Theorem 2. *Let* $n = 3$, $m \in \{1,2,3\}$. *If the system (1) with locally integrable and integrally bounded coefficients uniformly completely controllable, then the system (3) has the property of partial uniform global attainability.*

From theorems 1 and 2, the main result of this work

Theorem 3. *Let* $n = 3$, $m \in \{1,2,3\}$. *If the system (1) with locally integrable and integrally bounded coefficients are uniformly completely controllable, the corresponding closed system (3) is globally Lyapunov reducible.*

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PULSE MODULATION FOR ULTRA-WIDEBAND COMMUNICATION SYSTEMS

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The basic types of pulse modulation used for ultra-wideband communication systems are considered. The interactions between a modulated signal and additive white Gaussian noise are analyzed. The most noiseproof and optimum types of modulation for practical implementation are defined.

The fundamental direction is to increase the channel capacity for wireless telecommunication systems. Data transmission rate is proportional to the width of signal spectrum. So, for example, sufficient channel bandwidth makes 8 kHz for a voice signal, 180 kHz for high-quality transmission of music, 5 MHz for video [1]. The ideal case is to have a universal communication channel which can be used to transmit any kind of information, which implies a large bandwidth. Channel transmission ultra-wideband (UWB) communication systems or "impulse radio" has a similar property.

Information transfer in UWB communication systems is carried out by means of short pulses of sub-nanosecond duration. One of the major advantages of UWB systems is the lack of direct interference signal propagating with his reflections on various objects. Short pulses extend through different obstacles, because attenuation happens not in the entire range. UWB systems can operate with low average total transmit power due to the high effective gain, so these systems do not interfere with other wireless devices operating in the same band. Since the energy of the UWB signal is distributed in a wide range, the task of detection and interception becomes almost impossible. [2]

For the "mpulse radio" can be used various types of modulation: PPM, PAM, OOK, BPSK [3-4]. Therefore, the organization of UWB communication system appears task of choosing the optimal type of pulse modulation. The solution must satisfy the following conditions:

- high noise immunity;
- ease of implementation of the modulating demodulation equipment;
- high data rate.

In the case of Pulse Position Modulation (PPM) a logical "1" and a logical "0" encoded different positions relative to the reference pulse (Fig. 1 (*a*)). On-Off Keying (OOK) implies the presence of short pulses at "1" and their absence at "0" (Fig. 1 (*b*)). In case of Pulse Amplitude Modulation (PAM) "1" and "0" coded varying amplitude of ultra-short pulses (Fig.1 (*c*)). In the case of Binary Phase Shift Keying (BPSK) a logical "0" and a logical "1" corresponds to a certain phase of the pulse: 0^0 or 180^0 (Fig. 1 (*d*)) [4].

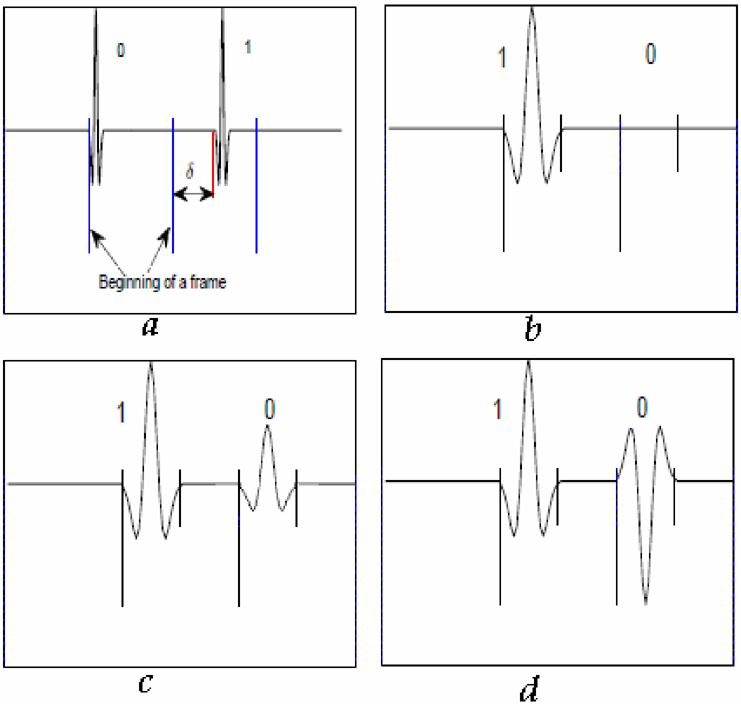

Fig. 1. Types pulse modulation: PPM (*a*), OOK (*b*), PAM (*c*), BPSK (*d*)

The noise affects the signal in the communication channel. The noise type can be different: RF interference, atmospheric noise, thermal noise of the receiver caused by the Brownian agitation. These effects can be described by additive white Gaussian noise. Stability of the transmitted signal to noise ratio is estimated as a function of bit error rate on the receiving side on the ratio of signal to noise in the channel.

For analysis effects of noise on the information UWB signal is used software environment «Matlab», in which by means of «Simulink» created a model of UWB data transmission systems. The structure of the model is shown in Fig. 2.

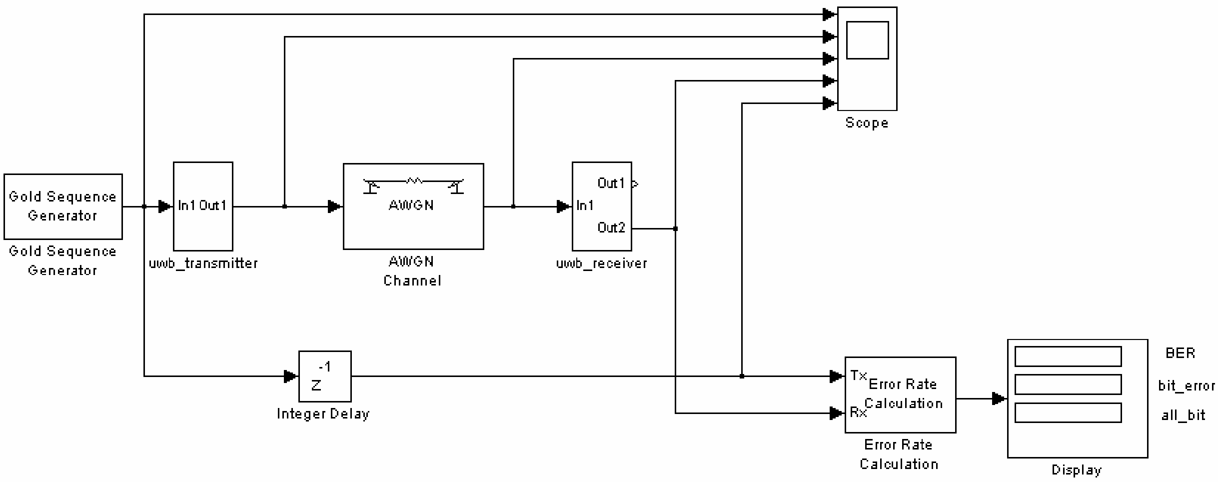

Fig. 2 Model UWB communication system

Block "Gold Sequence Generator" is the source of the transmitted data and represents a Gold code generator. In the blocks "uwb_transmitter" and "uwb_receiver" implemented UWB transmitter and UWB receiver respectively. By means of the block "Error Rate Calculation" with block "Error Rate Calculation" are calculated total number of bits transmitted (all_bit), the number of erroneous bits in the receiver (bit_error) and bit error rate (BER). The calculation results are displayed on the display. Simulation of transmission channel with additive white gaussian noise is carried out by means of the unit "AWGN Channel", where the desired signal is added to the white noise. The variance of noise is described by the equation (1) [5]:

$$\text{NoiseVariance} = \frac{(\text{SignalPower} \times \text{SymbolPeriod})}{(SampleTime \times 10^{\frac{Es/N_0}{10}})}. \quad (1)$$

The probability-density function of Gaussian noise described by the equation (2):

$$p(t) = \frac{1}{\sqrt{2\pi\alpha_u e^{-\frac{(u-u\cap)^2}{2p_u^2}}}}. \quad (2)$$

As the receiver is used strobe receiver model. Amplification of UWB signals in the stroboscopic receiver is provided due to the accumulation of received pulses at a certain time delay. It is known that the signal-noise ratio is proportional to the square root of the average number of pulses (assuming Poisson statistical distribution) [6]. Therefore, all dependencies are removed for the same number of pulses accumulation. The simulation results are summarized in the graph, and shown in Fig. 3 (*a*).

As seen from the graph in Fig. 3 (*b*) the highest noise immunity for the signal-to-noise ratio 10 dB has a system with BPSK keying, and the least – with PAM modulation. The PPM system is second with respect to noise immunity, but has an advantage before BPSK system relatively the complexity of the technical realization. Besides using PPM system becomes possible of coding one pulse delay directly of a combinations symbol that as a result, increase the speed of data rate.

