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Content

IMPLEMENTATION OF CUSTOMIZED ERP SOFTWARE

Aleksandar I. Borisov

ABSTRACT: *The report reflects the need for analysis of warehouse structure and processes before implementing customized ERP system.*

KEYWORDS*: Enterprise Resource Planning, Warehouse Architectures, Master Data, Cross-Process, Lot, Inbound Process, Outbound Process, Internal Process.*

1. Introduction

A large percentage of Enterprise Resource Planning (ERP) system implementations cause major operational disruptions after go live, or take longer than expected and the projects exceed budget. The main cause of the delays and over budgeting is the unclear definition of the ERP requirements. The ERP features must be synchronized with the needs of the factory.

2. Structural and functional analysis of logistics system before implementing ERP system

The opening move in Enterprise Resource Planning implementation is to diagnose the company's needs. The system performance functions are determined by constructive and functional requirements [1]. Following this and the best practices in logistics we have to consider in detail the warehouse architecture, processes, master data, and physical verification.

The warehouse architectures chart the real structure of warehouses and specify their characteristics on the basis of their designation and features. The first step in the optimization of the system is its structure analysis and potential analysis. In this way, the points and the configuration of the system are checked in order to see the reliability of performance and its effectiveness [1]. Along with master data, the warehouse architecture constitutes the basis on which all processes are designed. Companies have different warehouses - usually premises or covered spaces. They try to map various fields of the warehouse into the Enterprise Resource Planning system based on how products are stored, areas where different activities are carried out and frequency of goods moving in and out. Every warehouse is specific. For instance, it can be a distribution hub, production complex, third party logistics warehouse. Even in cases of ready products storing, warehouse architecture can vary based on the industry. Before designing the warehouse

architecture in Enterprise Resource Planning system we must realize the following basic characteristics taking a major part in affecting the warehouse plan.

Goods movement - the most important thing is to be aware of product movements in the warehouse.

Accessibility - products must be easily accessible and prioritized for accessibility. As an illustration the fast moving products must be located near the loading ramp.

Another important parameter to consider is to make the most efficient use of warehouse space. The optimal solutions are large stores with clearly distinguished storage areas and working areas.

Stowing - one of the most important characteristics is how goods will be stowed. There are different solutions like floor stowing, rack stowing, carousel stowing. The possibility of stocking into multiple stock keeping units should be taken into account.

The market offers ready – made integrated complex systems, based on the requirements of the modern management [2, 6]. Regardless of whether the companies own physical warehouses or start to design them from the ground, can not only chart their warehouse architectures and processes using standard utilities but also customized architectures and processes in ERP. The customized architectures and processes give us the opportunity to adjust the program with the real modus operandi.

Master data - warehouse master data contains storage locations, products, business partners, packaging specs and other data used to perform warehouse processes. Warehouse master data provides the foundation for creating operational documents in ERP system [5, 6]. There are different types of master data.

Supply chain data is used to form the supply chain of the company. It represents physical places or organizational structures, like boarding points and warehouses. A supply chain data contains information about its geographical position, address, time zone.

Business data - data for external and internal contractors with which the company works in partnership. The business data have a major role in the implementation of business processes in Enterprise Resource Planning system.

Product data - one of the most significant information types. Includes data for packaging materials, units of measure, type of storage, quality management, carriage group, shelf life, etc.

Packaging data - data for materials used to pack products. The packed product turns into storage unit. Last but not least are included the packaging

requirements determining different packaging levels required to put the product in the warehouse.

On the basis of factory needs we can not only built master data from old ERP system but also implement new from zero. Uploading new master data guarantees that the product information is up – to – date.

Cross – process setup is autonomous configuration for cross processes in the warehouse. They include warehouse requirements, storage units, quality control, goods recognition, execution orders setup etc. These adjustments have an impact and support key components based on which all logistics processes are executed. Therefore, after careful analysis of the current needs and future requirements [3, 7] the company can customize Enterprise Resource Planning software.

The management process of each warehouse can be split into three management sub – processes [2].

Inbound process in warehouse is the flow of products in the warehouse. Inbound process is fundamental to warehouse management. We can get in the warehouse purchased from supplier products, transferred from another internal store, issued from production area, or claimed products. The process begins with arrival of truck, unloading of products, and performing group of related operations. Unloaded materials have to be counted, QC released, unpacked, deconsolidated and stored. The type of operations that have to be executed before storing is determined by broad range of factors. The operations have to comply with the type of goods, stocking type, stowage position, etc. In addition the products have to be moved so that the best use of store resources and areas is ensured. We have considerable range of operational functionalities offered by customized architectures and processes in ERP system. They give us the opportunity to execute and control complex inbound processes.

Outbound process in Enterprise Resource Planning system provides different ways of product removing from the store. These are operations like picking, staging, and loading products into trucks. As a result the goods are sent to customer or another place. The outgoing processes are simple and complex. In a simple outgoing process, the products have to be picked from warehouse location and transferred to the loading ramp, and the process is completed. In a complex outbound process the products pass through different stages. Some products have to be picked, packed, staged and loaded. Even if perform simple outbound processes by using standard utilities, in order to control and execute complex outbound processes we need customized architectures and processes in ERP.

Internal processes. Product movements within the store are internal movements. Product movements can be changes in the position or in product

characteristics. The product can be moved to fulfill staging area, picking area, internal order, etc. Other types of movements are executed due to wrong product placement, damaged product, expired product, change of category or palletization and item, etc. Using the standard configurations is not enough to create, maintain, perform and control all of these complex processes.

Physical verification is a major storehouse process to keep track of physical stock in the storehouse. Physical verification let us monitor stock balance in the storehouse accurately. In companies, it is a critical need to keep track of the products and packaging materials in the storehouses for stock quantity and valuation consistency between system stock and physical stock in the storehouse [3, 4, 5, 6, 8]. Storehouse processes are complex, and the stock situation changes continuously and therefore increase the need to be controlled routinely. During the transfers we can lose or break the products. The possibility of being stolen or spoiled is not excluded. Sometimes, due to the lack of time or unavailability of stock in the required location a warehouse user can pick stock from another storage location. This may not be immediately updated in the system, thus causing a discrepancy in the physical and system stock count, which further leads to problems in fulfilling demands. An exact overview of physical verification also supports material requirement planning and precise availability checks. The availability check is a significant activity for companies not only for meeting ERP system reports and physical situation but also for keeping operational efficiency in the storehouse. Stock counting is often needed for audit purposes and can be demanded by inspectors. It also allows factories to activate major processes like product replenishment if the real quantity falls below the limit. It is crucial to have a clear view of the availability in the storehouse to avoid from stock out or inaccurate stock count in the storehouse. It is fundamental to consider everything written here for achieving a synergy effect [1].

3. Analysis of results

Many companies from various industries already use Enterprise Resource Planning systems for their distribution centers, production – related, and cross – dock warehouses. They lack the internal expertise and experience, and need to understand the difference between ERP package configuration and customization.

4. Conclusion and future work

In order to optimize warehouse processes, it is not enough to focus on the processes within the four walls of a single warehouse by implementing ERP standard package configuration – the whole supply chain has to be taken into account. In order to provide holistic control over warehouse structures,

processes and the flow of products when implementing the system, it is imperative to adapt the software in such a way that will meet the real company needs. In that way warehouse and supply chain operations can fully benefit from the technical and process capabilities of customized ERP system, which is essential to stay competitive in fulfilling increasingly complex customer requirements.

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Author's name and academic degrees and titles: Aleksandar I. Borisov, PhD student
Workplace: Faculty of Technical Sciences, Department „Engineering logistics", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: a.bogdanov@shu.bg

QUANTUM PRIME FACTORIZATION WITH SHOR'S ALGORITHM

Ekaterina M. Konstantinova, Tsvetoslav S. Tsankov

ABSTRACT: *The results obtained by Shor, in practice mean that a quantum computer is capable of breaking down, for example, the codes used in the blockchain of banking systems. Moreover, there is a widely used encryption system based on the current inability to decompose a sufficiently large number into simple multipliers for the time achievable by modern computers.*

"Quantum computers operate in a manner so different from classical computers that our techniques for designing algorithms and out intuitions for understanding the process of computation no longer work." Peter Shor, 2003.

KEYWORDS*: Quantum computer, Quantum information, Qubit.*

1. Introduction

From a theoretical stand point, the creation of a quantum computer is not very complicated - it is enough for the memory cells to interact with each other and we can purposefully influence their state. But in practice, everything is much more complicated. In 1982, Richard Feynman asked himself what a computer that could model nature would look like. The scientist concluded that this computer must be quantum. It wasn't that he had to work on the laws of quantum mechanics - all electronics were already being developed on the basis of its laws. The point was that while all modern gadgets and computers work under quantum laws, but in classic mode, a quantum computer should work in quantum mode. Feynman's ideas were intriguing, but they did not attract much interest in the scientific community [2], [4].

The situation changed dramatically in 1994, Peter Shor proposed a quantum algorithm that effectively solves the problem of prime factorization: to find simple multipliers of a complex positive odd number N. This is a central problem in computer science. Shor's algorithm successfully solves the problem of prime factorization with $O((n2lognloglogn))$ simple quantum gates, where $n = logN$ is the number of bits required to encode the input information N. Therefore, this algorithm provides an exponential improvement in computation speed compared to any known classical algorithm. The best one, the Number field filter, requires $exp(O(n1/3(logn)2/3))$ operations. It is worth noting that there are cryptographic systems, such as RSA, which are widely used today and are based on the

assumption that there are no effective algorithms to solve the problem of prime factorization. Therefore, Shor's algorithm, if implemented from a large-scale quantum computer, would break through the RSA cryptographic system [6].

