through a logical operation (exclusive OR). Adding this redundancy enables the decoder to the reception, to correct any errors in the transmission channel. Different algorithms have been developed for decoding. The best known is undoubtedly the Viterbi algorithm, published in 1967 and has the distinction of being optimal [11]. Since convolutional codes with Viterbi algorithm are increasingly used in digital communication systems such as error correction code FEC category ("Forward Error Correction"). Using such an error correction code introduces a gain, relative to non- encoded systems, which is very attractive especially for wireless systems.

3.1 Principle of convolution coding

A convolutional coder comprises a shift register consisting of K cells, V modulo-2 adder, a set of adders and the connections between the cells of the shift register and the iV switch positions [12]. Each convolutional encoder is characterized by the following parameters:

- Coding rate: $R=b/V$.

Where b is the number of concurrent bits to the encoder input V and the number of the encoded symbols output from the encoder.

- Length of the encoder constraint k :

Where k is the number of cells of the shift register.

The operation of the convolutional encoder [13] and the influence of these parameters on system performance are illustrated in Figure 6:

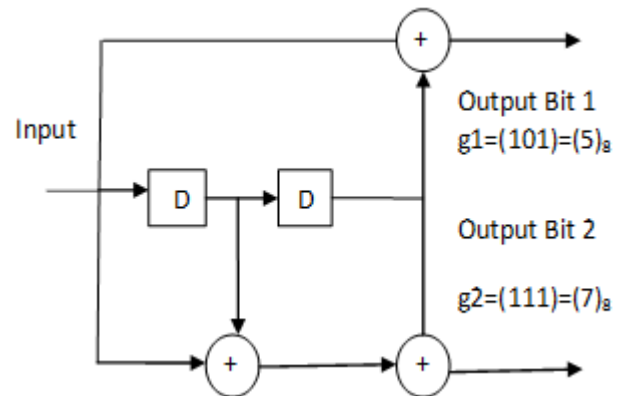


Figure 6: Structure of a convolutional encoder.

The number of adders in this example is $V=2$, the coding rate becomes $R=1/2$ for each input bit to the encoder produces at its output two coded symbols and the constraint length (number of cells of the register offset) is $K=3$ as shown in figure 6. All connections between the shift register and modulo-2 adders is shown by generating vectors. These are the generating vectors of the encoder which determine the rules by which the redundancy bits must be added to the information bits to be transmitted.

In our case, generators worth: $G1 = (101)_2$, $G2 = (111)_2$. Generators are often expressed in octal form, which in this case leads us to the following notation: $G1 = 5$, $G2 = 7$. This last notation we use throughout this work [14]. The encoder operates as follows: prior to the encoding process starts, the content of the shift register is initialized to zero. The information bits arrive at the encoder input continuously. The data bit at the input of the encoder is fed into the shift register and, by using the encoder generating vectors, the corresponding encoded symbols V are calculated [15].

The sequence of encoded symbols is obtained by sampling the modulo-2 adders using switch. Once all the data bits encoded. A sequence of $K-1$ zeros is added (and encoded) to restore the registry to its original state. Each encoded symbol does not only depend on the input bit to the encoder, but also the content of $K-1$ cells of the register before the current bit.

The output sequence is a linear combination of present and past inputs. This sequence can be expressed as the convolution of the input sequence and the impulse response of the encoder, hence the name of convolutional codes.

3.2 Representations of convolutional codes

The idea of a graphical representation of a convolutional code is made from Markov characteristics of the encoder output [13]. In effect, the output of the encoder depends on its input and its states. The equivalent graphs for the polynomial representation are often easier to handle and allows to derive more powerful results. All convolutional code is represented by three equivalent but different graphs: tree code, the code trellis and state diagram [16].

3.2.1 State diagram

A state diagram of the convolutional code represents the relationship between the coded symbols, information and statements encoder bits. This performance is made possible by the fact that the encoder can take only a finite number of states. Figure 7 represent state diagram of figure 6.

Table 1: Table state transitions.

Input	Current state	Next state	Output
0	00	00	00
0	01	00	11
0	10	01	01
0	11	01	10
1	00	10	11
1	01	10	00
1	10	11	10
1	11	11	01

Nodes in the state diagram represent the states of the encoder and the result of transition between two states represents v coded symbols that match the bit of information to the encoder input. Each branch of Figure 7 shows the corresponding encoded bit information corresponding to the symbols.

