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MEANS OF IMPROVING THE QUALITY OF SERVICE OF THE COMPUTER NETWORK OF THE FORENSIC INFORMATION SYSTEM

The **relevance** of research. In modern forensic practice, computer networks (CN) are an integral part of computer-technical examination, therefore, ensuring their normal functioning becomes a vitally important task. In this regard, the theory of the construction, modification and operation of digital telecommunication systems raises a fairly general problem of digital signal processing, network synchronization and its stability. A solution to this problem was devoted to research, which analyzed the characteristics of the stability of the network and proposed methods for measuring the physical parameters that determine it. Many of the studies conducted were based on the use of frequency measurements in communication channels of computer networks for transmitting information. Acousto-optic spectrum analyzers (AOSAs) are widely used in forensic information system networks improving the QoS of forensic computer networks. The **subject** of the research: resolution of acousto-optical spectrum analyzers. The **purpose** of the research to improve the quality of diagnostics of parameters of computer information transmission networks based on the use of the developed signal processing technique in acousto-optic spectrum analyzers, which allows increasing the resolution of AOSA by increasing the frequency resolution of two non-simultaneous long-duration radio pulses. The **results** of the research. The research presents analysis of the influence of the frequency parameters of the computer network on the implementation of the relevant requirements for quality of service. Studies have been carried out on possible ways to increase the resolution of AOAC in frequency. The nonlinear characteristics of AOSA were studied, which made it possible to modernize methods for increasing the frequency resolution. The classical method of processing radar signals is used, which allows determining the delay time of arrival of a sufficiently long pulse with an accuracy significantly exceeding the pulse size. When analyzing the operation of AOSA, it is taken into account that the signal photoelectron flux in the acousto-optical spectrum analyzer is known to be described by the Poisson distribution. But one of the main properties of random variables distributed according to Poisson's law is the lack of cross-correlation of the components of the Poisson stream. This assumption can significantly increase the frequency resolution of AOSA. **Conclusions.** The research ascertains analytical relationship for the dispersion of the signal frequency measurement. The research proposes a technique for processing signals in AOSA, allowing to increase the resolution of AOSA by increasing the frequency resolution of two non-simultaneous radio pulses of long duration.

Keywords: computer system; telecommunication network; acousto-optical spectrum analyzer; quality of service (QoS) indicators of computer networks.

Relevance of the research

Currently, decision support information systems and control information systems are used in various areas of human society: industry, business, science and education, finance and infrastructure projects, construction and law enforcement. Such information systems also occupy an important place in the system of forensic examinations, the operation of which can significantly improve the quality of the examinations performed, reduce the influence of the human factor on the adoption of expert decisions, and significantly reduce the time required for the examination.

A forensic activity of various forms and contents is impossible without the involvement of information resources, by which the legislator understands individual documents and individual arrays of documents, documents and arrays of documents in information systems (libraries, archives, funds, data banks, other information systems). Information support of forensic examination should be a process that is defined by the legislator as the process of collecting, processing, accumulating, storing, searching and disseminating information. Thus, the information support of forensics is necessary for solving forensic problems.

For the exchange of information in information systems of forensic science, both local computer networks are used, for example, in the implementation of forensic registration, and the global Internet. Many forensic institutions, both state and non-state, have their own sites where you can get very useful information.

One of the most important subsystems of this system is the telecommunication information transmission system. The telecommunication system is designed to reliably transfer the data and information necessary in the study of primary examination materials, and also plays an important role in the decision-making process on examination issues. Therefore, the telecommunication system has very stringent requirements, and it must meet the relevant restrictions. Only the fulfillment of these conditions will allow the entire information system to solve the tasks assigned to it.

In modern forensic practice, computer networks (CN) are an integral part of computer-technical expertise, therefore, ensuring their normal functioning becomes an extremely important task. This forces users to question the effectiveness of information control, protection and transmission systems.