2. Formulating the research problem

The base unit of quantum information is qubit (the quantum analog of the classical bit) and a quantum computer can be referred to as a very multi-bit system. A qubit is a two-level system similar to both spin states of one particle with spin 1/2, of states of vertical and horizontal polarization of one photon, or two levels of one atom. The classic bit is a system that can exist in two different states used to represent 0 and 1, i.e. on a separate binary digit. The only possible actions (gates) in such a system are identity ($0 \rightarrow 0, 1 \rightarrow 1$) and NOT ($0 \rightarrow 1$, $1 \rightarrow 0$). In contrast, one quantum bit (qubit) represents a two-level quantum system described in a 2-dimensional complex Hilbert space [1], [2].

According to superposition, any condition can be represented as (1).

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle, \tag{1}$$

the amplitudes α and β are complex numbers that satisfy the normalization condition $|\alpha|2 + |\beta|2 = 1$.

The power of quantum computers is due to their inherent quantum parallelism related to the principle of superposition. This means that a quantum computer can process a large number of classic inputs at a certain time. However, it is not easy to obtain useful information from the output. The problem is due to the fact that in a sense this information is hidden. Each quantum calculation ends with a predicted measurement based on calculations [3], [5]. The probabilities for different results are determined by the basic principles of quantum mechanics. However, there are quantum algorithms, that effectively extract useful information.

A classical procedure for finding two secret prime factors, p and q, of a given number N, $N = p\ x\ q$:

1. Pick a number, $a < N$, at random. Check to make sure it's not a factor of N;
2. Find r, the period of a $mod\ N$;
3. Check that r is even and $a^{r/2} + 1 \not\equiv 0\ mod\ N$; (2)
4. Let $p = \gcd(a^{\frac{r}{2}} - 1, N)$. (3)

3. Basic Quantum explanation

The quantum chain used for this algorithm is created for each variation of N and each variation of a random a depicted in $f(x) = a^x mod\ N$. With a given random N, find $Q = 2^q$ which satisfies $N^2 \leq Q < 2N^2$. The qubit registers for input and output are in superpositions from 0 to $Q - 1$.

1. Register initialization:

$$\frac{1}{\sqrt{Q}}\sum_{x=0}^{Q-1} |\,x\rangle \;=\; \frac{1}{\sqrt{2}}\sum_{x1=0}^{1} |x1\rangle \otimes \ldots \otimes \frac{1}{\sqrt{2}}\sum_{xq=0}^{1} |xq\rangle, \tag{4}$$

Here $Q - 2^q$ is reached through the hadamard gate, which creates an uniform superposition of all possible bit-strings.

2. Building f(x) as quantum function:

$$\frac{1}{\sqrt{Q}}\sum_{x=0}^{Q-1} |x, f(x)\rangle, \tag{5}$$

The computational register stores the result of the modular exponentiation function(MEF).

3. Applying the quantum Fourier transform(QFT):

$$U_{QFT}(|x\rangle = \frac{1}{\sqrt{Q}}\sum_{y=0}^{Q-1} \omega^{xy} |x\rangle, \tag{6}$$

Using the Q-th root of unity - $\omega = e\,\frac{2xi}{Q}$.

4. Doing a continued fraction expansion on $\frac{y}{Q}$. After that, checking with classical computational power whether the function $f(x)$ results in $f(x + s) \Leftrightarrow\ a^s \equiv 1\ mod\ N$;

If so, the factorization is finished. If not, the computation starts from step 1 once again.

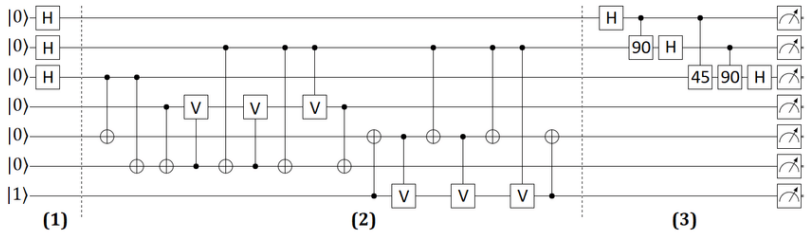

Fig. 1. A 7-qubit Shor's algorithm circuit used for factorizing 15

4. A short summary

The algorithm is comprised of two parts: the classical method can be done by a classical computer [3], [4]. The other transformations, example QFT, are what quantum computations are needed. That is because classical computers have hard time with prime factorization. N is a coprime integer group of $mod\ N$ and

$$a^r \equiv 1\ mod\ N \Longrightarrow\ N|a^r - 1. \tag{7}$$

Let's suppose that r is even. It can be factored to $(a_2^r$ -1)(a_2^r +1) $modN$. And last, checking if (a_2^r +1) $modN$ has a common divisor with N.If so, the two factors of N are $(a_2^r + 1, N)$ and $(a_2^r$ -1, $N)$.

5. Conclusion and future work

The main question is: is it possible to build a useful quantum computer that is better than the existing classical computers in solving computational problems? And if so, when? The difficulties are great. We know that the problem of decomposition of prime factors can be solved effectively with a quantum computer, but we do not know the answer to the following fundamental question: What class of problems can be solved effectively with a quantum computer? Quantum computers offer wonderful prospects, but in the coming years they are unlikely to become reality with practical application. How long will it take to develop the appropriate technologies? Although unexpected breakthroughs in technology are generally possible, the enormous effort required to develop the technology of classic computers should also be remembered.

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Author's name and academic degrees and titles: Ekaterina Minkova Konstantinova, student
Workplace: Faculty of Technical Sciences, Department of Communication and Computer Technologies, Konstantin Preslavsky University of Shumen, Bulgaria
E-mail: katminkova2@gmail.com

Author's name and academic degrees and titles: assoc. prof. eng. Tsvetoslav Stanislavov Tsankov, PhD
Workplace: Faculty of Technical Sciences, Department of Communication and Computer Technologies, Konstantin Preslavsky University of Shumen, Bulgaria
E-mail: cecko@shu.bg

PRELIMINARY PROCESSING OF SATELLITE MEASUREMENTS

Evgeni Gr. Stoykov

ABSTRACT: *One of the main and often difficult tasks in surveying is the evaluation of the quality of the measurements and the accuracy of the results obtained during the processing. In the case of satellite measurements, as an additional difficulty, it appears that the measurement process is not physically obvious, as for measuring angles, lengths and exceedances of classical geodetic methods.*

KEYWORDS*: Geodesy, GNSS, RTK.*

1. Introduction

In real-time measurements, after initialisation, the fixed receiver (if any) and the movable receiver shall be placed on the fixed starting point for several observation periods. The movable receiver is then moved to the points whose coordinates must be determined. The fixed point vectors can be defined with high accuracy if both receivers carry out continuous measurements to four or more satellites (with a small PDOP). When there is a signal interruption or cyclic errors, the initialization must be repeated. This may have occurred when the signal came from the satellite in the shade of buildings (some obstacle – bridges, trees or other objects). In practice, the points from which they are to be measured must be two-fold, so that a check is made on the determination of the situation. Also, if possible, include in the measurement several points with known coordinates (e.g. from static measurement) to provide additional verification.

The movable receiver shall normally remain at any point for several measurement periods, in which case the measurement results may be averaged and the position obtained more accurately.

2. Preliminary processing of satellite measurements

For measurements in RTK mode, the simultaneous measurements of the two points – reference and mobile, are combined and processed by the receiver's software in real time. Data files are transferred from the receiver to the computer, and the file names and heights of the antennas are checked. Actual processing differs depending on the software used, but a large part of the software offered is automated and no interference is needed. The basic check for real-time measurements is the calculation of the positions of the

rolling receiver and the verification of whether close values are obtained from the same points.

Signal filtering

The filtration of the signals is carried out by the program product of the respective measuring system. Filtering can be done by two metrics. One indicator is at a time. It eliminates measurements at a certain interval of the session, for which the signals of the satellites are disconnect or have a substantial multi-wayness. Filtering can also be done under PDOP criteria. In this case, signals are eliminated, adopted at a time of poor geometric configuration of the satellite constellation.

Besides filtering on these two indicators, which are optional and only used when the conditions require it, filtering of signals with the so-called. Mask on the satellites. This means that all signals adopted by satellites with a height of less than 15 º above the horizon are eliminated.

Ephemeris of satellites

As is known in the literature, the Ephemeris are data that allows to identify the vectors of the situation and the speed of a given celestial body moving under a known law at any moment. In the case of satellite measurements, except for the coordinates of the satellite, the Ephemeris also contain data on the correction of satellite clocks. In the GNSS, three types of ephemeris are used – data from the Almanac, Radio ephemeris and precise (precise) ephemeris. These types of ephemeris differ in accuracy (table 1) and by type of parameters that contain and are available either in real time or afterwards.

Table 1

Ephemeris	Precision	Note
Almanac	A few kilometres	Depending on the age of the data
Radio ephemeris	1 m	Or better
Precise	0.05 – 0.20 m	Depending on the delay

- *Almanac data*

The Almanac data are designed to provide the user with lower accuracy data to facilitate the search of the satellites or are used to plan the observations (when needed). The data shall be updated at least every 6 days and shall be broadcast as part of the satellite communication. Basically they contain the parameters for the orbit and correction members of the satellite clock for all satellites.

- *Radio ephemeris*

Radio ephemeris are calculated from the control segment of the system and sent to the satellites every twenty-four hours. They are part of the satellite communication and are used in the processing of the measurements. Essentially, the ephemeris contain records with general information, records with information about orbits and records with information about the satellite's clock.

- *Precision ephemeris*

The precise ephemeris are obtained on the basis of observations from the control segment of the system. The most accurate information about orbits is provided with a delay of about two weeks. More inaccurate information is provided about two days after observations. The preparation of the precision Ephemeris is based on the difference between the starting and ending points of the orbit (which theoretically must coincide), as well as various parameters and factors which influence the orbit of the satellite. The precision ephemeris describe an approximation of the factual orbit, which has a minimum deviation from the theoretical [14].

The accuracy of the ephemeris is relevant to the accuracy with which the measured vector is determined. The ratio of these points is given by the formula:

$$m_R = \frac{R.m_E}{h}, \qquad (1)$$

where R is the length of the vector, h is the height of the orbit, m_R and m_E the errors in the designation of vectors and ephemeris are accordingly.