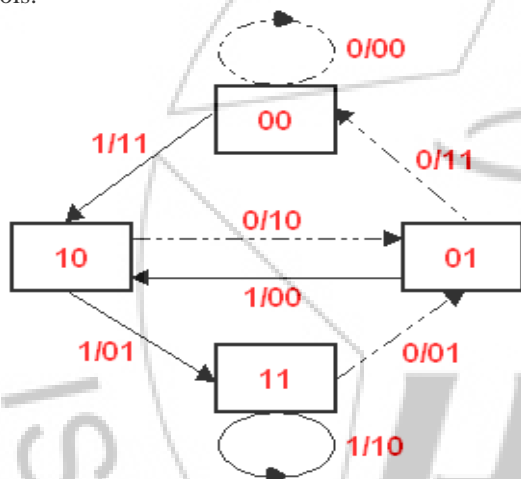


Figure 7: State diagram of Figure 6 (K = 3, R = 1/2)

3.2.2 Tree diagram

The tree is a graph of infinite height and width. A node in the tree represents a possible state of the encoder. A branch symbolizes a transition from one state to another. Virtually tree starts at the top by the state 0 (shift register is initialized to 0). Any path in the tree code is a possible sequence (a code word) at the output of the convolutional encoder [17]. The Trellis is obtained by bending the shaft about its width.

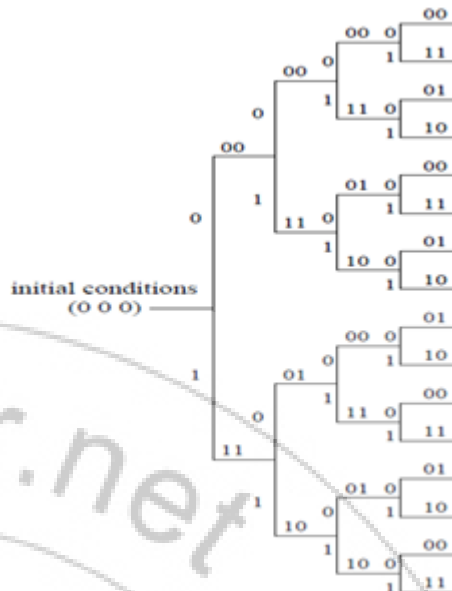


Figure 8: Tree representation of the convolutional code in Figure 6

3.2.3 Trellis diagram

A trellis encoding is a representation of the convolutional encoder that takes into account the fact that the number of states of the encoder is finished and the convergence property [16]. This characteristic reflects the fact that when two information are identical sequences for at least (K-1) consecutive bits, then the coder is in the same state for both sequences. The mesh consists of nodes representing the states of the encoder in question and branches connecting the nodes of the mesh. As shown in Figure 9.

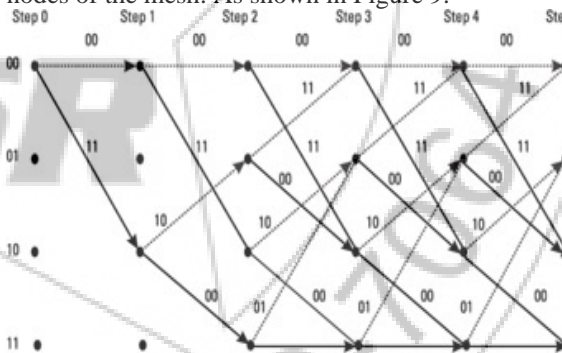


Figure 9: Trellis representation of the convolutional encoder of Figure 6.

4. Simulation and results

The message consisted of a binary sequence is composed of a sequence of 800 bits "0" and "1" (0110100 1001), the transmitter" must adapt the message to the physical channel , the signal takes the form of a sinusoid, the amplitude, or the frequency code information. The receiver interprets the physical signals received binary messages. This interpretation is disturbed in that the channel affects the transmitted signals.

