

Our results for 2006 and plans for the current year

Dear visitors of our web-site!

As we already marked in our previous messages, support of researches and development on subjects MTD by the Russian Fundamental Investigations Fund, the Russian Academy of Sciences and by some other large organizations of communication industries had allowed to speed up essentially achievement of new levels of multithreshold decoding algorithms efficiency for various applications. Thus it is necessary to describe different directions of spent MTD algorithms researches.

It is necessary to emphasize achievements to the first in area of maximum high algorithm efficiency. Here already now the absolute result is received similar to achievement, for example, of 100 % efficiency in mechanics: binary MTD can be realized as hardware so, that it as though will not notice in general calculations that it carried out during decoding an input digital stream. It is achieved due to full one-step parallel work of this error correcting algorithm. At each step of data movement in the decoder shift registers errors estimations are seemed to be already ready simultaneously. This information symbols will be corrected at the next data shift in the decoder. And as in this case speed of decoding will be determined only by the maximal speed of data shifting in registers which are the fastest elements of circuitry, that, keeping extremely high for the given element base speed of data movement through registers, we receive full 100 % efficiency of element base usage. And if simultaneously with it they also organize parallel movement of the data through many information and syndrome registers of MTD (that it was already done in all previous MTD developments!) decoding speed can be increased in 5-30 times additionally. For this reason productivity MTD already now can make up to many hundreds Mbit/s and even 1÷2 Gbit/s for especially high-speed applications, for example, for Distant Earth Sounding (DES) and for other problems.

The second direction of works is connected to software decoding. We already wrote estimations of operations number for fast variants of decoding when at each MTD iteration only few operations of addition and comparison are carried out. These estimations are both in the our reference book, and in our last monograph on MTD. We offer you a new illustration of high MTD efficiency by the example of the software non-binary MTD version. As well as fast demoprogram for binary streams, the program for symbolical MTD together with the simple instruction for its usage can be copied from page "Education" of our web-site. As you will see from results of its work, speed of non-binary MTD decoding for low redundant code with $R=0,95$ at rather big channel error probability ($\sim 10^{-2}$ per a symbol of the channel) can achieve decoding rate in tens megabits per a second even in this difficult for realization area of redundancy and noise. Here it is unique Read-Solomon codes (RS) used till now are completely already inapplicable because of absolute loss decoding ability at so large noise level. In this area of researches we offer any co-operation forms as by way of the further increase of overall performance MTD in the field of high noise of the channel, and in sphere of the further reduction of operations number in symbolical MTD. All our last publications on QMTD can be found on the first pages "Method" of our web-site.

Further it is necessary to note works on maximum high values of real practically code gain (CG) achievement. They have been successfully finished the last year and reported at spring conference DSPA'07 in Moscow in March 2007. Achieved difference CG with extremely possible level determined by Shannon bound is now essentially less than one decibel for MTD. Our cycle of researches which have been directed to realization of simple decoding methods at the big noise level now is ended. The matter is that the real equipment of coding always needs a stock on power about 1dB or more for instability of parameters of the equipment, else it is necessary to take into account presence of an additional stock on power near 1 dB on fluctuations of a signal level decrease in a path of data transmission, and also to take into account presence of internal noise of receiver system near several tenth of decibel. For this

reason the further CG growth making at the best already and for MTD algorithm of the order only 0,5÷0,7 dB from limiting possible values, - is not required, as instability of system parameters essentially exceeds a shortage by decoding algorithms of several tenth parts of decibel in power. Taking into account, that high power characteristics described in the report on DSPA'07 MTD are achieved for a realization variant which in the hardware version will have also the maximal high-speed opportunities up to hundreds Mbit/s, the further works in this direction will be oriented for decrease the MTD decoder memory sizes.

And, at last, let us see absolute Olympic competitions in coding. We mean the most complicated problem of achievement of extremely small difference in real decoding characteristics with Shannon bound. Works in this direction are intensively conducted by many successful various experts all over the world already more than during 10 years. Undoubtedly, these researches serve development of more and more powerful methods of data transmission under extremely high noise of the channel. Now there are the methods which have reached a level of difference in power with Shannon bound, essentially smaller, than 0,1 dB. These works proceed and extend.

We also are connected to this competition and we believe, that MTD can take a worthy place on Olympiad of CG records as all researches executed by us in this area show, that in process of difficult (!!!) growth achievable CG MTD algorithm complexity, certainly, increases also rather appreciably, but this grows, nevertheless, is rather moderated. It is quite possible, that differences in power about 0,1 dB for MTD with Shannon bound will correspond still extremely high its productivity and a moderate memory size whereas the part of other declared methods with record decoding characteristics was not yet even simulated simply owing to very high complexity of offered methods of error correction.

We have else more some directions of research which will be interesting as for experts with mathematical education, for algorithm researchers, software developers and the engineers with deep understanding microprocessor technique. You are waited with interesting problems.

Join us!