Methods for solution of ambiguity

Ambiguity or multisignificarity is called the number of whole wavelengths in the pseudo-distance. It depends on both the receiver and the satellite. There is no dependence on time, while the observation of satellites is maintained without interruption. Ambiguity is a defining element in phase measurements. For its determination there are different ways depending on the type of measurements.

Once ambiguous is defined as an integer, it is said that it is allowed or fixed. In general, the fixation of unambiguity improves the decision of the underlying vector. When processing the carrier phase, it is important to use double differences instead of the single ones. This is because when we have single differences, an additional unknown parameter should be considered for the correction of the receiver's clock, which does not effectively divide the integers into the correction of the clock. When double differences are used,

the clock members are eliminated and the separation of the uncertainties becomes possible.

An important moment of resolving the ambiguity is the geometry of the satellites, which can be observed from two points. Firstly, the observed number of satellites at any current time generally affects the value of the accuracy criterion. The second point is the duration of the measurement required to resolve the ambiguity, since the information contained in the carrier phase is in a function of time. Time is a critical component in resolving ambiguity, even when we have good geometry on satellites.

Another critical factor is the multiwayness. Because the multiwayness depends on the location of the station, it can be significant, except for long and short bases [14].

Enabling ambiguity includes three main steps:

- Create combinations of potential integers numbers unambiguity;
- Identification of correct combinations of integers unambiguity;
- Verification of the solution of ambiguity-assessment of the correctness of the resulting integers.

For static measurements, a fixed solution and a floating solution can be used to solve the uncertainties. The fixed solution, using phase differences, directly outputs the number of whole lengths as an integer. From a theoretical and practical point of view, fixed solutions offer higher accuracy. For long vectors, however, it is impossible to use fixed solutions. In the case of a floating solution, the ambiguity is presented as a decimal number parameter, the value of which is obtained by the joint processing of the data by the two receivers. For the calculation of the pseudo-distance, a rounding is made to the nearest integer. When the session is extended, the floating solution begins to approach the fixed accuracy.

Different methods have been developed for the kinematic measurements to resolve the ambiguity. In general, code distances are used to determine the search area of the Kinematic method. They are used as the best estimate to determine the position of the antenna, and the corresponding standard deviations are used to define the size of the search space. In order to reduce the number of combinations to be tested, the code solution must be very precise, which will mean that the choice of the receiver will matter.

3. Conclusion

The analysis of the existing software that is used to process observations offers all or most of the described methods for removing different types of interference. The adjustments should be based on the two-speed measurements of the difference between both frequencies or the carrier

frequency phase. In the solution of ambiguity, only fixed solutions should be used.

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Author’s name and academic degrees and titles: Chief Assistant eng. Evgeni Grishev Stoykov, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: e.stoykov@shu.bg

METHODOLOGY FOR SURVEYING AND TRACING OF OBJECTS BY USING GNSS

Evgeni Gr. Stoykov

ABSTRACT: *With the introduction and development of GNSS, and permanent geodetic networks, the measurements in RTK mode become much faster and accurate. The optimum planning, the choice of positioning of the points of the geodesic network, the duration of the session and the interval of the recording are of utmost importance for increasing the efficiency and quality of the observations made with GNSS.*

KEYWORDS*: Geodesic surveying, Tracing, GNSS, RTK.*

Real Time GNSS Method – RTK (Real Time Kinematic) is used for capturing and tracing objects.

For base stations, a user or permanent base station is used from the established infrastructure network of the respective manufacturer of the GNSS system.

1. The dots are filmed and traced using a removable GNSS receiver.

2. To achieve precision in position 5 cm and height 10 cm and higher, all points must be determined with fixed solutions.

3. Points can be used as starting points for shooting and tracing objects:

- The state GPS network;
- GNSS infrastructure on the territory of the country;
- Geodetic networks with local purpose – defined in BGS 2005, adopted by the AGKK and received by Geocard Fund;
- Working geodesic basis – defined in BGS 2005, adopted by AGKK and received by Geocard Fund.

4. When using custom base stations, the permissible distance to the snowy and the points is 10 km, and when using the GNSS infrastructure, the use of data from real and virtual base stations is permissible, according to the current normative Arrangements.

5. Measurements may be carried out on:

- Permanently marked points;
- Non-marked points;
- Terrain and contour points.

6. The duration of measurement during shooting can be from 10 to 30 sec., and the recording interval 1 sec.

7. On permanently marked and nodal points, control measurements are made by double-stationing or the points are captured by two different user base stations (or a user and permanent base station from an infrastructure network).

8. The deposition of project points on the terrain consists in matching the current coordinates, indicated numerically or graphically by the rolling GNSS receiver, with the design position of the tracer elements, within the specified accuracy. Control measurements of persistently stabilized points can also be carried out by tracing.

9. In order to achieve better results it is recommended that the mobile receiver is fixed in a stationary state during the measurement using clamps.

10. When tracing, the points that will be deposited on the pitch can be entered in advance in the GNSS system controller or entered manually on the pitch.

11. For control, the tracer points are filmed.

12. The measurements of detailed points and their tracing are carried out by Polish teams, whose composition is determined by the nature and volume of the work, as well as the available GNSS equipment. The team (s) consists of a Polish chamber, which is equipped with technical means for independent work of the locality. Each chamber must have an operator-engineer or technician-a geodesist with the necessary qualification to work with GNSS equipment.

13. In order to achieve better results and depending on the nature and volume of work, filming and tracing can be entrusted to a specialist-geodesist with the necessary experience and qualification in the field of geodesic works with GNSS.

The methodologies developed need to be put into practice in order to prove their effectiveness and further use in this type of geodesic activities.

Conclusion

Widespread use of GNSS is a indisputable fact and the need for them is increasing. For geodetic purposes interest are the multi-channel receivers, which have the opportunity to receive simultaneous signals from many satellites. The modernization and introduction of additional GNSS signals improves the accuracy and accessibility to the users. With the introduction and development of permanent geodetic networks, measurements in RTK mode become much faster and accurate. For their mass entry into the geodesic practice it is necessary to conduct research on the possibilities for their application in geodetic surveying and tracing of objects.

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Author's name and academic degrees and titles: Chief Assistant eng. Evgeni Grishev Stoykov, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: e.stoykov@shu.bg

ASSESSMENT OF THE ACCURACY OF SURVEYING AND TRACING OF OBJECTS BY CLASSICAL AND GNSS METHOD

Evgeni Gr. Stoykov

ABSTRACT: *The development of satellite navigation methods in surveying enables GNSS technologies in RTK mode in the use of appropriate methodologies to be applied for geodetic surveying and tracing of objects. The article analyses and compares the obtained coordinates and heights of the points of the different measurement methods (classic and GNSS).*

KEYWORDS*: Geodesic surveying, tracing, GNSS, RTK.*

1. Introduction

For geodetic surveying and tracing of detailed points, a working geodetic base was used in the area of the University of Shumen.

Marked 35 detailed points, which were subsequently recorded by direct geodetic measurements by polar method with a total station Leica TCR 405 power. The coordinates of the detailed points are calculated and aligned with the Tplan software in the 1970 coordinate system and the Baltic altitude system. The coordinates obtained in the 1970 system were transformed into BGS 2005 - UTM coordinate type, zone 35. A list of the point numbers and their coordinates are given in Table No. 1.

Observations were made with the Trimble permanent GNSS network in RTK mode. The points are measured with a recording interval of 1 sec. and with a duration of 60 seconds.

Table 1

		Classic method			GNSS Method-RTK		
№	№ т.	X (m)	Y (m)	H (m)	X (m)	Y (m)	H (m)
1	1	4791907.047	495486.964	217.363	4791907.067	495486.963	217.370
2	2	4791906.675	495484.031	217.371	4791906.684	495484.039	217.367
3	3	4791901.817	495476.166	217.417	4791901.827	495476.167	217.426
4	4	4791896.900	495468.450	217.496	4791896.905	495468.447	217.493
5	5	4791891.506	495459.823	217.559	4791891.511	495459.820	217.552
6	7	4791880.802	495442.683	217.679	4791880.807	495442.693	217.652
7	8	4791875.314	495434.034	217.744	4791875.328	495434.036	217.741
8	9	4791870.452	495426.322	217.831	4791870.457	495426.322	217.827
9	27	4791854.634	495405.807	217.630	4791854.623	495405.817	217.639
10	28	4791855.373	495407.169	217.644	4791855.375	495407.193	217.627

11	29	4791861.247	495410.136	217.755	4791861.269	495410.154	217.754
12	30	4791866.483	495413.390	217.867	4791866.497	495413.402	217.843
13	31	4791871.005	495417.495	217.933	4791871.014	495417.501	217.943
14	32	4791875.020	495422.130	217.944	4791875.037	495422.127	217.951
15	33	4791880.478	495430.697	217.883	4791880.494	495430.711	217.869
16	34	4791886.203	495439.785	217.833	4791886.209	495439.788	217.824
17	35	4791891.600	495448.371	217.774	4791891.613	495448.383	217.778
18	36	4791896.754	495456.674	217.731	4791896.763	495456.691	217.726
19	37	4791901.966	495464.893	217.686	4791901.982	495464.896	217.686
20	38	4791907.108	495473.083	217.660	4791907.129	495473.101	217.663
21	39	4791912.202	495481.167	217.610	4791912.207	495481.171	217.618
22	40	4791915.005	495484.203	217.715	4791915.022	495484.222	217.716
23	41	4791919.085	495486.575	217.850	4791919.108	495486.580	217.878
24	42	4791921.381	495487.088	217.809	4791921.402	495487.102	217.772
25	43	4791925.560	495486.718	217.904	4791925.564	495486.724	217.880
26	94	4791953.643	495492.293	218.372	4791953.657	495492.303	218.307
27	100	4791926.718	495508.646	217.537	4791926.657	495508.545	217.751
28	101	4791922.682	495513.079	217.305	4791922.669	495513.114	217.264
29	102	4791924.399	495514.923	218.623	4791924.413	495514.903	218.596
30	103	4791922.226	495516.932	218.629			
31	105	4791919.004	495516.171	217.270			
32	106	4791918.388	495518.763	217.231			
33	108	4791910.341	495530.318	216.742	4791910.347	495530.243	216.716
34	129	4791965.355	495452.616	219.337			
35	130	4791945.669	495429.183	219.324	4791945.630	495429.256	219.346

2. Study

The coordinate system in which the RTK mode observations are made is WGS 84, the type of coordinates received is UTM, Zone 35. Scheme of the detailed points is given in Figure 1.