Computer-technical and telecommunication forensics have features that are difficult to document by means of the classical preservation of official information. This situation is due to the rapid growth in the volume and variety of storage devices in the world market that can be used to store digital information by various users. Hundreds of thousands of possible types of research objects can be counted only in the expert specialty "Research in computer hardware and software products", most of which will require an individual approach, because each of the objects is unique in terms of manufacturing and use. Each of these research objects has individual features that must be considered when conducting expert research. So, two versions of the same

software product can have different individual features and, accordingly, create different artifacts. Increasingly, forensic experts need to get super-fast access to information – compiled and verified. The expert spends considerable time searching for print and electronic sources of information, which significantly increases the time for performing examinations.

Based on the foregoing, specialists in the sector of computer-technical and telecommunication research of the Kharkov Research Institute of Forensics named after Em. Prof. M.S. Bokarius developed the forensic "Automated system for the accumulation of empirical data on the practice of computer-technical expertise". The developed system requires a dynamic, fast-filling, easy-to-operate and easily accessible system, capable of storing the above information in large volumes and organizing access to it. Given the nature of the information, the access time to it should be minimal, which can be done using high-speed Internet.

Formulation of the problem

The widespread use of digital systems and information transfer technologies, in addition to a significant number of new opportunities that open up using new communication principles, has created a large number of problems caused by the peculiarities of digital signal transmission. This also applies to the activities of the expert community, which should monitor the current state of communication channels, the possibility of unauthorized access to them, as well as information transmitted through these channels. In this regard, the theory of the construction, modification and operation of digital telecommunication systems raises a fairly general problem of digital signal processing, network synchronization and its stability.

Numerous studies have been devoted to solving this complex and multifaceted problem, which analyzed the characteristics of the stability of the functioning of the network and proposed methods for measuring the physical parameters that determine it. Many of the studies conducted were based on the use of frequency measurements in communication channels for the analysis of processes in computer data transmission networks. Indeed, increasing the accuracy of measuring the frequency of the transmitter and receiver in the communication channel will reduce information loss and increase the speed and reliability of data transmission, which will significantly increase the quality of service (QoS) of computer networks.

Currently, there are several approaches to the method of measuring the frequency of the studied signal. Despite the fact that today, acousto-optical methods compete with digital technology, the pace of development of which allows one to efficiently solve a number of information processing problems, there are problems in which digital devices are inferior to acousto-optical. Digital technology, unlike an acousto-optical device, is not able to provide a wide instantaneous band of analysis of radio signals with an acceptable frequency resolution.

Due to the high value of the simultaneously analyzed frequency band, the resolution in frequency and signal arrival time, acousto-optical analyzers are widely used in electronic warfare systems, radar systems, for spectral and correlation signal analysis and other information processing tasks that require high speed of mathematical transformations.

Acousto-optical spectrum analyzers (AOSA) can also be used in information transmission networks, including in the networks of the forensic information system. The use of these devices will improve the QoS performance of computer networks of the forensic system. But in view of the rapid increase in the number of users of the radio-frequency space and the limited frequency resource, according to [1], the question arises of modernizing the existing systems of spectral analysis. And a special place among the spectral analysis technique is given to acousto-optical spectrum analyzers. Existing AOSAs have a fairly high frequency resolution, but still they have not reached their theoretical limits.

Using the advantages of non-search spectral analysis and expanding the band of simultaneously analyzed frequencies in acousto-optical spectrum analyzers necessitates a deeper analysis of their resolution.

Thus, improving the quality of QoS indicators of computer networks of a forensic system by increasing the resolution of an acousto-optical spectrum analyzer is an urgent research task.

Literature analysis

The study of factors affecting the QoS of computer networks has received much attention [4-21]. Studies of the influence of the bandwidth of data transmission channels were carried out in [4-6]. Analysis [7, 8] of the influence of the architecture of computer systems and computer networks was carried out in [4, 5, 7, 8]. The papers [9-14] are devoted to the analysis of packet queues and the development of an integrated approach for diagnosing QoS of computer systems and networks. In addition, there is a separate question about the relationship of QoS indicators and the fulfillment of the requirements for the transactions of a computer system [15–20]. In [21], the basic parameters of the basic telecommunication network that affect the quality of transaction execution of a computer system are identified. In particular, it was shown that when choosing special platforms with centralized control (convergent and hyperconverged), the synchronization of a computer system plays an important role. To ensure the required level of synchronization, it is necessary to control the stability of the functioning of the generators of a computer system. In [23], a method was developed for the on-line calculation of the jitter of a telecommunication network based on a method for increasing the resolution of acousto-optical spectrum analyzers, which allows dynamic reconfiguration of network parameters. In [28], a method was developed for diagnosing synchronization disturbances in the telecommunication network of a computer system of critical application by

increasing the resolution of an acousto-optical spectrum analyzer.

The **aim** of the article is to improve the quality of diagnostics of parameters of computer information transmission networks based on the use of the developed signal processing technique in acousto-optic spectrum analyzers, which can increase the resolution of AOSA by increasing the frequency resolution of two non-simultaneous long-duration radio pulses.

Main part

Quite relevant is the question of improving the tactical and technical characteristics of radio frequency analysis tools. One of the promising classes of radio frequency monitoring tools are acousto-optic spectrum analyzers.

A fairly large number of papers have been devoted to optimizing the operation of acousto-optical spectrum analyzers.

So, in [29], the possibility of increasing the accuracy of measuring the average frequency of the signal spectrum in acousto-optic spectrum analyzers with a spatially non-invariant hardware function is analyzed.

The conditions for the formation of an optimal estimate of the parameters of optical signals during their acousto-optical conversion are considered in [30].

In [31], the problem of finding additional signal processing to compensate for both a nonlinear dependence of the acousto-optic conversion efficiency and a decrease in the amplitude of the spectral components is considered.

The possibility of reducing the time for obtaining a spectrum estimate is considered in [32]. The authors proposed methods for the formation of quadrature components, which can reduce the time to obtain an estimate of the spectrum in interference acousto-optic spectrum analyzers, and also, if necessary, simplify their implementation.

Among the advantages of acousto-optical devices in comparison with purely electronic analogues, the authors of [33] distinguish such as simplicity, smaller dimensions, power consumption and cost. Moreover, their disadvantages include a relatively low dynamic range associated with the nonlinearity of AO interaction.

Basic relationships and formulations

We assume that two pulses of the same duration τ_i , the first in the time interval t_1 and t_2 , and the second in the interval t_3 and t_4 , arrive at the radio engineering complex, which includes an acousto-optical spectrum analyzer, and $\tau_i \gg \frac{D_{Lz}}{V_{zv}}$, i.e. pulses of long duration, with filling frequencies ω_1 and ω_2 , such that $\omega_1 - \omega_2 \ll \omega_{1,2}$ (fig. 1).

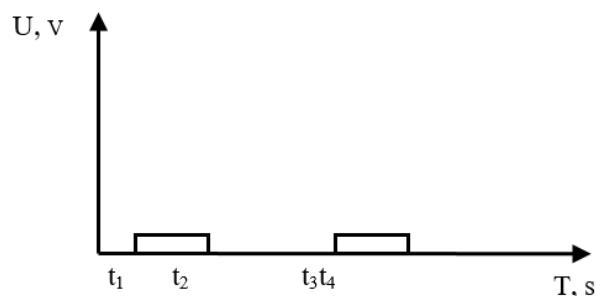


Fig. 1. Input signal (two long pulses with close carrier frequencies)

At the output of the acousto-optic spectrum analyzer, the spectra of the analyzed pulses will have the form shown in fig. 2 (solid lines show the spectra of each pulse individually, and dashed lines show the resulting spectrum). It is clear that the accuracy of the frequency measurement will be determined by a value $\delta\omega_{mes}$ that depends on the parameters of the acousto-optic spectrum analyzer. This dependence can be estimated as

$$\delta\omega_{mes} = 2 \frac{\pi}{a},$$

where a is the parameter characterizing the

diffraction characteristics of the spectrum analyzer. Thus, it is clear that two pulses arriving at different time intervals with close values in frequency $\omega_1 - \omega_2 < \delta\omega_{mes}$ cannot be distinguished based on the Rayleigh criterion.

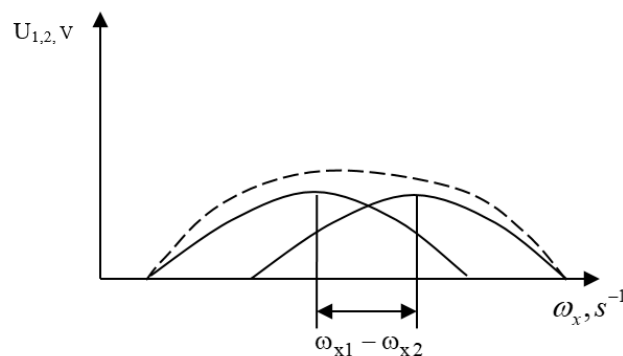


Fig. 2. The output signals of the pulses with a small detuning frequency

But, as noted above, such pulses often need to be distinguished, i.e., to measure the frequency with an accuracy significantly higher than the accuracy of measurements by traditional methods.

To solve this problem, we use the methodology for processing radar signals [34], which in radar allows us to determine the delay time of the arrival of a sufficiently long pulse with an accuracy significantly exceeding the pulse size. It is based on the fact that when integrating a pulse signal over a strobe of alternating sign and further summing, it is possible to obtain the value of the mathematical expectation of the time of arrival of the signal with dispersion, significantly shorter than the pulse duration.

In this paper, this approach will be extended to the measurement of the spatial spectrum in acousto-optical spectrum analyzers.

Fig. 3 shows the simplest case when the strobe has the form of two step functions: positive and negative. The axes ω_x, s^{-1} and T, s are essentially identical, since the count of the flow of photoelectrons is, generally speaking, a function of time. The structural diagram of the device in which the proposed technique is implemented is shown in fig. 4.

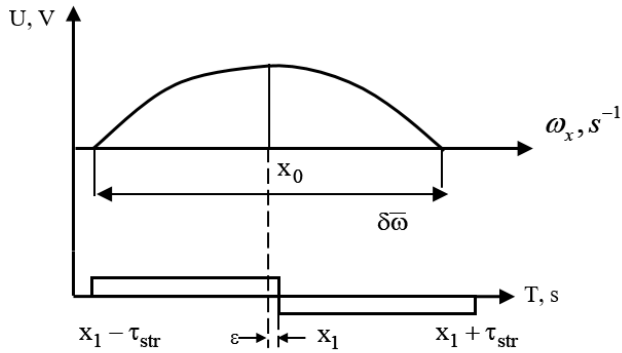


Fig. 3. Gating of spectrum distribution by two step pulses

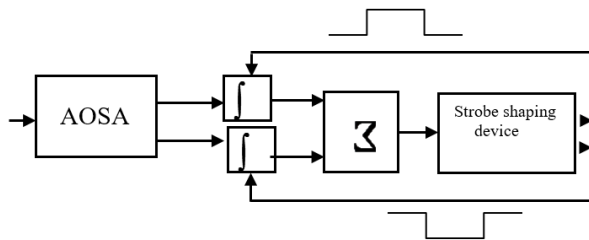


Fig. 4. Block diagram of a spectral information processing device for increasing the resolution of an acousto-optic spectrum analyzer

As can be seen, in figs. 3 and 4, the processing of the radar signal reduces to integrating the signal over a strobe of variable sign and then the integral over the entire strobe can be replaced by the sum of two integrals

$$I = I_1 + I_2,$$

where the integrals I_1 and I_2 can be represented as:

$$I_1 = \int_{x_1 - \tau_{str}}^{x_1} \text{rect}\left(x_1 - \frac{\tau_{str}}{2}\right) \hat{n}(x) dx; \quad (1)$$

$$I_2 = - \int_{x_1}^{x_1 + \tau_{str}} \text{rect}\left(x_1 + \frac{\tau_{str}}{2}\right) \hat{n}(x) dx, \quad (2)$$

where $\text{rect}(x)$ is a rectangular impulse function; $\hat{n}(x) = n_s(x) + n_n(x)$ is the density of the flux distribution of photoelectrons; n_s is the distribution density of the signal photoelectron flux; n_n is the distribution density of the interference photoelectron flux.

For average photoelectron flux, the following relation is valid:

$$\overline{\hat{n}(x)} = N_s + N_i, \quad (3)$$

where N_s and N_i – the average values of the count rate for the frequency of signal and interference photoelectrons, respectively.

As it is known [35], the distribution density of the signal photoelectron flux in acousto-optical spectrum analyzers obeys this distribution law:

$$n_s(x) \cong N_{s0} \frac{\sin^2 a(x-x_0)}{[a(x-x_0)]^2}, \quad (4)$$

and the average value of interfering photoelectrons is constant over the entire frequency measurement interval.

Integrals I_1 and I_2 in turn can be represented as the sum of two integrals each, respectively:

$I_1 = A_1 + B_1$; $I_2 = A_2 + B_2$, where A_i are integrals describing the behavior of the signal component of the photoelectron flux, and B_i – interfering:

$$A_i = \int_{\tau_{str}} n_n(x) dx, \quad (5)$$

$$B_i = \int_{\tau_{str}} n_n(x) dx, \quad (6)$$

where the designation $\int_{\tau_{str}} n_n(x) dx$ corresponds to the integration of the photoelectron flux over the strobe.

Then we can compose an expression for the function that describes the spectrum processing as $|I_2 - I_1| = (x_1 - x_0)N_{s0}$. We introduce the value of the deviation x_1 from x_0 as ε . The processing algorithm can be represented as

$$A_1 - A_2 + B_1 - B_2 = 2\varepsilon N_{s0}. \quad (7)$$

Let the expression ε go to zero, then $x_1 \rightarrow x_0$, i.e. the boundary of the strobe will correspond to the mathematical expectation of the spectral line. Then the value of the average deviation ε in accordance with (7) will take the form

$$\varepsilon = \frac{\overline{A_1 - A_2 + B_1 - B_2}}{2N_{s0}} = 0. \quad (8)$$

Let us analyze the dispersion of the deviation x_1 from x_0 at the conditions of the proposed processing of spectral information. It's well known that $D[\varepsilon] = D|I_2 - I_1| = D[I_1] + D[I_2]$ or, given the ratio (6, 7):

$$D[\varepsilon] = D\left[\frac{A_1}{2N_{s0}}\right] + D\left[\frac{A_2}{2N_{s0}}\right] + D\left[\frac{B_1}{2N_{s0}}\right] + D\left[\frac{B_2}{2N_{s0}}\right]. \quad (9)$$

If we assume that the form of the spatial spectrum is symmetric, then to simplify the analysis, we can assume that $D[A_1] = D[A_2]$ and $D[B_1] = D[B_2]$.

Then the expression for dispersion ε can be rewritten as

$$D[\varepsilon] = 2D\left[\frac{A_1}{2N_{s0}}\right] + 2D\left[\frac{B_1}{2N_{s0}}\right]. \quad (10)$$

To find the dispersion of the quantity ε , we analyze each of the terms of expression (10). Given that constant coefficients can be taken out from under the sign of dispersion, raising them to the second power, we represent the first term in the form (10):

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{1}{4N_{s0}^2} D[A_1] = \frac{1}{4N_{s0}^2} D \int_{x_1-\tau_{str}}^{x_1} n_s(x) dx. \quad (11)$$

The expression (10) includes the dispersion of the integral of the flow signal photoelectrons for the gate. For further analysis of expression (11) it should be noted that the flow of signal photoelectrons in acoustooptic spectrum analyzer, as is known, is described by the Poisson distribution. But one of the main properties of random variables distributed according to the Poisson law is the lack of correlation with compound Poisson stream, i.e. $n_s(x)$, each value of the implementation is included in the integral (11) can be considered independent from the previous and subsequent. Given the above, the integral can be represented by an infinite sum of mutually independent components of the flow signal photoelectrons. Due to the fact that the dispersion of the sum, though infinite, is equal to the sum of the dispersions, then the dispersion can be made under the integral sign

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{1}{4N_{s0}^2} \int_{x_1-\tau_{str}}^{x_1} D[n_s(x)] dx. \quad (12)$$

We substitute expression (4) in (12) and obtain the expression

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{1}{4N_{s0}^2} \int_{x_1-\tau_{str}}^{x_1} D\left[n_s(x) \frac{\sin^2 a(x-x_0)}{[a(x-x_0)]^2}\right] dx. \quad (13)$$

The ratio $\frac{\sin x}{x}$ in expression (13) is constant, i.e. not changing from implementation to implementation and therefore it can also be taken out of the sign of dispersion

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{1}{4N_{s0}^2} \int_{x_1-\tau_{str}}^{x_1} \frac{\sin^4 a(x-x_0)}{[a(x-x_0)]^4} D[n(x)] dx. \quad (14)$$

Since the Poisson distribution is characterized by the equality of mathematical expectation and dispersion, the expression for dispersion (14) can be finally represented in the form:

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{1}{4N_{s0}^2} \int_{x_1-\tau_{str}}^{x_1} \frac{\sin^4 [a(x-x_0)]}{[a(x-x_0)]^4} N_{s0} dx, \quad (15)$$

The resulting integral is easily reduced to a table one, and as a result we get

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{\pi}{3aN_{s0}}. \quad (16)$$

Using the relation between a and $\delta\omega_{mes}$, expression (16) can be represented as

$$D\left[\frac{A_1}{2N_{s0}}\right] = \frac{\delta\omega_{mes}}{6N_{s0}}. \quad (17)$$

When multiplying the numerator and denominator in the expression (17) and taking into account the equality of the dispersions along the symmetric gate for the dispersion of the signal component, we obtain the corresponding expression

$$D\left[\frac{A}{2N_{s0}}\right] = \frac{\delta\omega_{mes}^2}{3W_s}, \quad (18)$$

where W_s is a measured optical signal energy (W_s is a dimensionless quantity, since in our case the energy of an optical signal means the total number of photons).

After similar reasoning, we can obtain the expression for the dispersion ε due to the interference component of the photoelectron flux:

$$D\left[\frac{B}{2N_{s0}}\right] = \frac{N_n}{N_{s0}} \cdot \frac{\delta\omega_{mes}^2}{W_s}. \quad (19)$$

Thus, the dispersion of the signal frequency measurement takes the form

$$D[\varepsilon] = \frac{\delta\omega_{mes}^2}{W_s} \left(\frac{1}{3} + \frac{N_n}{N_s} \right). \quad (20)$$

It can be seen from (20) that the dispersion of the signal frequency measurement is proportional to the width of the measured spectrum and inversely proportional to the signal energy. But at the same time, it can be seen from (20) that even in the absence of an interfering component, the dispersion of the signal frequency measurement will be nonzero due to the quantum nature of the processes occurring in the acousto-optic spectrum analyzer. Obviously, by increasing the energy of the optical flow, one can achieve the ratio: $D[\varepsilon] \ll \delta\omega_{mes}^2$, which will allow a much more accurate measurement of the frequency of a radio pulse of long duration.

Thus, as a result of using the proposed signal processing technique in acousto-optic spectrum analyzers, their resolution can be significantly improved compared to methods based on the use of the Rayleigh criterion.

Conclusions

The article analyzes the main reasons that affect the quality of service (QoS) indicators of computer networks of the forensic system. Features of using AOSA for testing communication channels of a computer network of a ship forensic information system are considered.

The article also proposes a technique for processing signals in an acousto-optical spectrum analyzer. This

technique makes it possible to increase the resolution of AOSA due to the fact that when integrating a pulse signal over a variable-sign strobe and further summing it is possible to obtain the value of the mathematical expectation of the arrival time of a signal with dispersion much shorter than the pulse duration. In the proposed case, this technique will be extended to the measurement of the spatial spectrum in acousto-optical spectrum analyzers. Taking into account the fact that the signal photoelectron flux in the acousto-optical spectrum analyzer is described by the Poisson distribution, the accuracy of the frequency measurement is determined by the ratio $D[\varepsilon] \ll \delta\omega_{mes}^2$, which can significantly increase the frequency measurement accuracy in the CN

information transmission channel, which in turn provides a significant increase in the QoS of computer networks of the judicial system expertise

Existing hardware limitations of the resolution of acousto-optic spectrum analyzers based on the Rayleigh criterion are not limiting. Using a variety of signal processing techniques, it is possible to significantly increase the frequency resolution of acousto-optic spectrum analyzers.

Further research should be directed to the development of optimal algorithms for measuring the frequency of an optical signal in acousto-optical spectrum analyzers.

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ЗАСОБИ ПОЛІПШЕННЯ ЯКОСТІ ОБСЛУГОВУВАННЯ КОМП'ЮТЕРНОЇ МЕРЕЖІ ІНФОРМАЦІЙНОЇ СИСТЕМИ СУДОВОЇ ЕКСПЕРТИЗИ

Актуальність дослідження. У сучасній судово-експертній практиці комп'ютерні мережі (КМ) є невід'ємною частиною комп'ютерно-технічної експертизи, тому забезпечення їх нормального функціонування стає надзвичайно важливою задачею. У цьому зв'язку в теорії побудови, модифікації й експлуатації цифрових телекомунікаційних систем виникає досить загальна проблема по цифровій обробці сигналів, синхронізації мережі і її стабільності. Розв'язку даної проблеми були присвячені дослідження, у яких аналізувалися характеристики стабільності функціонування мережі й пропонувалися методи виміру фізичних параметрів, що визначають її. Багато із проведених досліджень ґрунтувалися на використанні частотних вимірів у каналах зв'язку комп'ютерних мереж передачі інформації. Акустооптичні аналізатори спектра (АОАС) широко застосовуються в мережах інформаційної системи судової експертизи, що дозволяє підвищити показники QoS комп'ютерних мереж системи судової експертизи. **Предмет** дослідження: роздільна здатність акустооптичних аналізаторів спектра. **Метою** статті є підвищення якості діагностики параметрів комп'ютерних мереж передачі інформації на базі використання розробленої методики обробки сигналів в акустооптичних аналізаторах спектра, яка дозволяє підвищити роздільну здатність АОАС за рахунок підвищення роздільної здатності по частоті двох неодноразових радіоімпульсів великої тривалості. **Результати** дослідження. Проведений аналіз впливу частотних параметрів комп'ютерної мережі на забезпечення виконання відповідних вимог по якості обслуговування. Проведені дослідження можливих шляхів підвищення роздільної здатності АОАС по частоті. Вивчені нелінійні характеристики АОАС, що дозволяють проводити модернізацію методів підвищення роздільної здатності по частоті. Використана класична методика обробки радіолокаційних сигналів, що дозволяє визначити час запізнювання приходу досить довгого імпульсу з точністю, що значно перевищує розміри імпульсу. При аналізі роботи АОАС враховується, що потік сигнальних фотоелектронів в акустооптичному аналізаторі спектра, як відомо, описується розподілом Пуассона. Але однією з основних властивостей випадкових величин, розподілених за законом Пуассона, є відсутність взаємної кореляції складових Пуассонівського потоку. Це допущення дозволяє суттєво підвищити роздільну здатність АОАС по частоті. **Висновки.** Наведено аналітичні співвідношення для дисперсії виміру частоти сигналу. Запропонована методика обробки сигналів в АОАС, яка дозволяє підвищити роздільну здатність АОАС за рахунок підвищення роздільної здатності по частоті двох неодноразових радіоімпульсів великої тривалості.

Ключові слова: комп'ютерна система; телекомунікаційна мережа; акустооптичний аналізатор спектра; показники якості обслуговування (QoS) комп'ютерних мереж.

СРЕДСТВА УЛУЧШЕНИЯ КАЧЕСТВА ОБСЛУЖИВАНИЯ КОМПЬЮТЕРНОЙ СЕТИ ИНФОРМАЦИОННОЙ СИСТЕМЫ СУДЕБНОЙ ЭКСПЕРТИЗЫ

Актуальность исследования. В современной судебно-экспертной практике компьютерные сети (КС) являются неотъемлемой частью компьютерно-технической экспертизы, поэтому обеспечение их нормального функционирования становится чрезвычайно важной задачей. В этой связи в теории построения, модификации и эксплуатации цифровых телекоммуникационных систем возникает достаточно общая проблема по цифровой обработке сигналов, синхронизации сети и ее стабильности. Решению данной проблемы были посвящены исследования, в которых анализировались характеристики стабильности функционирования сети и предлагались методы измерения физических параметров, определяющих ее. Многие из проведенных исследований основывались на использовании частотных измерений в каналах связи компьютерных сетей передачи информации. Акустооптические анализаторы спектра (АОАС) широко применяются в сетях информационной системы судебной экспертизы, что позволяет повысить показатели QoS компьютерных сетей системы судебной экспертизы. **Предмет** исследования: разрешающая способность акустооптических анализаторов спектра. **Целью** статьи является повышение качества диагностики параметров компьютерных сетей передачи информации на базе использования разработанной методики обработки сигналов в акустооптических анализаторах спектра, которая позволяет повысить разрешающую способность АОАС за счет повышения разрешения по частоте двух одновременных радиоимпульсов большой длительности. **Результаты** исследования. Проведен анализ влияния частотных параметров компьютерной сети на обеспечение выполнения соответствующих требований по качеству обслуживания. Проведены исследования возможных путей повышения разрешающей способности АОАС по частоте. Изучены нелинейные

характеристики АОАС, позволяющие проводить модернизацию методов повышения разрешающей способности по частоте. Использована классическая методика обработки радиолокационных сигналов, позволяющая определять время запаздывания прихода достаточно длинного импульса с точностью, значительно превышающей размеры импульса. При анализе работы АОАС учитывается, что поток сигнальных фотоэлектронов в акустооптическом анализаторе спектра, как известно, описывается распределением Пуассона. Но одним из основных свойств случайных величин, распределенных по закону Пуассона, является отсутствие взаимной корреляции составных Пуассоновского потока. Это допущение позволяет существенно повысить разрешающую способность АОАС по частоте. **Выводы.** Приведены аналитические соотношения для дисперсии измерения частоты сигнала. Предложена методика обработки сигналов в АОАС, которая позволяет повысить разрешающую способность АОАС за счет повышения разрешения по частоте двух неодновременных радиоимпульсов большой длительности.

Ключевые слова: компьютерная система; телекоммуникационная сеть; акустооптический анализатор спектра; показатели качества обслуживания (QoS) компьютерных сетей.

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