HIGH INTERFERENCE IMMUNITY UWB RECEIVER

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Consideration is given to the alternative UWB signal processing methods, which allow to increase the interference immunity of the system. The problem of interest is the difference in construction of UWB processing technologies and their effect on the receiver parameters. The results of modeling and practical testing are given.

The majority of theoretical and practical works, devoted to the UWB signal processing are concidering the so called correlation receivers. Many authors propose a practical realisation concepts, but most of them are either expensive, or extremely complicated. Also, due to multipath, a correlation receiver is practically not capable of collecting all the existing energy, even though if it is realized in the rake-receiver form.

The idea, underlieing the proposed method of UWB signal processing comes from the simple notion. The matter is that the spectrum of the short pulse is extremely wide. For instance the spectrum width of the 1 nanosecond pulse is 1 GHz. In other words, when the short pulse is transmitted in the air, the integral energy level increases on every frequency of interest. Therefore, analizing the energy level increase in every point of the spectrum, it is possible to unambigously detect the UWB signal presence. But practically, it is easier to analize signals only in several bands. This approach also gives a possibility to simplify the further signal processing, because the short pulse signal, being applied to the bandpass filter input, as a result gives a wide radiopulse in the output. But in order to derive the envelope, the amplitude detector is needed. The modeling results are given on the fig. 1.

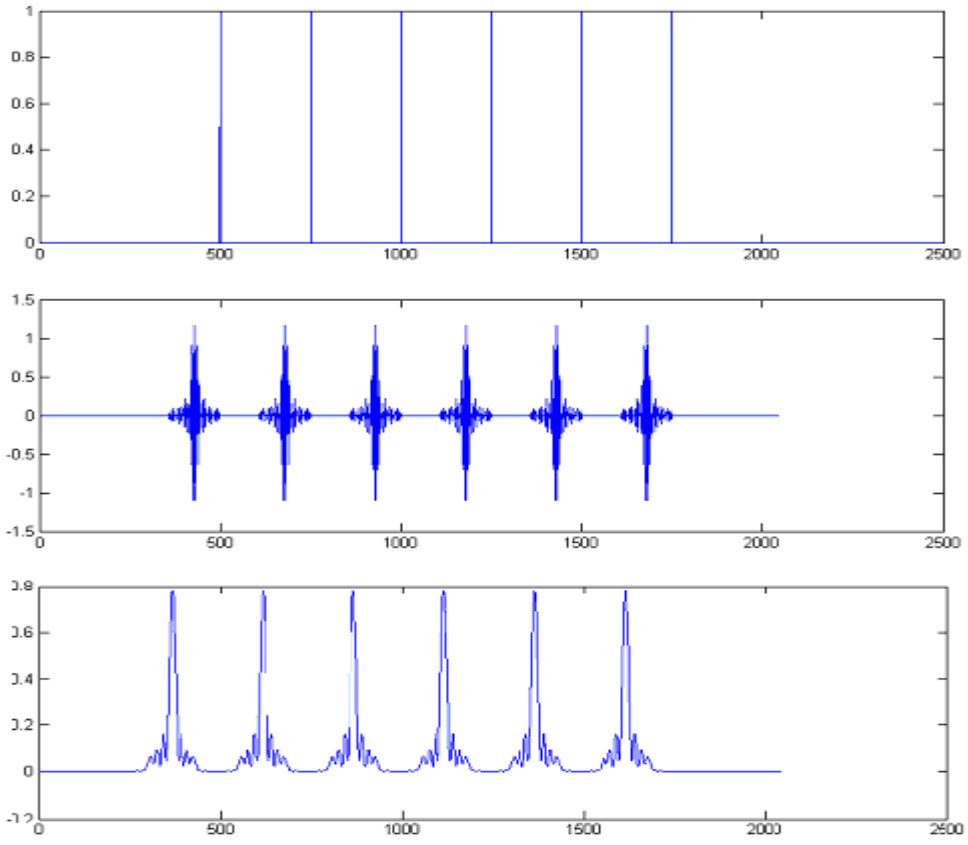

Fig. 1.

As one could observe, the output pulse is much wider, than the input. This feature allows to catch the UWB pulse with a simple comparator or low speed ADC. Than the strong narrowband interference and a white noise were added. The result is shown on the figure 2.

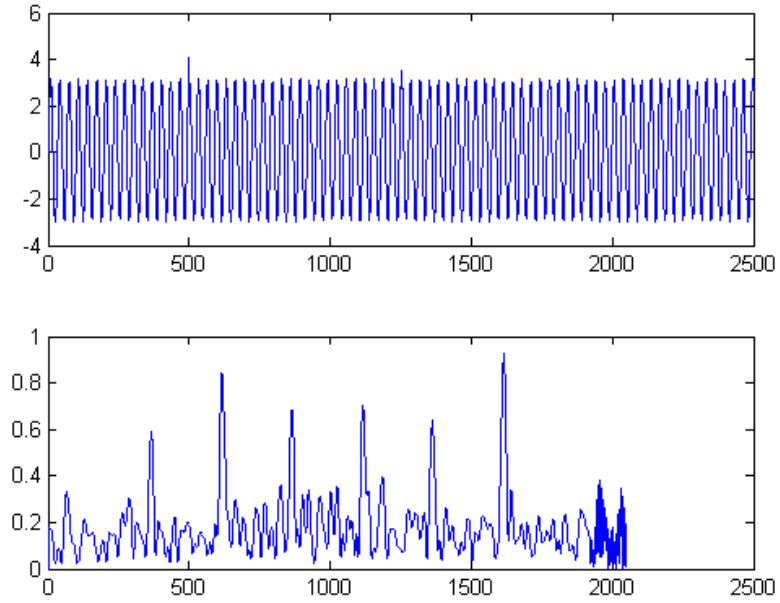

Fig. 2.