For measurements in RTK mode, detailed points 103, 105, 106 (near building) and detailed point 129 (edge of a building) could not obtain a fixed solution, the accuracy was very low and the measurement did not take place at all.

Fig. 1. Scheme of detailed points in the SHU area

Analysis and comparison of the obtained coordinates and heights of the points of the different methods of measurement (classic and GNSS) is made.

Table 2 presents the results of the study in the area with an assessment of the accuracy.

Table 2

	Comparisons (dx, dy, dh)	
	Classic Method - "Geonet" RTK 60s	**Classic Method - "Geonet" RTK 60s**
Area	SHU	SHU
Number of measurements	31	30 (without p.100)
Mean squared error m (cm)	mx = 1.75	mx = 1.24
	my = 2.91	my = 2.20
	mh = 4.42	mh = 1.96
	ms = 3.40	ms = 2.53

We compare the accuracy of detailed points by using the set parameters in the instruments.

The following results are obtained from the calculations:

- When tracing with GNSS in RTK mode and using the Trimble permanent network – "Geonet", the average error in m_S position is 3.80 cm. In side S of the range of 30 km.
- When tracing with GNSS in RTK mode and use of a user base station (for example, item 103 of the working geodesic base in the area of the SHU "Ep. Konstantin Preslavski "and a mean distance of 100 m), the average error in m_S position is 0.81 cm.
- When tracing by classical method with total station Leica TCR 405 power, and average distance 100 m, the average error in m_S position is 0.32 cm.

From the analysis it is concluded that the precision of tracing by classical method is higher than when tracing with GNSS in RTK mode, but when tracing in RTK mode and use of a user base station, GNSS is approaching significantly to those performed with Classic tool.

3. Conclusion

It is apparent from the examinations made that GNSS can be used to capture and trace detailed points related to objects in open areas. For capturing points from the contours of buildings and property boundaries in populated areas where there are obstacles and the multi-wayness factor for satellite signals is realised, the use of GNSS in RTK mode is difficult. In this case it is necessary to combine the GNSS measurements with the classical measurements with a total station (with Prism and unprismatic), which allow greater flexibility and achieve the final results.

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Author’s name and academic degrees and titles: Chief Assistant eng. Evgeni Grishev Stoykov, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: e.stoykov@shu.bg

CIRCULARLY POLARIZED ANTENNAS FOR DRONE RADIO COMMUNICATION

Svetoslav S. Zabunov

ABSTRACT: *Circularly polarized antennas are an effective solution to the small drones' radio communications problem. The current article observes a number of circularly polarized antenna families and discusses the advantages and shortcomings of each in regard to unmanned aerial vehicles applicability.*

Further, a novel circularly polarized antenna design developed by the author and his colleagues is presented. The article elaborates on the application of the invention mounted on a drone coupled with a spiral circularly polarized antenna engaged at the ground base station.

KEYWORDS: *Circularly polarized antennas for drones, unmanned aerial vehicles radio communication.*

1. Introduction

Due to the recent advance in electrically powered unmanned aerial vehicles (UAVs), also called drones, all avionics systems are under considerable demand for innovations. This trend is particularly pronounced in respect to the communications systems. Information with the drones is generally negotiated through wireless means.

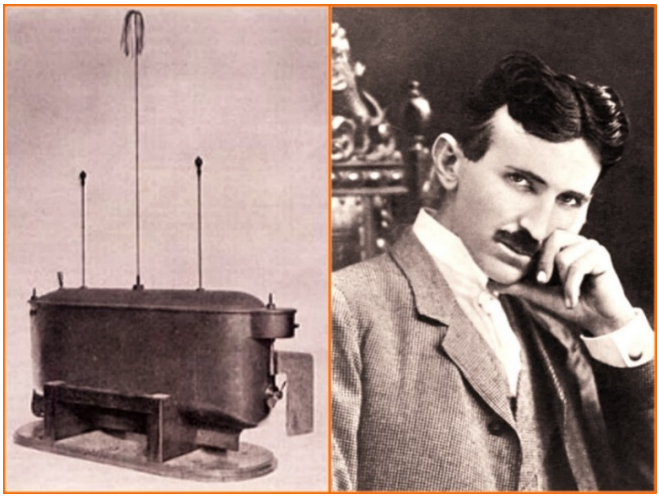

Fig. 1. Nikola Tesla's radio controlled boat – 1898

Radio or optical communication links are mostly employed with the latter being still an immature method.

Radio communications have long been used for control, telemetry, data exchange, and conversations with personnel on board of the airborne and spaceborne, marine and land based platforms. On the other hand, the first in history radio controlled model was the unmanned boat developed and operated by Nikola Tesla in 1898 [1]. During the past 120 years radio links have gathered a vast arsenal of experience, knowledge, experimental data, inventions and technologies. Notwithstanding, every new radio communications application is specific in its requirements and opens the frontiers to research, inventions and novel ideas.

The current article concentrates on the innovations and applications of circularly polarized antennas in tasks related to UAVs. Circular polarization is gainful, due to plenty of advantages such as odd reflections attenuation [2].

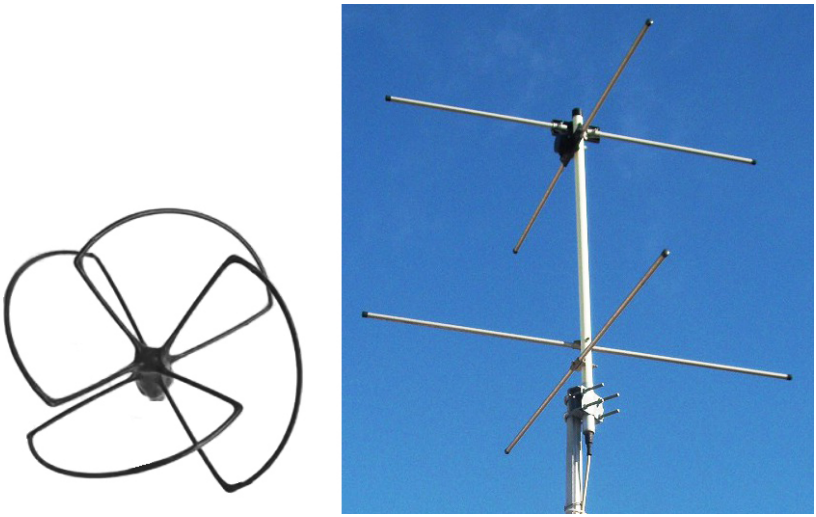

Fig. 2. Left: Skew-planar wheel antenna; Right: Turnstile antenna (Original work: K. Krallis, SV1XV, via Wikimedia Commons).

2. Advantages and shortcoming of circularly polarized antennas

Circular polarization in drone radio communications is employed for a number of reasons. As already mentioned, the major advantage of circularly polarized antennas is the attenuation of the odd reflected waves at the receiving site. For this incentive when resorting to circularly polarized antennas in drone communication, a common practice is to employ an

airborne antenna with a given direction of circular polarization – right hand circular polarization (RHCP) or left hand circular polarization (LHCP), but seldom both. Distinctly, the base station may use in tandem two, or even more, circularly polarized antennas realized in both directions of rotation. Thus the coincidently polarized ground-based antenna would communicate using the direct wave and the oppositely polarized antenna shall rely on the first reflection wave. The ground antennas in such a scenario are supposed to operate in a diversity arrangement.

Fig. 3. Right – helical antenna (Attribution: Kingbastard [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)]); Middle – quadrifilar helix antenna; Right – spiral antenna (Attribution: Bin im Garten [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)])

Another benefit of adapting the circularly polarized approach is the diminished reliance on aircraft momentary orientation. Nevertheless, circularly polarized antennas are not perfectly omnidirectional and aircraft attitude still matters.

Added, the Faraday effect is a phenomenon that changes the angle of a linearly polarized signal passing through a magnetic field. Thus signals propagating through the Earth's magnetic field tend to be affected by this influence, while circularly polarized signals are unaffected [3].

3. Circularly polarized antennas suitable for drones

Most drone communication links are happening at 2.4 GHz. This frequency band has wavelength of 12.5 cm and the antenna sizes are in accord with this dimension. Nevertheless, small UAVs may have dimensions comparable to the wavelength and hence to the antenna size. Consequently a circularly polarized antenna for 2.4 GHz could be inbuilt into the fuselage only for larger drones in the 1 meter range of sizes and above.