Consider the simplest case of an ideal transmission channel, so noise is not present, Figure 10. (1a) shows the results of simulation of the sequence of 800 bits transmitted on 200

sub-carriers. This representation was preferred to the temporal representation for visibility. The additive channel noise is white noise type Gaussian with zero mean value. The entered values of the noise have been generated using Gaussian random values. The simulation result of the noisy received signal is shown in Figure 10. (2a), for a SNR = 10dB

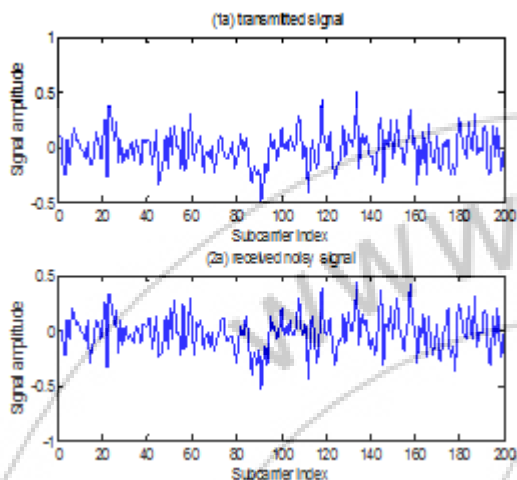


Figure 10: Transmitted and received noisy signal

The received signal during the transmission of a symbol $S_i(t)$ is not $S_i(t)$, but a noisy signal, as shown in the figure, in the case of a disturbance of the white Gaussian noise, this disturbance signal communication can lead the receiver to misinterpret, and could detect different from those issued binary messages.

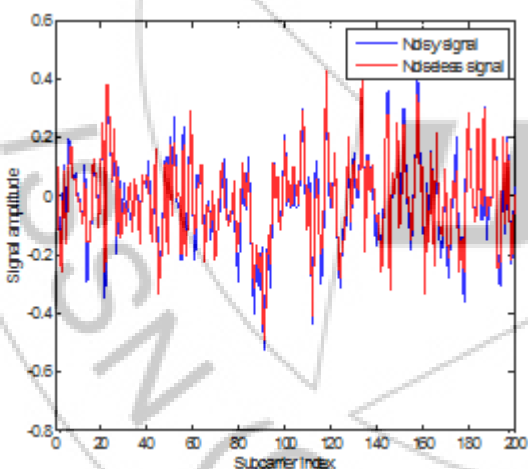


Figure 11: comparison of original signal and noisy signal

The two signals, the first issued but not noisy (red curve) and the second received noisy is accompanied by a white Gaussian noise with zero mean (blue curve) are plotted on the same Figure 11, to guide the eye, we see clearly the effect of the added noise on the shape of the original signal.

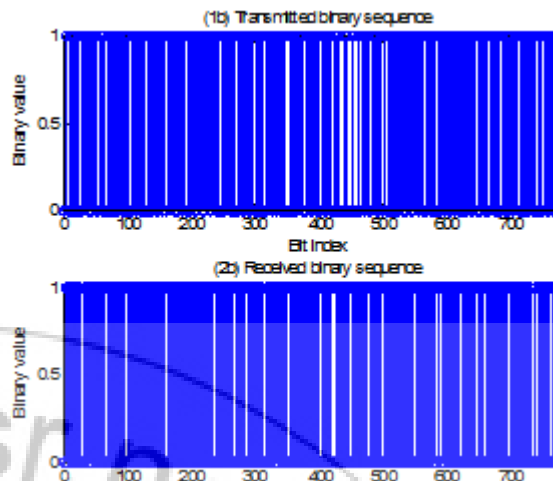


Figure 12: transmission and reception of a binary sequence.

Finally, the transmitted bit sequence that represents the original message is illustrated in FIG 12 (1b) and the received bit sequence that represents the recovered message is illustrated in FIG 12 (2b).

Table 2: Simulation parameter

Simulation parameter	Value
channel	AWGN
Subcarrier number	200
modulation	16 QAM
Guard type	Cyclic prefix
SNR	10 dB
Number of bits	800

5. Conclusion and Prospects

The objective of a communication system is to provide for all users, the maximum flow with minimum bit error probability (probability of being wrong on the value of a bit). We know these two objectives are contradictory, so it is a tradeoff between the quality (speed and error rate) desired for the intended application and the constraints imposed by the channel.

In general, the information conveyed by the signal is degraded or lost, in the presence of noise superimposed on the useful signal. The outlook for the next job is to present the different sources of noise in a transmission channel to present the variables to characterize (signal to noise ratio) and to link the amount of noise degradation of a digital signal (relationship between the signal to noise ratio and bit error rate). Given that knowledge of the noise power has a value only if it can be compared to that of the signal and infer its impact on signal degradation. This is why we generally use a power ratio called signal -to-noise (Signal Noise Ratio) report. Based on these criteria the minimum amplitude required of the signal to avoid an erroneous transmission, it is possible to dimension the power to be transmitted in the channel, signal characteristics, gains and losses of the different elements of the channel.

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