The is clearly seen that the narrowband interference, deployed outside of the filter band does not affect the output signal much. But the white noise gives a significant influence. There could two major conclusions be made. First is that the proposed construction has a good interferece immunity, in case if several identical channels, tuned to the different frequency bands are utilized. And second, the noise immunity of the proposed technology needs to be increased by means of barker codes, for example.

Being guided by the abovemntioned notions, the practical model of the receiver was built. The flow chart of the proposed construction approach is introduced on the figure 3.

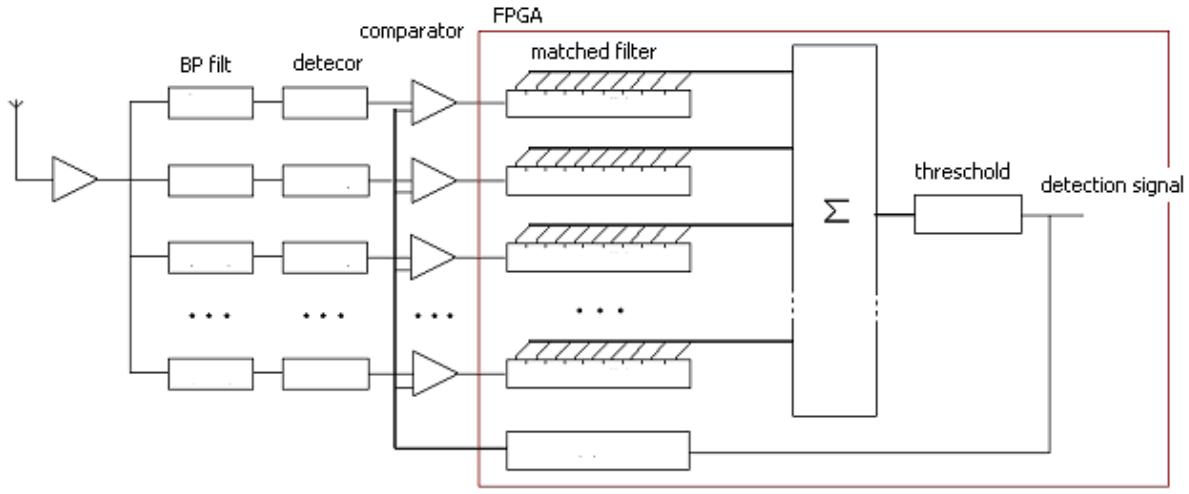

Fig. 3.

The receiver consists of a LNA at the input, the bank of bandpass filters, the energy detecors stage and a stage of comparators, the threshold voltage of which is controlled by the special alghrithm. Further signal processing is performed by an FPGA, which implements a bank of barker code matched filters for each channel and a summer. Also some service functions are performed by an FPGA. Due to presence of both time analisys and frequency analisys, the signal processing performance is highly increased in comparsion with only time domain analisys, like in corellation receivers and all the existing energy is collected.

To verify the reciver capability of reliable detection of UWB signals in the conditions of high narrowband interference, the following experiment has been carried out. The proposed reciever was subjected to the useful UWB signal and narrowband interference. The results are shown on the figure 4.

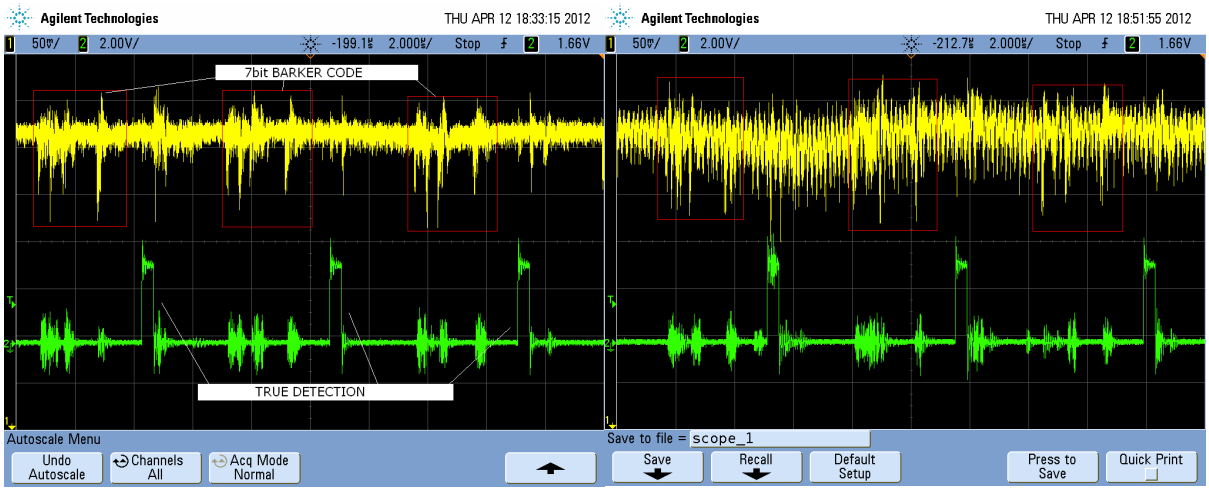

Fig. 4.

The yellow channel stands for the output of one of the detectors before a comparator (fig. 3). The green channel represents the FPGA processed UWB detection signal output (fig. 3). On the left picture the pulses of interest (yellow signal) can be easily catched by a comparator, whereas on the right picture, the pulses of interest are mixed with a narrowband interference (yellow signal), set at the band of the bandpass filter. In both cases the integral output of the receiver gives a correct detection signal (green signal) due to other channels, which still operate properly and an optimally set threschold.

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