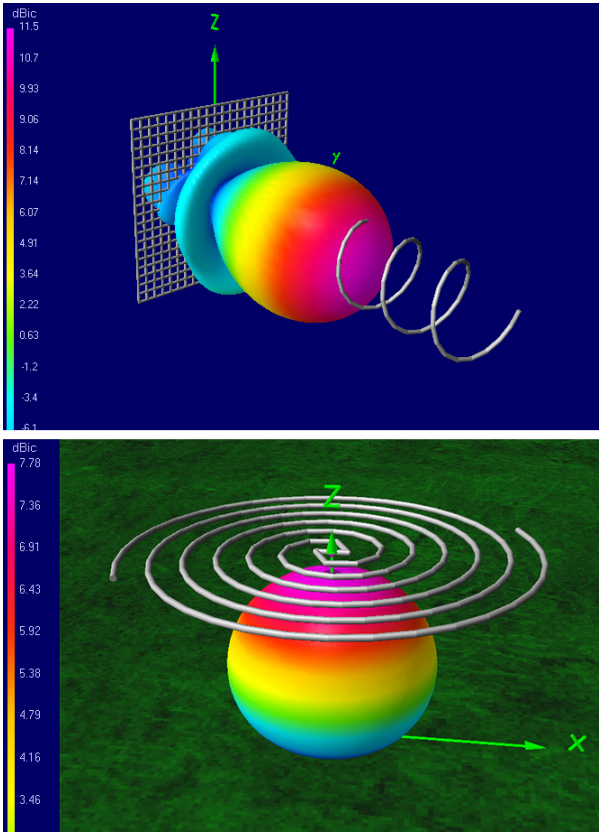

Fig. 4. Radiation patterns and gains of: Top – helical antenna (7 turns) with maximum gain of 11.5 dBic; Bottom – Archimedean spiral antenna (3 turns) having gain of 7.78 dBic.

Smaller aircraft would resort to antennas mounted outside of the flying machine's structures and thus will be susceptible to air drag. The team led by the author at the Space Research and Technology Institute – Bulgarian Academy of Sciences has invented a novel antenna for circularly polarized signals. This design bears low air drag but still exhibits favourable omnidirectional characteristics [4] (see Fig. 5). The invention shall be scrutinized in the next section.

Fig. 2 shows two circularly polarized antennas: on the left a skew-planar wheel antenna [5] and on the right – a turnstile antenna [6]. The skew family of antennas is generally suitable for mounting on small drones. The

turnstile antenna and its counterparts, like the double cross antenna, are not. They are made of self-supporting geometrically open electrical conductors. This aspect makes them fragile and induces structural problems even when employed as ground based antennas.

Another family of antennas for circular polarization are built using complex construction technologies involving PCB sections, volumetric self-supporting conductors and dielectric 3D structures. These devices tend to be heavy and manifest significant air drag [7], hence shall not be considered here.

Yet another family of circularly polarized antennas are the devices resorting to spiral structures. Notable representatives of this group of antennas are the axial-mode helical antenna, quadrifilar helix antenna (QFH) and the spiral antenna [8] (see Fig. 3). None of them is optimal for utilization on board of drones, but due to their more rigid structures and simpler construction than the turnstile family of equipment, might be employed in ground based stations with better success. The quadrifilar helix has the smallest wind loading, it is also employed in some satellites for its close to omnidirectional radiation pattern. The helical antenna is often operated as ground based antenna with satellite and drone radio links for its high gain and directionality. The simplest to produce of the above is the spiral antenna – again advisable only for ground based facilities for its large wind loading and weight. Still the spiral antenna has the greatest structural rigidity due to its solid arrangement. The spiral antenna has a few more advantages in comparison to the helical and QFH representatives, namely it is an extremely wideband antenna and even the helical antenna, which by itself is considered a wideband one, has inferior bandwidth efficiency. Accordingly, the spiral antenna is applicable to versatile communications that are engaged with various airborne and spaceborne platforms establishing radio-links on very different frequencies and bandwidths. Its beam angle is wide – not like the radiation pattern of the helical antenna – thus achieving wider space coverage without the need to be rotated mechanically. A comparison between the radiation patterns of the helical and the spiral antennas is displayed in Fig. 4.

4. The novel design of a circularly polarized antennas suitable for drones

This novel design was introduced in a utility model at the Bulgarian Patent Office in 2019 and was registered on 7th of August, 2019 [4]. The antenna belongs to the skew-planar wheel family of antennas, but unlike its relatives it implements no curved sections, thus making the manufacturing, adjusting and maintenance much easier. The geometric design is demonstrated in Fig. 5, on the left. The right part of the figure shows the

electrical design employed in the numerical calculations and simulations. The antenna exhibits excellent circular omnidirectional radiation pattern (Fig 6. left) and quite satisfactory axial ratio (Fig. 6 right).

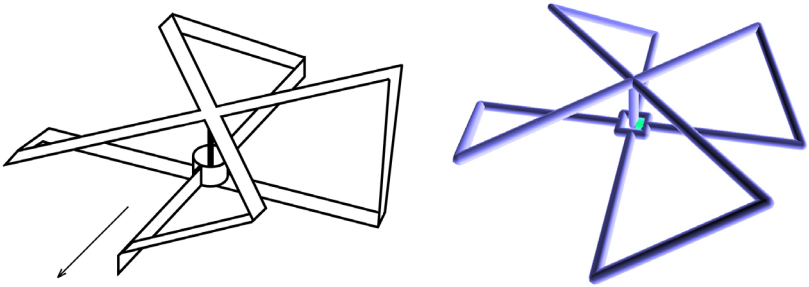

Fig. 5. Streamlined RHCP circularly polarized antenna designed at the Space Research and Technology Institute – BAS. Left: design schematic based on flat surfaces (direction of movement shown); Right: 3D electrical model employed in numerical simulation.

The antenna dimensions are calculated with the help of Fig. 7., which speaks for one of the four identical leafs of the antenna.

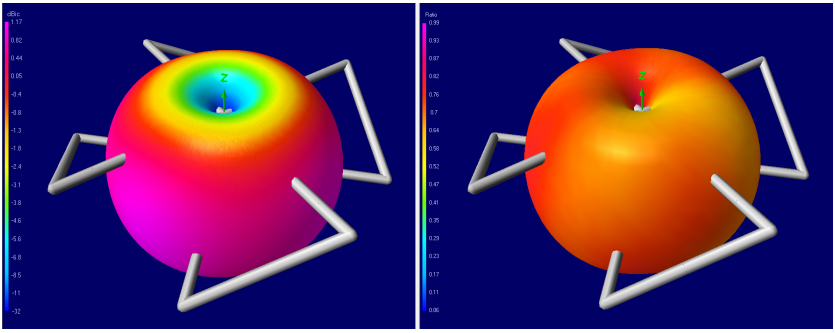

Fig. 6. Parameters of the novel circularly polarized antenna: Left – radiation pattern with maximum gain of 1.17 dBic; Right – axial ratio between 0.85 and 0.65.

By choosing the length of the vertical element **h** and the horizontal element **a** one could easily calculate the length of the inclined element **b**. The first two lengths are calculated using the numerical simulation in order to tune and match the antenna to the desired central frequency and impedance.

First we compute the length of the inclined element projection in the horizontal plane (length **p**):

$$p = \sqrt{\left(\frac{a}{\sqrt{2}}\right)^2 + \left(a - \frac{a}{\sqrt{2}}\right)^2} \tag{1}$$

Or after simplifying:

$$p = a\sqrt{2 - \sqrt{2}} \tag{2}$$

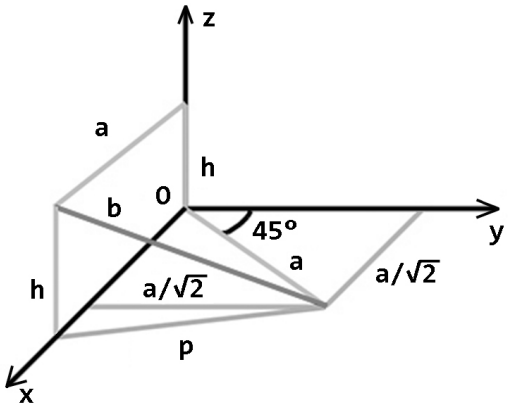

Fig. 7. Geometrical design of the novel circularly polarized antenna. Showing one of the four identical leafs of an LHCP variant.

Then employing (2) and knowing the length **h** we find **b**:

$$b = \sqrt{p^2 + h^2} = \sqrt{a^2\left(2 - \sqrt{2}\right) + h^2} \tag{3}$$

3. Analysis of results

The novel antenna proposed in this article makes for a good choice in regard to airborne circularly polarized antennas for drones having dimensions less than approximately 1 meter where the fuselage is not large enough to house the antenna inside. The suggested antenna model yields favourable aerodynamic characteristics and radiation diagram.

On the other hand, for a base station equally fitting are the helical antenna and the spiral antenna, with the first requiring mechanical steering

and the second one demanding at least three units engaged in diversity scheme, but without moving parts. When simplicity, low maintenance efforts and cost are the predominant criteria the spiral antenna approach is preferable.

4. Conclusion and future work

The investigation and research into novel antenna designs with application to small drones is an endeavour undertaken at the Space Research and Technology Institute and will continue in the next year with exploring new designs and ideas. The circularly polarized antennas are preferred way of addressing the radio communications problem for small drone, but also for unmanned aerial vehicles alike. Antennas with circular polarization are also relevant to other unmanned vehicles such as marine vessels, ground based robots and to spacecraft, consequently widening the application and research area of this technology.

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Author's name and academic degrees and titles: assoc. prof. eng. Svetoslav Svetoslavov Zabunov, PhD
Workplace: Aerospace Control Systems Department, Space Research and Technology Institute – Bulgarian Academy of Sciences, Sofia, Bulgaria
E-mail: svetoslavzabunov@gmail.com

CRIME – TYPES AND CRIMINAL ASPECTS

Ilin A. Savov

ABSTRACT: *The need for cyber security nowadays is tangible. The article reviews and assesses the notions of cyber space, cyber crime, and cyber security. In order to meet the operational needs of the security sector, it is necessary that information systems that work are adequate to cyber-threats and minimize vulnerabilities in their own system. An analysis has been made and three main types of cybercrime have been identified. In connection with the development and absorption of cyberspace, an urgent task for forensic science in the Republic of Bulgaria is the development of optimal tactical rules for conducting such investigative actions, such as the location of the accident, computer view, inspection of the machine carrier, document on the machine carrier of information, seizure of the personal computer and computer information, search and seizure of e-mail, appointment of court expert reports. In view of the adopted national, European and international treaties, the Republic of Bulgaria is obliged to develop and pursue a specific cyber security policy as a measure to counter cybercrime and cyber terrorism and to protect national interests.*

KEYWORDS*: Crime, cyber, criminal, security.*

1. Introduction

The rapid development of modern information technologies, the widespread deployment of digital video and audio media, photo and mobile communication have led to recent investigators increasingly confronting a new crime scene - the cyberspace created by the media computer information presented in a discreet form. These technologies, through the Internet, are constantly shaping a new environment for communication and, in general, the life of the members of human society, the number of which is constantly growing.

There is a growing need for cooperation between countries in the fight against crime, which is determined by the particular nature of cybercrime. This kind of crimes affect many countries. The need for coordination to prevent criminal acts and to provide mutual assistance in the investigation of criminal cases is growing. Cyber-crime, by its very nature, transcends national borders and the fight against them can only be effective through close international cooperation.

2. Cyber space

The term Internet originated for the first time in 1968 in a document prepared by the United States Department of Defense, which established the Defense Research Agency (DARPA). The first appearance of the term "cyberspace" appears in the novel Neuromancer in 1984 by American writer William Gibson.

The term "cyberspace" is used by Cyberpunk science fiction writer William Gibson and in his story "Burning Chromium," although the concept has been described earlier, for example, in the short story of Verne Verde, "Real Names "(True Names), and even earlier than John M. Ford in the novel" Web of Angels ".

Cyberspace is a term that means the global network, as a collection of independent information technology infrastructures, telecommunication networks, and computer processor systems in which online communication takes place.

The first cyber crime scene dates back to the 1940s, almost the time the first computer was created. In the years to come, with the development of the global network in terms of "global economic integrity," international internet crimes are growing and are beginning to acquire different forms of expression.

In this respect, it is well-founded the view that increasing the role and significance of cyberspace as an interactive information and communication environment has resulted in the emergence of a whole range of new risks and threats related to increasing the vulnerability of the information infrastructure, the destructive information impact of people using the possibilities of cyberspace for committing criminal offenses.

This is explained by the fact that many processes of production and financial nature, which have traditionally been done manually, are now simply unthinkable without the use of computer technology. If a computer virus interferes, for example, in the work of the local or global information network, it will end bank payments, start off power, passengers will be left without tickets for trains and planes. And this is only an insignificant part of the possible harmful consequences.

3. Cyber security and cyber crimes

Cybercrime refers to such criminal offenses committed in cyberspace against computer data by means of or through computer systems or networks, as well as other means of access to cyberspace. Therefore, any crime committed in an electronic environment (as defined by the Xth United Nations Convention on Crime Prevention and Juvenile Delinquency) can be referred to cybercrime. In a more specific context of cybercrime, this is a

crime in the field of high-tech information, carried out by villains using these technologies to achieve unlawful goals.

Cybercrime can also be defined as: "Offenses committed against individuals or groups of individuals with a criminal motive to deliberately harm the victim's reputation or to cause physical or moral damages to the victim directly or indirectly using modern telecommunication networks such as the Internet (chat, emails, forums and groups) and mobile phones (SMS / MMS).[1]

The emergence of new types of crime requires new approaches to combat them. Areas of criminology that deal with cybercrime and computer crime are computer criminology and cybercriminality[2].

Depending on the purpose for which the cyber-perpetrator invades computer systems, it is possible to offer the emergence of three major types of cybercrime:

The emergence of new types of crime requires new approaches to combat them. Areas of criminology that deal with cybercrime and computer crime are computer criminology and cybercriminality. Depending on the purpose for which the cyber-perpetrator invades computer systems, it is possible to offer the emergence of three major types of cybercrime:

1. Criminal offenses when a computer is used as a crime, i. unauthorized access to information, its destruction, theft of important information, etc.;

2. Acts in which the computer acts as a weapon of crime, for example in electronic theft;

3. Crimes in which the computer performs the role of an intellectual medium, for example, in the creation of pornographic or psychological pornographic sites or suicide, the placement on the sites of information likely to lead to inter-religious or international enmity, etc. The public danger of illegal activities in the field of computer technology and high information technology (cybercrime) is that they can lead to gross violations of the operation of the automated control and control systems of various important sites. Additionally, personal computers and their systems can initiate unlawful actions to destroy, modify, copy information and information resources that are capable of causing severe irreversible consequences not only for property damage but also physical disability for large groups of people.

[1] Halder, D., & Jaishankar, K. (2011) Cyber crime and the Victimization of Women: Laws, Rights, and Regulations. Hershey, PA, USA: IGI Global. ISBN: 978-1-60960-830-9.

[2] K. Jaishankar, Cyber Criminology: Exploring Internet Crimes and Criminal Behavior, CRC Press, 2011.

Over the last few years, so-called branched attacks on closed sites have been made possible, many of which have been used for the use of computers. Holders of computers hit by different types of viruses programmed to destroy the "virus" code after the attack is complete may be non-knowledgeable cyber-attackers or unwitting "allies." It is not easy to trace such attacks, and even more to identify the specific culprits of the committed, especially when the territory of the country is small (as is the case with Bulgaria).

It is no coincidence, therefore, that 150 countries of the world community are developing measures to combat cyber attacks, and cyberspace is increasingly seen as the fourth site of warfare ("hybrid wars") alongside drought, atmosphere and seas.

The need for cybersecurity is growing rapidly as more and more information and technology is being provided in cyberspace. Nowadays there is an increasing concern among governments that virtual space will become the next scene for military action. Thus in 2011, Mark Clayton of "Christian Science Monitor" describes in his article, titled "The New Cyber Arms Race (New Cyber Arms Race)":

"In the future the wars will not be led by soldiers with weapons or by bomber aircraft. The war will begin with one click of the mouse across the globe, unleashing weapons-turned-computer programs that break or destroy critical industries such as utilities, transport, communications and energy. Such attacks could also disable military networks that control the movement of troops, jet fighters, command and control of warships."

The expressed views and analyzes of many experts in the field of national security around the world have led to the introduction of new terms such as "cyberwar" and "cyber terrorism" into national doctrines of national security. It is seen that more and more critical infrastructure is controlled through computer systems and programs that, at the same time, increase the efficiency of individual processes but also detect new vulnerabilities.

Taking into account the above, we must admit that the information processes and interactions that are inherent in cyberspace are already the basis of the vast variety of phenomena in the material world, the intellectual sphere of society, the life of every civilized person. Recognition of this important circumstance has become a major achievement of scientific thought over the last decades. At the same time, it has to be noted that saturation of the reality with computer systems and telecommunication networks not only has a noticeable impact on crime but has also opened up new approaches to investigating cybercrime that quickly becomes a major field of business relationship.

A characteristic feature of cyberspace from a forensic point of view is that the interacting objects in it (information files and programs) involved in the process of formation of the resulting traces do not have an external structure. The whole arsenal of tools and methods for dealing with the material traces accumulated by the trasology here is practically useless. The methods of working with virtual traces have not been found so far and could not find the correct coverage in the Code of Criminal Procedure (CPC) of the Republic of Bulgaria. They appear only in the form of separate forensic recommendations, mainly in foreign literary sources. For example, virtual traces are meant to mean "traces stored in the memory of technical devices in an electromagnetic field on carriers of machine-readable information occupying an intermediate position between material and ideal".

Cybercrime refers to the field of high-tech information and is carried out by villains using these technologies to achieve unlawful purposes. Overwhelming violations have been the breaking of passwords, theft of credit card numbers [16], [17] and other bank details, the dissemination of socially harmful information on the Internet (pornographic material, defamatory information, materials incitement to international or inter-religious enmity, etc.)

Cybercrime is very often international when criminals are operating in one country and their victims are in another country. Therefore international cooperation is of particular importance for the detection and investigation of such crimes.

At the same time, the modern criminal world no longer sees its criminal functioning without the Internet, with the help of which:

- Remote communication between criminal groups of different criminal backgrounds;
- Exchange of criminal experience;
- Attracting accomplices in prepared crimes, criminal search for victims and means;
- Sale of property acquired in a criminal way;
- Execution of payment transactions between persons in the conditions of preparation and committing of crimes;
- Crime through the network information space.

It is therefore perfectly normal that criminologists have also begun to develop such areas of use of computer information and tools for its processing in the fight against cybercrime, such as the application of universal and specialized computer programs and devices as a means of forensic engineering, the formation of legal bases and defining the prospects for the use of information systems and computer networks for detecting and investigating crimes, using computer technology Training of employees of

law enforcement. In recent years, traditional search technology in operative search activity has been considerably surrendered to operational-technical events, such as the use of various operating modes in the application of special intelligence means, analysis of telephone traffic and data retention, identification of sources of specific messages and their location, etc.

In Bulgaria, with the detection and investigation of cybercrime, the specialized sector "Cybercrime" of DG "Struggle with Organized Crime" - the Ministry of Interior, deals with the priority of countering organized crime groups[3]:

1. Unregulated access to computer-information resources, destruction and modification of computer data, distribution of passwords and infection with computer viruses;

2. Financial fraud on the Internet and theft of virtual identity;

3. Breach of copyright and related rights;

4. Production, possession and distribution of pornographic material with minors, preaching or incitement to discrimination, violence or hatred based on race, nationality or ethnicity.

5. Setting up online gambling without the proper permission of the State Gambling Commission.

Sector employees interact with government organizations, private companies, foundations and citizens to timely counteract crimes in which using high-tech means.

The understanding of the essence of the Internet makes it possible to conclude that it is necessary to regard it as a global phenomenon, which has an ever-increasing influence on the nature and structure of modern crime. As such, it has a number of specific properties, the analysis of which allows a deeper understanding of the forensic issues for detecting and investigating network and IT-related cybercrime. The most significant among them, perhaps, are the following:

1. The Internet has a non-state and decentralized nature, there is no single organization fully coordinating and controlling its functioning. In most countries, including Bulgaria, the global network regulatory and control system is in the phase of creation.

2. Technologically unprotected by the Internet, which has since been created as an open communication environment for research and military computer centers (now includes over 10 500 telecommunication networks of different types).

3. The possibility of anonymous activity on the Internet, simplified user registration procedures, the virtually complete absence of identifiers of

[3] www.gdbop.bg

visitors on the global network make it difficult to detect persons who commit cybercrime, especially cross-border.

The factors mentioned, the list of which can be significantly expanded, complicate the weakly developed scientific and legal bases to counteract criminal offenses on the Internet and the mechanisms for their realization. There is a huge field for criminologists, although a number of scientific steps have been made (unfortunately, in our country they are still a bit hard). Among the conditions that support the criminalization of cyberspace are:

- Increasing the number of Internet users, the sharp increase in the amount of stored, processed and transmitted computer information;
- The deregulation of the possibilities of illegal use of information and communication technologies, of the pace of informatisation in all spheres of public life;
- Formation of the "electronic" economy: increasingly distributed electronic payment and purchase systems via the Internet, financial and banking operations are carried out in electronic form;
- The low level of legal and computer culture, the poor preparation or complete absence of such in the field of information security;
- The presence of weaknesses in computer software, including those in government bodies and organizations;
- Active use of the most modern technical means and technologies in criminal activities, etc.

In connection with the development and absorption of cyberspace, an urgent task for forensic science in the Republic of Bulgaria is the development of optimal tactical rules for conducting such investigative actions, such as the location of the accident, computer view, inspection of the machine carrier, document on the machine carrier of information, seizure of the personal computer and computer information, search and seizure of e-mail, appointment of court expert reports.

In the production of these investigative actions, the investigating officer should be well guided by the specificities of cyberspace, familiar with the terminology in order to communicate with criminals on an equal footing, to handle without the help of the specialist concerned. There is no need to prove that such investigators are still very few now.

From the review and assessment made, we can conclude that our forensic practitioners will have to study in detail the specificities of cyberspace and the crimes committed in it, develop adequate forensic, tactical and methodological approaches to their investigation and prevention. Some positive experience in this area already exists.

Maintaining security is one of the fundamental issues of international relations and contemporary international law. Apart from contributing to positive social development, the development of information technology has a strong negative side. This is cybercrime.

In international law, transnational cybercrime requires adequate counteraction through concerted action by the international community.

To date, most countries still apply the territorial principle and their national laws on cybercrime. This, in turn, raises a number of difficulties in determining the locus delicti[4].

For example: unauthorized access to a system has at least three possible places that can be identified as locus delicts:

- the location where the hacker is physically present at the time of committing the offense;
- the place where they operate and where they apply their tools to commit the act;
- the place where the result occurs and where the purpose and victim of the act is localized and where the result of the crime actually arises.

The solution to this problem cannot be found only at national level. There is a growing need to create common rules that are applicable in all countries in this area. At this stage there is no solution to this problem at international level. The main international act The Cybercrime Convention does not provide clear criteria for determining the crime scene.

This would mean creating a special regime that would only apply to cybercrime, but would not be applicable to other acts. At this stage, an adequate solution is also lacking at international level.

One of the main challenges of international criminal law is the determination of the applicable jurisdiction in the conduct of cybercrime. In view of the fast-growing information and technological systems and communications, it is difficult to achieve a universal solution to the problem. There is a growing need for a different approach to each case, as well as flexible legal instruments, readiness of each jurisdiction to correctly interpret the criminal law of the respective country.

In addition to the basic regulation contained in the Cybercrime Convention, there are many international acts adopted. Bearing in mind the information provided by the German newspaper Bild, according to which it is clear that terrorists from the bloody attacks in Paris on November 13, 2015, have ordered their guns on the Internet from Germany, reinforcing the need to improve the international law on cybercrime.

[4] The place where the crime was committed; the crime scene

The way of countering cybercrime proceeds through the implementation of complex measures and measures in order to eliminate the causes and conditions conducive to the commission of these acts. There is an increasing need for the creation of a quality international criminal justice system related to this type of crime.

4. Conclusion and future work

In conclusion, we can point out that urgent tasks related to the development of optimal tactical rules for carrying out a number of investigative actions, the development of tactical methods for conducting investigative experiments in cyberspace, and so on, are emerging. In the field of forensics, there is a need in the coming years to study in detail the specificities of cyberspace and cybercrime, to develop adequate forensic, tactical and methodological approaches to their investigation, detection and prevention. Cyber security can be defined as a condition determined and measured by the level of confidentiality, authenticity and identity of information resources, systems and services. Cyber security is based on effective building and maintenance of active and preventive measures. One of the objectives of cyber security is to preserve the availability and integrity of networks and infrastructure as well as the confidentiality of the information contained therein. The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them.

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Author's name and academic degrees and titles: prof. Ilin A. Savov, PhD
Workplace: Academy of the Ministry of Interior, Faculty of Police, Department of Operational Search, Sofia
E-mail: ilin_savov@abv.bg

IMPACT OF THE ACCURACY OF THE MANUFACTURING OF THE SHELL ON ITS BALLISTIC CHARACTERISTICS

Krasimir G. Kalev

ABSTRACT: *In this paper the main systematic and random factors are considered as a result of which the shell of the projectile is manufactured with some deviations from the theoretically designed one. The changes in the ballistic coefficient, the shape coefficient and their impact on the dispersion parameters of the firing trajectories are analyzed.*

KEYWORDS*: Shell, Production tolerance, Ballistics.*

1. Introduction

Increasing the tactical and logistical requirements [3] in the modern combat use of the artillery, as well as the modernization and design of new ammunition and their subsequent utilization, necessitate the application of new materials and technologies in three main directions. The first is the development of smokeless propellant capable of regulating the process of gas formation [5], the second is the creation of new high - explosive materials [6, 7, 8] and the third is the refinement of the shell of the projectile. This paper investigates and analyzes the last direction regarding the design and machining the shape of the projectile.

2. Factors affecting the accuracy of machining of the shell

The precision of manufacture means the degree of conformity of the manufactured projectile with the theoretically designed projectile, in which the finished product is in the highest degree meets the set technical requirements. The difference between them is the result of manufacturing errors. The accuracy of the machining is a function of the accuracy of the shape, the dimensions, the mutual arrangement of the surfaces and the purity of their processing. The quality of the shell must not be overlooked using modern methods of measurement [1, 9].

Factors leading to errors in the machining process are [4]:

- asymmetry of the original workpiece - stamping or casting;
- geometric inaccuracy of the metal cutting machines when they unloaded;

- deformations of the technological system of the metal cutting machine - cutting tool – details and the gaps between the units of the metal cutting machine;

- temperature deformations of the technological system;

- inaccuracy, insufficient hardness and wear of the cutting tool;

- misalignment of the centering bases during machining;

- inaccuracy in adjusting the size of the machine tool.

It is known that part of the factors that lead to the appearance of inaccuracies in the production process are systematic or random. Therefore, errors also consist of systematic and random components. It is also possible and the onset of rough errors that are a consequence of such factors, which do not occur in course of the manufacturing process in the normal conditions.

In this regard, for ammunition production, the largest values of errors resulting from the assembly conditions, movement in the tube of the gun and firing grouping requirements are fixed in the form of manufacturing tolerances and surface roughness.

From the analysis of the working drawings of projectiles of different caliber and the requirements specified in the technical documentation the following conclusions can be drawn about the accuracy of their manufacture:

1. The tolerances of most linear and diameter dimensions are standard and are determined by the accuracy classes according to BDS-EN.

2. Special tolerances are required for the machining of:

- the diameter of the centering thickness;

- the total length of the projectile - on which the position of the center of mass depends;

- the diameters of different sections of the outer surface, for which equal tolerances are accepted for the sake of ease machining by the copy method.

3. Impact of machining accuracy factors on the accuracy of firing

In order to increase the efficiency of firing, it is necessary to improve the grouping of impacts, and one of the ways is to increase the accuracy of projectile machining. But unjustified minimization of tolerances makes the production process more expensive and complicated, whereby a corresponding improvement in grouping characteristics is not always achieved. In this sense, one of the main tasks in the production stage is to set such requirements for the precision of the production of the shells, which ensure assembly without additional processing, interchangeability of details and high manufacturability of the products. The solution to this problem can be obtained as a result of studying the influence of different inaccuracies in

the machining on the grouping of projectile impacts. The firing grouping, in turn, is characterized by deflection and range dispersal.

The deflection dispersion of the projectiles is determined by the angular dispersion of the velocity vector and depends on the initial velocity of the projectile and the initial angle of attack. The angular dispersion of the velocity vector depends on the angular velocity of the projectile relative to its equatorial axis and the initial angular deviation in the horizontal plane. The deflection dispersion is dominated by the relative angular velocity in the vertical plane, which, due to the gyroscopic properties of the rotating projectile, causes a greater angular deviation away from the trajectory toward the target. Initial disturbances of the projectile are formed as a result of the imbalance of the mass, oscillations of the firing system and vibrations of the gun tube. In most cases, the influence of unbalanced mass is predominant, especially for shells of larger caliber.

The initial disturbance caused by the unbalance of the projectile is formed by the movement of the projectile's main inertial axis around its central axis, the movement of the central axis relative to the gun tube's axis and the vibrations of the artillery system, caused by the centrifugal force of the unbalanced projectile mass [2]. Therefore, in order to improve firing grouping, it is necessary to minimize dynamic imbalance and to control the quality of machining according to this indicator.

Processing of statistics of the variation the machining quality tolerance field shows that the random variable distribution law is closest to the Maxwell law with distribution density

$$f(w) = \frac{w-a}{\sigma^2} e^{-\frac{(w-a)^2}{2\sigma^2}} \tag{1}$$

where a expresses a systematic error;

σ – standard deviation, representing - (1/6)δ;

δ – the highest value of the tolerance field.

The graphical interpretation of the density function $d=f(w)$ is of the form (fig. 1).

