Using PSNR Parameter as a Measurement Tool in Real-Time Estimation of Multimedia Information in Wimax Systems

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Abstract – **The given work is about of searching in field of transmission of multimedia data through wireless radio systems, based on *OFDM*-modulation technique, such like *WiMAX*. It's about ways to get the optimum scheme of adaptive coding and modulation.**

Keywords - **PSNR, BER, WiMAX, OFDM.**

I. INTRODUCTION

Today, the most common metric of the quality estimation of data transmission in TV and wireless systems is a bit error rate: BER. It used in various transmission systems, such like IEEE 802.16 WiMAX[1] or IEEE 802.11 Wi-Fi. In such systems requirements for quality of service for the subscriber QoS (Quality of Service) are based on this metric. As far as modern transmission systems are able to transmit different kinds of information: audio, video, images, text-pages, mixed and complex kinds of data and each kind of data has their own way of estimation of their quality, BER is not always able to act as a universal metric. For one type of data (text) BER = 10^{-3} is good enough, but for example, high resolution video, it can be insufficient. So, it could be a good idea, that modern transmission system will has such a metric, which can recognize the differences between various kinds of data.

II. MAIN PART

In the role of such universal metric will be offered a peak signal-to-noise ratio (PSNR). It is easy enough to implement and count. At the same way, it has data, which characterize type of transmitted information. PSNR is most commonly used to measure the level of distortion in operation of image compression. It calculated as:

$$PSNR = 10\lg(\frac{MAX_I^2}{\sqrt{MSE}}) = 20\lg(\frac{MAX_I}{\sqrt{MSE}}) \qquad (1)$$

there MAX_I – it is a maximum value, that pixel can have (for video measurements) or maximum amplitude of sample (for audio measurements), and MSE – is a mean squared error, that calculated as:

$$MSE = \frac{1}{m*n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}|I(i,j) - K(i,j)|^2 \qquad (2)$$

At the end, PSNR calculated as:

$$PSNR = 20\lg\frac{MAX_I}{\frac{1}{m*n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}|I(i,j) - K(i,j)|^2} \qquad (3)$$

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To prove the viability of such idea was constructed an imitation model in MATLAB software, which consists of such blocks: channel forward error coder (FEC), OFDM transmitter, channel block with noise, OFDM receiver, channel decoder, block of quality measurement. OFDM signal transmitter contains a serial to parallel converter (S / P), a digital modulator M, the unit of inverse fast Fourier transform module (IFFT), a character generator of OFDM (P / S). Accordingly, the OFDM signal receiver includes an input converter (S / P), module of fast Fourier transform (FFT), the demodulator DM, parallel to serial converter (P / S). Adaptive modulation and coding (AMC) controller, which can set the level of modulation and coding to implement the target function. In the role of criteria was used rate of PSNR >=37dB, which correspond to mark 5 of mean opinion score MOS (table 1).

Table 1

COMPLIANCE ASSESSMENTS MOS AND PSNR

Mark of MOS	PSNR, dB	Quality of image
5	>37	Perfect
4	32-37	Good
3	26-31	Satisfactory
2	20-25	Bad
1	<20	Poor

PSNR criteria compared with rate of BER = 10^{-3}, which is a QoS requirement in WiMAX systems [1]. In comparison, were taken such data types: color image, black and white image, audio sequence. Channel block has white noise, signal to noise ratio changed from 30 dB to 0, in decrements of 0.5 dB. The task was to change coding and modulation scheme, when BER or PSNR become lover than defined as a criteria. It was shown, that with the use of PSNR, scheme change occurs in a few dB (in SNR) earlier, corresponding to BER.

III. CONCLUSION

Using the quality assessment by PSNR metric of multimedia data transfer can improve noise immunity of transfer channel through the optimal choice of coding scheme and modulation.

REFERENCES

[1] IEEE 802.16e-2009. IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands.