Neuromonitoring and neuroclassification of crime events in distributed network

Нейромониторинг и нейроклассификация криминальных событий в распределенной сети

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Abstract

Systemic analysis of criminal events and situations in some distributed network is a pressing problem not only of law enforcement structures, but also of the authorities, the whole society. In the investigation of each the crime requires speed, as well as completeness, accuracy and low uncertainty of the event. Effective investigation requires the involvement of IT procedures based not only on criminology, but also on psychology, mathematics, system analysis, computer science and other fields of knowledge. Only in this way can we analyze the goals, situations and tasks, develop and take decisions to counter crime not only in Vietnam, but also in many countries, including Russia. It's important to have not only methodology, but also technology, methods and tools. The work separately explores the monitoring tools of crime events. A systematic analysis of the problem has been carried out, on the basis of which methods of transition from traditional monitoring of a specific (problem-oriented) criminal situation to intellectual, systemic monitoring of the entire criminal environment have been proposed. Criminological identification of an event is a complex and multidimensional problem. The system analysis carried out will make it possible to formulate assessment measures, for example, based on neural systems. Procedures of neuro-classification and neuro-clustering of crime events, including mathematical and neural, as well as evaluation of efficiency of the conducted criminal policy are proposed. Methods of system analysis have been used - analysis-synthesis, decomposition, aggregation, identification, classification and monitoring, as well as mathematical and neural network modeling. This will improve the quality of crime analysis, both

Аннотация

Системный анализ криминальных событий и ситуаций в той или иной распределенной сети является актуальной проблемой не только правоохранительных структур, но и органов власти, всего общества. При расследовании каждого преступления требуется быстрота, а также полнота, точность и низкая неопределенность события. Эффективное расследование требует привлечения ИТ-процедур, основанных не только на криминалистике, но и на психологии, математике, системном анализе, информатике и других областях знаний. Только так можно анализировать цели, ситуации и задачи, разрабатывать и принимать решения по противодействию преступности не только во Вьетнаме, но и во многих странах, в том числе и в России. Важно иметь не только методологию, но и технологию, методы и инструменты. В работе отдельно исследуются инструменты мониторинга криминальных событий. Проведен системный анализ проблемы, на основе которого предложены методы перехода от традиционного мониторинга конкретной (проблемно-ориентированной) криминальной ситуации к интеллектуальному, системному мониторингу всей криминальной среды. Криминологическая идентификация события - это сложная и многомерная проблема. Проведенный системный анализ позволит сформулировать оценочные меры, например, на основе нейронных систем. Предложены процедуры нейроклассификации и нейрокластеризации криминальных событий, в том числе математические и нейронные, а также оценки эффективности проводимой уголовной политики. Это позволит повысить качество

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theoretically (modelling) and application (forecasting of counter-crime results). It's noted that multilevel and fragmented monitoring system does not contribute to operational law enforcement practice, IT-oriented monitoring is proposed.

Keywords: crime, criminogenic event, monitoring, system analysis, law-enforcement practice, classification, neurosystem.

анализа преступности, как теоретического (моделирование), так и прикладного (прогнозирование результатов борьбы с преступностью). Отмечается, что многоуровневая и фрагментированная система мониторинга не способствует оперативной правоприменительной практике, предлагается ИТ-ориентированный мониторинг.

Ключевые слова: преступность, криминогенное событие, мониторинг, системный анализ, правоприменительная практика, классификация, нейросистема.

Introduction

In the investigation of crimes, modern information technologies are often necessary not only for the speed of disclosure, but also for its completeness, accuracy, evidence. Especially if the rate of crimes using IT or requiring their use in investigation is also increasing.

Monitoring information "in the sphere of interest" of some distributed network is the result of implementation (under the corresponding hypotheses) of special procedures for obtaining and updating the necessary data. In criminal practice, information is a set of data considered in a comprehensive and integral manner, depending on the needs of criminal policy actors. Digital transformations of criminal law, analysis of crime events are the process and result of the introduction into practice of quantitative models and methods of assessment, analysis and forecasting of crime, as well as combating it (Maksimov, Vasin, Valukov and Utarov, 2019). Taking into account the relevant criminal response measures, including methods of system analysis, criminological, information-logical and mathematical modelling in the implementation of these measures.

But Vietnamese experience of mathematical description and modeling of crime control processes is limited to the current tasks of investigating specific crimes (e.g. models of pyramids, accidents, disasters, logical situations and hierarchies). As, however, in Russia and other countries where there is some experience of digital transformations of criminal policy.

But there is a need everywhere for a systematic approach and policy analysis linked to criminological realities and environments. Taking into account the ergent properties of the criminal system, the elimination of intra-system contradictions - from banal errors to systemic inconsistencies. Systemic contradictions of

criminal policy will increase, as will the complexity of the disclosure of criminal offences. This is also influenced by the fact that the digitalization of society has made criminal offences more accessible, technological and rapid for many.

The development and application of information and intellectual crime investigation systems is of interest not only to system developers, but also to operational and investigative structures. An effective (accurate and prompt) effective investigation of the crime will require the analysis of multilateral and voluminous information. Therefore, our systematic analysis and recommendations based on it is a useful methodological tool for electronic law, creativity and application of its norms. System analysis allows you to approach the investigation problem from the perspective of IT applicability and effectiveness.

Theoretical framework

The main objectives of monitoring are to obtain diverse information on crimes and criminals, reasons and results of combating it, expert assessments, which allow to correct conclusions on criminal events. But such monitoring will be effective only if the key principles of its implementation are respected - coverage (geographically and in time), coordination and responsible implementation of functions and tasks, including coordination of experts, ensuring monitoring.

Sources of monitoring information concerning the crime situation are:

1) official information, documentation;
2) informal departmental information;
3) information from various state organizations;

4) information from citizens and public organizations ("feedback" effect).

Without them, monitoring will be unidirectional and one-sided. According to (Aminov, 2012) feedback is more often realized through communications:

1) applications to law enforcement agencies (37%), claims to justice agencies (23%);
2) rallies (15%) and elections (11%);
3) media (10%) and otherwise (4%).

The main ones in such links are the information of criminal policy subjects, the justification or not the justification of criminal decisions. If feedback is not implemented in time (cannot be monitored) or distorted, there is significant harm to criminal policy and public confidence in it.

The feedback is characterized by ambivalence: on the one hand, it increases the effectiveness of criminal policy, on the other - it's impossible without trust of the authorities. The effectiveness of criminal policy is severely diminished if real or virtual feedback is replaced by imitation. In Vietnam, Russia and many other countries, there is often a situation where some officials mimic such activities - up to the falsification of some data, statements "on behalf of the people." The illusion of the success of the work of the organs of law is created; the opinion of all sectors of the population is not fully taken into account.

It follows from the above that well-established feedback is necessary, but not through the creation of additional structures or the introduction of new functions (they are already sufficient), but through the application of IT, new methods of monitoring and processing large amounts of data, the updating of Big Data (Williams and Burnap, 2016).

The need for relevant information also defines its functions in legal systems. The information processes should be organized in relation to the crime event. It's necessary to analyses the possibilities of information and legal impact on crime and deterioration of crime situation from various aspects:

1) systemicity and self-organization (Kaziev, 2007; Gluhova, Kaziev & Kazieva, 2018);
2) semantics and ontologies (Uschold, King, Moralee & Zorgios, 1997; Chan, Moses, 2017);
3) pragmatics (Williams, Burnap & Sloan, 2017; Vasin, 2018).

The information used in the criminal policy of the law enforcement agencies of Viet Nam is diverse and heterogeneous - laws and by-laws, legal decisions and documents, etc., including information on the level of corruption activities. Information is also circulated in the system of analysis of criminal events, including in the system of monitoring and "electronic norm-setting." But, from our point of view, it is often disconnected from criminological realities. Therefore, modeling, application of high technologies is necessary. The task is complex, requires digital transformations, intelligent systems of analysis of crime events (Cochegurov and Martynova, 2020) and support of decision-making.

But in its decision, legislators have the possibility of evidentiary formulation of criminal legal prohibitions and optimal sanctions in case of their violation (Valuiskov, Bondarenko, and Arutyunyan, 2017). This is necessary for neuro-monitoring analysis of the links between the intensity of the application of liability measures and criminalization in society. Necessary for forecasting "species" crime and continuous automatic monitoring and analysis, making proactive decisions. Through this approach, criminal events and crime can be studied.

In Viet Nam, in our view, legislators should develop plans for legislative work in the field of criminal policy, that is, criminal law, criminal procedure, criminal correction, operational investigation and criminological and preventive policy. But without increasing the load on police, internal affairs units, and, on the contrary, for possible reduction of such load, especially, routine (Kovandzic, et al, 2016). This will allow effective implementation of personnel and time management and will effectively reduce crime in the juvenile sphere, including of a non-systemic nature.

The system of monitoring the criminal environment and crime in Viet Nam requires a restructuring of the fight against crime. In our view, it should be based both on familiar credentials, databases and technologies, as well as on intelligent systems of prevention (forecasting) and response. In particular, on the following components: cognitive maps, fuzzy sets, deep machine learning systems, etc.

Criminological analysis identifies key criminogenic factors, allowing them to be managed and to combat the manipulation of criminal statistics, including the skilful

application of mathematical statistics (correlation links). This approach makes it possible to modify and supplement the criminal legislation of the country, taking into account more fully the criminal factors affecting the measures to combat crime. For example, resource planning of measures to influence it and transition to preventive-punitive evidence model (Maksimov, Utarov, 2018).

A law worker has to process voluminous data, he needs to analyze and "filter" information without loss at many levels: from the central apparatus to the investigative division of the province, the municipality. It's based on forensic investigation techniques. Uses automated interactive systems of accounting, control, search, statistics and analysis, methodological and technological support, office management.

Virtualization of the investigation process will increase the efficiency of the investigation, primarily to find quick solutions and "distributed" proceedings, communicate with the participants of the case, etc.

The use of neuro-monitoring and neuro-classification in this process will improve assessment tools. It will also improve crime prevention and analysis. Neuro-systems can take into account the levels of punishability of comparable crimes, and a comparative analysis of the dynamics of crime indicators can be carried out. It's possible to entrust the intelligent system with analytics, to output a logical sequence of legal conclusions, to assess options and possible risks. But given that this is not the decision on which the judgement should be rendered. Even the use of a polygraph does not determine the guilt of a person and the reason why he responded to the question in this way, the polygraph only records the reaction. Neuro-systems and networks provide an opportunity to update expert conclusion based on knowledge bases or training samples.

Law enforcement agencies need to update IT-rich methods of combating criminality, analysis of criminal events. Although technological, forensic crime investigation procedures are sufficiently developed, they need to be used systemically, in a comprehensive manner, according to the ergent properties (Volodina, Zaluzhy & Tarasova, 2019).

Criminological analysis uses IT to update legal knowledge in investigations, instrumental, communicative or applied, such as object

accounting or reconstruction ("Photo-robot"), Data Mining, taxonomy and clustering, decision making, animation, recognition, reduction of uncertainty (in particular at the beginning of the investigation), etc.

The non-systemic approach to the use of ICT, legal IS is one of the reasons for the lack of effectiveness of crime investigation, despite the extensive class of technology, forensic algorithms. Actions for crime detection not only technological and use of ICT, but also system application of legal intellectual systems (Kalafati, Moiseyev, Starkov and Shushkova, 2008).

The monitoring system should have modern tools to predict and model the dynamics of criminal events, the effectiveness of crime control and resource planning and the response to the real situation.

The approach that solves these problems is systemic, using statistical, mathematical and information-logical modeling of crime events. Quantitative and qualitative, as a social and legal phenomenon, its trends and conformity of statistical indicators with the identification of trends in the crime situation.

Criminologists rely on the probabilistic nature of models, forecast results (Luneev, 2005). This approach is also used to compare the crimes committed (recorded) and the conformity of the authorities' response to the activities of the law bodies, taking into account latency.

Methodology

To improve the efficiency of the investigation, primarily to find quick solutions and "distributed" proceedings, the work uses the method of virtualizing communication with the participants of the case, etc.

Neuro-monitoring and neuro-classification methods are used, which are effective evaluation tools for this process. They also improves the results of crime prevention forecasting and analysis of crime control measures. The neural network method takes into account the levels of punishability of comparable crimes, which is important. It is also possible to carry out a comparative analysis of the dynamics of crime indicators. The method of intelligent output is used: intelligent analysis and output of logical sequence of legal conclusions, which allow to assess options and possible risks. But it should be

taken into account, it's methodically very important that it will not be a court decision. Even the use of a polygraph does not determine the guilt of a person and the reason why he responded to the question in this way, the polygraph only records the reaction.

Using the neural network approach, we get the possibility of expert conclusion, which is based on training samples.

The proposed classification procedure uses activity parameters (factors). For example, on the payment platform, in the criminal social network community, etc. Systemic and synergistic analysis of socio-economic and legal risks is also actiulized.

Results and discussion

Consider the task of neural network classification of strongly criminogenic structures, clusters (sites). Classification is carried out by activity (for example, in the social network, on payment platforms, in the criminal community, etc.). This will identify important systemic socio-economic and legal risks.

In classification, it's important to highlight the main components, features, provided that the consistency, accuracy and sufficient completeness of monitoring or other information is maintained. But in difficult-to-structure clusters it's often impossible to take into account the structure of the cluster, to identify "leaders" (recidivists), possible unacceptable classification errors.

We use the master component method. It's used in various tasks, has shown high efficiency in many areas (Besudnov, Lande & Snarsky, 2009) and in real mode. The method adapts to organizational challenges and used in Big Data, Data Mining, analytics and data of monitoring. For example, from distributed monitoring and analysis points of crime events for the country.

In the method of main components, each such component is decomposed into internal factors or fluctuations, so-called empirical mode function or IMF (Borzov and Pototurkin, 2018). They are not defined (as in Fourier-transform) by analytical ratios and are determined only by the input data stream being analyzed, but show their effectiveness.

The main component method finds the maxima and minima of the input data streams by crime events, then are built on these "reference points" and the "midline" obtained by subtracting the average envelopes from the input data streams is identified. This process can then be iteratively continued until the stop criterion is met (e.g., achieving the required accuracy of identifying a crime event; usually a few iterations are enough). The process of finding the empirical modes of the IMF(1), the IMF(2),..., the IMF(m) is efficient. For two-dimensional data (for example, on time and criminal activity), a similar iteration is built on the N main components of the m×n length feature vector.

Another approach to the problem of classification of crime events may be the blockchain methodology now adaptable for a variety of applications (Babkin, et al, 2018). The impetus for the development of a new information system, new applications may be the requirements of society, the availability of new technologies or management strategies.

Classification methods of "rapid response" are important, in conditions of lack of information or uncertainty of the situation. Criminological actions should be monitored by the neural system and classified. For example, if to present them as a nonempty set of actions of leaders to crime, damage to business, then vector record of the scheme j=1.2...N will have an appearance: $X_j = < x_{j1}, x_{j2}, ..., x_{jm} >$, where x_ji is an indicator of risk of realization in criminal scheme j of action number i. Then a risk matrix - $X = || x_{ji} ||_{j=1,2...N; \ i=1,2..M}$.

Dimension is important to reduce without losing information value, because it determines the quality of the classification. Each feature of a criminal scheme has a certain measure of informativity, from not informative completely to informative completely.

Different classification procedures based on informative characteristics are applicable: factor analysis; statistical analysis (e.g. on χ^2 statistics) information and entropy; expert and heuristic; fuzzy sets and logic; genetic algorithms and evolutionary modeling (e.g. Kohonen self-organizing maps, figure 1), etc. (Nazarov, Konysheva, 2019).
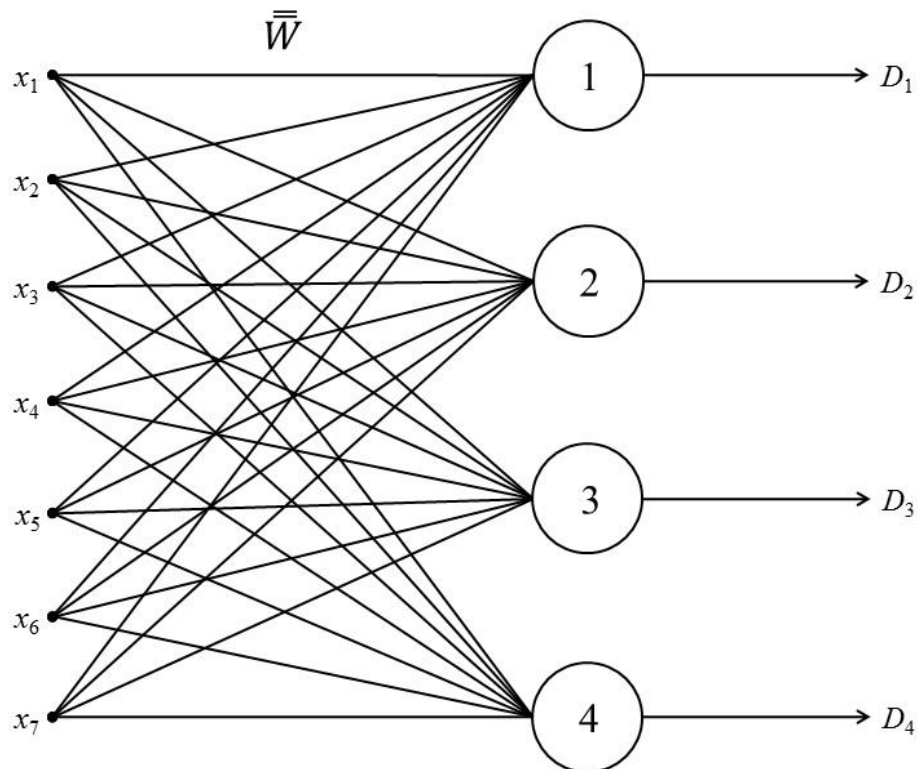
Figure 1. Structure of Kohonen single-layer neural network for clustering of crime actions (schemes, events).

In the figure, the scheme is distributed into 4 conditional types of D_1, D_2, D_3, D_4, for example, four degrees of activity (large and worked scheme, medium and worked, medium and nascent, small and nascent). As input variables 7 characteristics, signs of schemes are used conditionally: the activation duration, danger (threats), the number of criminals, territorial influence, and narrowness of communications, "equipment" (including and IT) and mobility. The scale matrix W is also defined, which determines the degree (measure) of close neuro-connections (it's specified by experts and as a result of neural network training).

A crime event (scheme) is identified after training on monitoring data on the most common schemes in practice and jurisprudence. The purpose of scales is a responsible moment, it's desirable to formalize it, to free it from subjective influence. For example, by frequency f_{ij} occurrence of illegal acts i in scheme j, i = 1,2,.., M; j=1,2,...,N; N_i is the total number of situations (schemes) where actions j are identified: binary weighing - "occurs - 1; is not occurs - 0". Can be used to calculate weights

$$w_{ij} = f_{ij} \log_2\left(\frac{N}{N_i}\right)$$

Or its normalized version:

$$w_{ij} = \frac{f_{ij} \log_2\left(\frac{N}{N_i}\right)}{\sqrt{\sum_{i=1}^{M}(f_{ij} \log_2\left(\frac{N}{N_i}\right))^2}} \; .$$

Conclusions

A non-systemic approach to the development of procedures and methods to influence the crime situation already prevents its full control, use of IT and intellectual legal systems. This is a key reason for the inefficiency of crime investigation and crime management. But there are many modern technologies and forensic algorithms, there are various activities of a criminological nature. With the system approach, these resources are activated more fully and more intelligently.

A reassessment of the realities of criminological monitoring and event classification is needed and a new base of information technology-rich and

evidence-based investigation should be built. Forensics must also evolve to meet the demands and needs of digital society.

Effective monitoring, classification of criminal events and effective crime prevention are the basis for crime prevention. The analysis carried out in the work and the proposed approaches will allow to study crime events "in general," systemically and to develop also systemic counteractions and classifications.

Bibliographic references

Aminov, D.I. (2012) On the Role of Monitoring in the Implementation of Modern Criminal Policy//Journal of the Moscow University of the Ministry of Internal Affairs of the Russian Federation. Right. No. 11, pp. 46-47.

Babkin, A.V., Burkaltseva, D.D., Betskov, A.V., Kilyaskhanov, H.S., Tyulin, A.S., Kurianova, I.V. (2018). Automation Digitalization Blockchain: Trends and Implementation Problems // International Journal of Engineering and Technology, 7(3.14). - pp. 254-260.

Besudnov, I.V., Lande, D.V., Snarsky, A.A. (2009) Internetics. Navigation in complex systems: models and algorithms. -M.: Libron. - 264 p.

Borzov S.M., Pototurkin O.I. (2018) Spectral-spatial methods of classification of hyperspectration images (overview) // Autometry, vol. 54, № 6, pp.64-86.

Chan, J., Moses L.B. (2017) Making Sense of Big Data for Security // British J. of Criminology. Vol.57, iss.2. – pp.299–319.

Cochegurov, E.A., Martynova Yu. A (2020) Aspects of continuous user identification based on free texts and hidden monitoring // Programming and Computer Software, Vol. 46, No. 1, pp. 12-24.

Gluhova, L.V., Kaziev, V.M., Kazieva, B.V. (2018). System rules of financial control and management of innovative business processes of the enterprise. // Journal of the Volga State University named after V.N. Tatischev, vol.2. No.1. -pp.118-126.

Kalafati, Y.D., Moiseyev K.V., Starkov S.O., Shushkova S.A. (2008) Technology of Storage and Processing of Electronic Documents with Intellectual Search Properties // International J. Information Theories and Appl. (IJITA), Vol.15, 184.

Kaziev, V.M. (2007) Introduction to analysis, synthesis and modeling of systems. Binom. Laboratory of knowledge. Intuit. – 244 p.

Kovandzic, T., Shaffer, M.E, Vieraitis, L.M., Orrick, E.A., Piquero, A.R. (2016). Police, Crime and the problem of weak instruments: Revisiting the «More police, less crime» Thesis // J. of Quantitative Criminology. Vol.32, iss.1. – pp.133–158.

Luneev, V.V. (2005) Crime of the 20th century: world, regional and Russian trends. 2nd ed. -M: Volters Cluver. - 912 p.

Maksimov, S.V., Vasin, Y.G., Valukov, N.V., Utarov, K.A. (2019) Digitalization of criminal policy as a tool to overcome its asistemicity // Russian J. of Criminology, vol.13, No. 3, pp.395-407.

Maksimov, S.V., Utarov K.A. (2018) Criminal policy in the field of competition protection: goals and opportunities / Under ed. V.P. Zavarukhina. -M.: IPRAN RAS. -80 p.

Nazarov, D.M., Konysheva, L.K. (2019) Intellectual systems: foundations of fuzzy set theory (tutorial, 3rd ed.). -M.: Jurite. -186 p.

Uschold, M., King, M., Moralee, S. & Zorgios, Y (1997). The Enterprise Ontology AIAI Edinburgh: The University of Edinburgh. – p. 208.

Vasin, Y.G. (2018) Criminal Policy and Combating Organized Crime: Some Possibilities for Improvement // Education and Law. No. 3. -pp.11-21.

Valuiskov, N.V., Bondarenko, L.V., Arutyunyan A.D (2017). Juvenile Crime: Current State and Dynamics // Journal of Politics and Law. Vol.10, iss.4. –pp.225–232

Volodina, N.V., Zaluzhy, A.G., Tarasova, D.M. (2019) The systematic approach to modern political and legal systems of states on countering international extremism // Amazonia Investiga, vol.8, N20. –pp.98-103. Retrieved from: http://www.amazoniainvestiga.info/index.php/amazonia/article/view/68

Williams, M.L., Burnap, P. (2016) Cyberhate on Social Media in the Aftermath of Woolwich: a Case Study in Computational Criminology and Big Data // British J. of Criminology. Vol.56, iss.2. – pp.211–238.

Williams, M.L., Burnap, P., Sloan, L. (2017) Crime Sensing With Big Data: The Affordances and Limitations of Using Open-source Communications to Estimate Crime Patterns // The British J. of Criminology. Vol.57, iss.2. – pp.320–340.