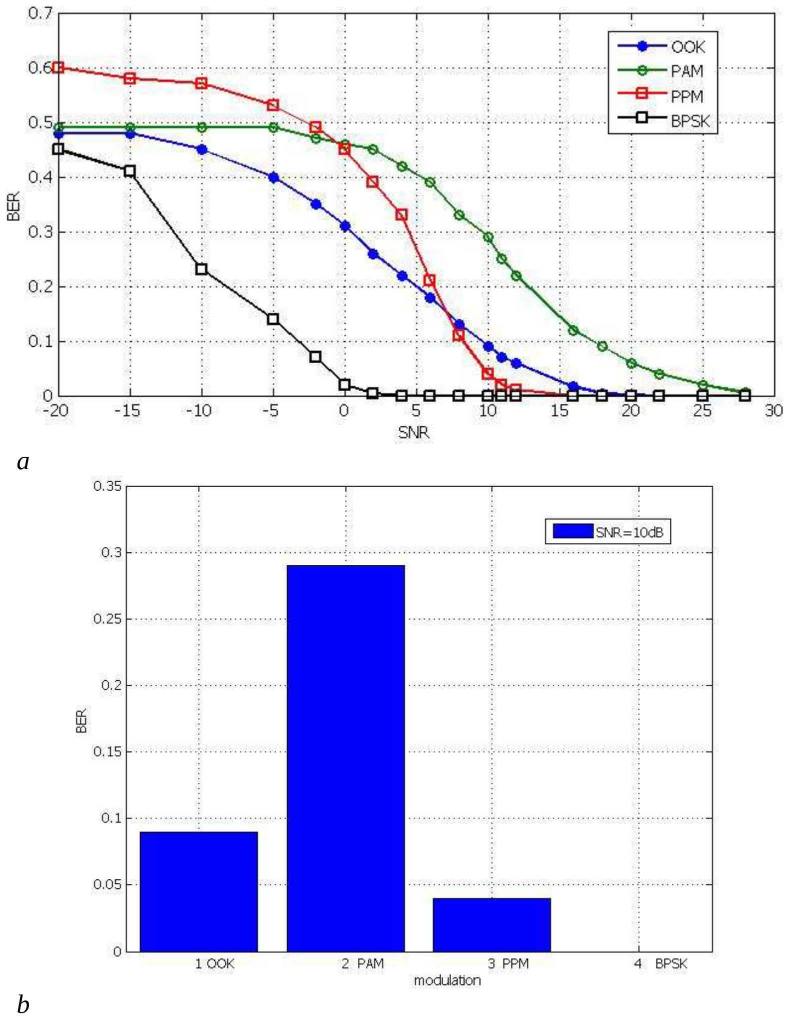

Fig. 3. The dependence of the bit error rate of the signal to noise ratio in the channel at different modulation types (*a*), the dependence of the bit error rate for the signal-to-noise ratio in the channel equal to 10 dB for different types of modulation

For the implementation of UWB communication system optimal type of pulse modulation will be PPM modulation, considering analysis results of noise immunity of a signal and a condition of simplicity of a technical implementation of system. The use of modern PLDs allows creating a flexible structure of the modulator / demodulator. To achieve optimum sensitivity of the receiver can be varied the number of pulses accumulation while adhering to the specified data rate. The classical approach of coding logical "0" and logical "1" different pulse delay can be replaced with coding single delay directly a certain bit pattern, which will increase the capacity of the channel.

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THE DEVELOPMENT OF THE INFORMATIONAL AND EDUCATIONAL ENVIRONMENT BASED ON GOOGLE APPS FOR EDUCATION

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The article is devoted to the establishment of educational environment based on the platform Google Apps for Education, which would facilitate the work of students and teachers in higher education institutions, as well as enhance study progress control.

High-quality training at university is not possible without study progress control throughout each semester. An effective system of study progress control allows assessing not only each student's implementation of the curriculum at university, but also helps to evaluate the quality of ongoing educational programs, to draw attention to the difficulties students encounter in their studies, and to obtain certain indicators of effective teaching.

If we consider the fact that the 21st century is a century of information technology, it becomes clear that modern information technology can be reasonably used for study progress control at university. For example, you can use cloud services to store electronic registers that can be accessed and searched in an easier way in comparison with paper registers and numerous archives.

Thus, an idea to develop a system that would help to facilitate lecturer's work in relation to study progress control has appeared.

The modern system of university education is gradually adapting the rating system of academic progress assessment. **The rating system of academic progress assessment** is a set of organizational, educational and control measures, based on all sorts of didactic resources available for this or that subject.

Taking into account what has been said above, the establishment of the electronic environment able to control the learning process of students becomes of current importance. Moreover, it can be helpful in final evaluation of students' academic progress together with the rating system.

Since March 2012, Polotsk State University has been developing informational and educational environment based on Google Apps for Education. Since August 2014, this medium was supplemented with a new service **– Goggle Classroom**.

Google class helps teachers save time by organize classes quickly and easily and communicating effectively with students. It allows teachers to create and maintain a task quickly, assign grades, leave comments and communicate with students. In turn, students can keep a job to Google Drive and take the work performed in the classroom and to communicate directly with each other and with teachers.