NEW METHOD TO IDENTIFY TELEPHONE STANDARDS IN SOFTWARE RADIO

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ABSTRACT

The transition from the second to the third generation of mobile phones was determined to face the explosion of telecommunications market and to answer to the request of mobile multimedia applications. The importance of the investments engaged in the display of the UMTS networks, as well as the time required for the implementation of this network impose to us a progressive transition from the GSM towards the UMTS. It thus turns out indispensable to foresee bi-modes terminals GSM / UMTS. From then on, managing to broadcast and to receive with various standards using the same terminal appears as a stake that is at the same time technical and economic [MAR 03].

Many carried out studies have shown the complexity of the problems and the considered solutions. Among which we distinguish radio software systems whose purpose is to create a multi-standard terminal. The latter adapts itself automatically by programming In order to adapt itself automatically to the standards, a Universal Self-adaptive Terminal has to integrate two fundamental functions. The first one consists of the Wide Band Analysis (WBA) and the second is to adapt its architecture (hardware / software) to the various successful signals [ROL 02]. In this article, we present a method based on neurons networks which allows to identify the standard to which we are connected.

1. INTRODUCTION

For mobile radio communications, we observe at the present a proliferation of the standards (GSM, IS95, DECT, UMTS) among which Radio modules Radio frequency (RF) is incompatible. The purpose is to conceive a multi-bands and multi-modes receiver which can be modified by software, which is the concept of radio software (SWR). The Self-adaptative Universal Receiver (AUR) will be multi standards and modifiable dynamically by software after having analyzed the received signal. Among the functions that interfere in the AUR, we distinguish the Wide Band Analysis (WBA) function that plays a very important role in the identification of the standards to which the receiver can be connected.

The WBA module calculates the Power Spectral Density (PSD) then it retrieves inside a given frequency band much information such as frequencies carrier of received signals and standards which are attached. This phase of analysis can also allow to determine other important parameters for the demodulation phase such as the rhythm frequency and the band width [ROL 01].

We have studied the various parameters that intervene in a wide band signal and we have concluded that the Band Width Canal (BWc) is a discriminating parameter for the recognition of a received signal [BEN 03]. After the WBA step we move to the determination of the standard, we chose to treat this issue with neurons networks.

In practice, neurons networks are not used to realize estimates of known function, but we look implicitly for a mathematical formula of the relation that exists between the process variables and its results, especially for the processes which we cannot model. In literature, neurons networks are defined as universal estimators [DRE 98], [HOR 89].

Neuron network is defines by two essential characteristics:

- First of all the task under study by the network is decomposed into elementary tasks, realized by neurones.
- Every neuron has entrances and an exit (figure1). Neurones can be organized into layers and be interconnected.

![Figure 1. Diagram of a neuron and an example of a network](image-url)
Thus a neuron can be described as a machine deprived of deciding, it consists of 2 parts having different functions:

- Evaluation of the received stimulation
- Definition of its internal state

2. PRESENTATION OF THE PROBLEM

For our application, we are going to solve a problem of classification, we suggest a neuron network to classify the standards by their spectrum forms, thus we have to appeal to reference spectrums to build our database:

Every spectrum at the network entrance is compared to reference spectrums stored in a data bank.

2.1. The learning Phase

The learning phase depends a lot on the network structure. Its purpose is to fix the weights of the connections.

In the majority of networks, the learning will be supervised, because we impose a fixed entrance and we try to get back a known exit. Therefore we make the modification to the weights to find this compulsory exit.

There are also networks for learning that are not overseen, as for example the topological cards of Kohanen.

Finally, some networks associate two types of learning, it is the case for example of the network of Boltzmann.

2.1.1 The learning mechanism and recognition

We distinguish two types of learning: the overseen learning and the not overseen learning.

- Algorithms with overseen learning

The overseen learning determines the synaptic weights based on examples to which we associate precise exits or desired targets thanks to a specific strategy. After the phase of learning and the convergence of the calculations, it is no longer necessary, in general, to remember learning exercise. The mostly used method is the rule of learning by the retro-distribution algorithm.

- Algorithms with not overseen learning

The not overseen learning is similar to the working of the human brain which finds information by association: we present to the network entrance known examples and it gets organized by itself around attracters which correspond to stable configurations of nonlinear dynamic model that is associated with the network. The learning is carried out by means of the rules that change or adapt the weight of the synaptic coefficients according to the examples presented to the entrance and in some cases according to the desired exits.

For our application we have used the retro-distribution algorithm of the gradient.

2.1.2. Retro-propagation Algorithms of the gradient

Mono-layer networks (input and/or output layer) are able to be adapted to the learning rules that are relatively simple. However, this type of network is limited to the very simple calculation functions, so the interest to create more elaborated networks containing for example hidden neurons, that is neurons which are neither of the of input layer nor layer of output one.

Meanwhile, even if these networks have larger calculation capacities, their learning or weights allocation of the connection becomes very difficult. Multi-layer networks are rather recent such as the multi-layer perceptron, it uses the algorithm of retro-propagation of the gradient to make the implementation of the Network moderation.

The network, which we have adopted for our study, has the following characteristics:

- It contains a single input layer,
- It contains a single output layer,
- It can contain a hidden layer,
- Every neuron is only connected to all the neurons of the following layer.

To explain the functionality of the network, we consider a neuron of the intermediate layer \( k + 1 \). It receives in the input a balanced sum function of the state of the previous neurons (figure 2).

2.2 Results of the simulations

To validate our work we built a base of test which contains 100 spectrums by standard, these spectrums are obtained by addition of a Gaussian noise for the signals GMSK, QPSK, QASK and PSK8 with different SNR (10, 15, 20, 25, 30) to represent the transmission environment.
We are going to deduct afterward the performance of the network. The suggested neurons network contains:

- An input layer (4 neurones)
- A hidden layer (10 neurones)
- An output layer (4 neurones)

The network input is a vector of 2048 points obtained after the calculations the DSP of the received wide signal bandage.

2.2.1 Learning with non disturbed reference spectrums

The main function of the network is to measure the Circulating Band Canal of the received signal and to compare it with reference spectrums.

We preferred to begin our study with a data base which contains non distributed spectrums: the base contains 4 reference spectrums associated with the 4 chosen standards.

Charts [1; 2; 3; 4] give the rates of recognition for the signals PSK8; GMSK; PSK4; QASK.

2.2.2 Learning with disturbed reference spectrums

Having made the learning, we make tests to deduct the performance of the network.

We stimulate the network by various signals of the test base that is built.

Charts [5; 6; 7; 8] illustrate the recognition rates for the signals PSK8; GMSK; PSK4 and QASK for various values of SNR.
The figure 4 shows the performances of network 2 (networks with distributed reference spectrums). With regard to network 1 (network with non-distributed reference spectrum), we see that there is a big improvement in the rates of recognitions for all the standards, the network becomes successful for a big value of SNR with a number of sufficiently important examples.

5. CONCLUSION

We have presented in this paper a method of classification of the various standards by neurons network, the aim of neuron network is to identify the standards by their spectrum form, thus we have to appeal to reference spectrums to build our database. We tried to modify the base of learning of the network in order to improve its performances and to decrease its error.

The second stage of our work is to increase our data base, to improve our results by using other architectures of neuron networks and finally to implement our algorithm on specific circuit (FPGA, DSP...).

6. REFERENCES