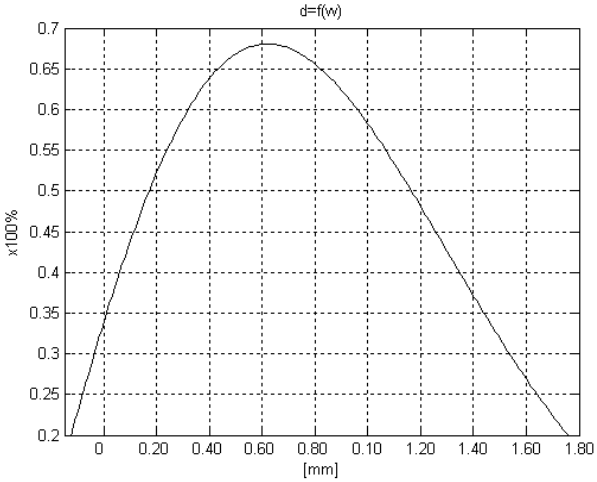

Fig. 1.

The effect of machining accuracy on range dispersal (2) is manifested by the distribution of projectile mass and ballistic coefficient, ignoring the variation in the initial velocity of the projectile δ_v. The mass distribution δ_q is determined by the distribution of linear tolerances and, in particular, by the tolerances of the outer and inner diameters of the shell elements of the projectile. Weight tolerance as well as linear tolerances are subject to normal distribution law.

The distribution of the ballistic coefficient δ_c is mainly determined by the dispersal of the coefficient of shape, the various configurations of the shape of the projectile, the condition of the outer surfaces, etc. The quantities δ_q and δ_c enter directly into the expression to determine the dispersal values

$$B_{Д} = \sqrt{\delta_v^2 + \delta_c^2 + \delta_q^2} \quad . \tag{2}$$

Statistical data on the effect of the shape of the projectile $r_w=f(w)$, in particular the variation of the tolerance field of the diameter of the outer part - fig. 2. The data obtained are in good agreement with Maxwell's law.

The inaccuracies in the machining of the shells affect not only the weight of the shell, but also on the value of the forcing pressure due to the gap between the centering thickness and the lands between the grooves and cause geometric imbalance. Also, different values of the diameter of the guide belt lead to different values of the forcing pressure and therefore different initial velocities.

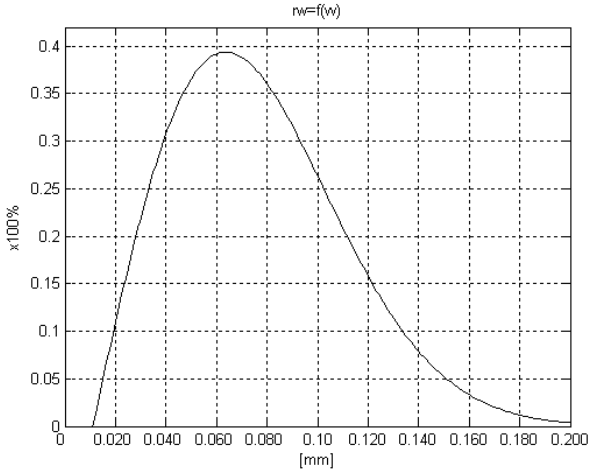

Fig. 2.

To improve the firing grouping, the most important thing is the accuracy of machining the projectile centering elements and obtaining optimum clearance between them and the inner surface of the gun tube. The minimum clearance emanates from the free charge requirements and the resulting elastic deformation of the chamber by the pressure of the powder gases.

In the experimental determination of radial deformation, the minimum clearance was found to be in the range of 0.2 to 0.45 *mm*. As the projectile moves along the gun tube, the gap between the centering thickness and the lands between the grooves cause the projectile axis to shift. This change in the position of the projectile axis also determines the initial angle of nutation

$$\gamma = \frac{\Delta_{\max}}{2l} \tag{3}$$

where: $\Delta_{\max}$ is the largest clearance;

l - the width of the centering base of the projectile at loading.

The increase in the gap impairs the centering of the projectile in the tube of the gun, increases the amplitude of the rotational oscillations and the velocity of the center of mass in a plane perpendicular to the axis of the tube.

The clearance $\Delta_{\max}$ is determined by the guaranteed clearance, the tolerances for machining the centering thickness and the lands and the wear of the lands when firing.

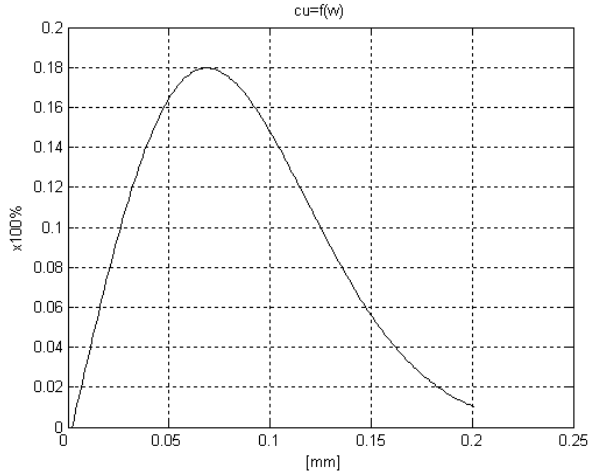

Fig. 3.

Statistical results on the deflection of the beating of the centering thickness of the projectile *cu=f*(*w*), are given in fig. 3. The data obtained show that the change in the random variable with sufficient accuracy is described by the Maxwell distribution law.

Reducing the clearance of unused gun tubes is achieved by setting minimum clearances and improving the machining accuracy of the centering thicknesses of shells. In determining the minimum clearance, the condition for free charge, deformation of the housing in the upper centering thickness and the difference in temperature between the projectile and the gun tube shall be used. The tolerance of the diameter of the centering thickness must be not very large in order to uniformly center the projectile in the tube gun. Usually, a fine-tuning operation of the centering thickening is performed, which provides surface treatment with less tolerance than the drawing.

4. Conclusions

From the analysis made, it should be noted that narrowing the machining tolerance makes sense in determining the unbalance tolerance of the projectile. However, reducing the clearance for machining the centering thickness may be a necessary condition for the effectiveness of other measures taken to achieve uniformity in guiding the projectile through the tube of the gun.

In controlling the production process from the raw material to the final product, it is necessary to apply new methods for measuring such as using computer-controlled laser sensors and detecting discrepancies.

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Author’s name and academic degrees and titles: col. prof. eng. Krasimir G. Kalev, PhD
Workplace: NMU, Faculty “A, AD and CIS”, Shumen, “K Skorpil” str. №1.
E-mail: kraskalev@abv.bg

METHODS FOR PRESENTING, PROCESSING AND INTERPRETING THE RESULTS OF GEODETIC OBSERVATIONS OF GEODYNAMIC PROCESSES

Kiril F. Yanchev

ABSTRACT: *The subject of the study is to develop a methodology for investigating the influence of geodynamic processes on geodetic measurements and networks.*

The developed methodology for monitoring, mathematical processing of the results and reproduction of the different inter-block slip and study of regularities in the change of their state, in the course of their formation, allows to model the movement of the individual blocks and to correctly account the extreme effects of deformation through their influence. on geodetic measurements and networks.

KEYWORDS*: geodynamic process, geodynamic network, geodetic measurements, geodetic networks.*

Introduction

The interest in the study of modern movements and deformations of the earth's surface is caused by the fact that the solution of a number of scientific and engineering problems related to the Earth is possible only in the presence of a complete idea of the geodynamic processes occurring in the earth's interior and the earth's surface. Computer modelling of geodetic, geophysical, seismic and other data from the conducted researches allows to increase the efficiency in making decisions related to theory and practice in the field of geodesy.

1. Analysis of methods for observing geodynamic processes

The geodynamic processes are monitored by the construction of geodynamic poligons in order to determine the movement and deformation of the earth's surface and changes in the local gravitational field, as well as to study the development of these processes over time.

1.1. Classical method for observations of geodynamic processes

Until the emergence of global satellite systems, geodetic observations for horizontal displacement of points from the Earth's surface were mainly performed as linear measurements, transverse to the fault in the form of triangular or three-lateral networks. These nets consist of about 20 - 25 points and fully cover the deformable zone, as well as adjacent non-deformable

sections of the crust. The most appropriate figure for identifying deformations and controlling displacements in these local sections of predicted geodynamic polygons is the geodesic quadrangle. It is positioned so that two of its sides are located on different blocks of the fault (Fig. 1)

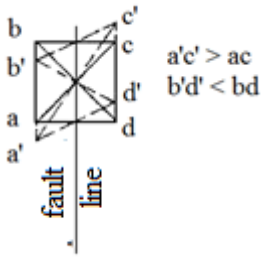

Fig. 1. Construction of a geodetic quadrangle

1.2. Modern methods for observing geodynamic processes

The International GNSS Service (abbreviated IGS) began operating in 1994. Its purpose is to provide various research organizations with high-precision satellite measurement data. The main purpose of IGS is to support the study of the movement of the Earth, the Earth's crust and its processes. IGS also monitors the movements and deformations of tectonic plates, monitors changes in the mean sea level, synchronizes temporary deviations and determines the exact trajectories of low-orbiting spacecraft.

Modern satellite technologies have significantly increased the role of geodetic methods for assessing geodynamic phenomena and processes, both locally and regionally and globally.

1.3. Remote monitoring methods for geodynamic processes

The increasing role of space methods allows for a complex interpretation of the materials from Earth's remote sensing from space, geological and geophysical data, on the basis of which new patterns in the formation of the Earth's crust can be identified. Space methods for regional geological surveys increase efficiency in finding solutions to problems in the fields of mining, geology and the environment. The most important result of regional geological surveys is to obtain comprehensive information, including 2D and 3D mapping models of the geological structure as a whole, in individual regions and specific areas.

2. Analysis of the methods for estimating the deformed state of sections of the crust

The various methods for estimating the deformed state of a part of the earth's crust are intended to describe the process of transition from data obtained in the geodetic measurements of the geodynamic polygon to parameters, models and other descriptions characterizing the movement of the earth's surface.

Graphic methods are mainly used to represent the results of the re-leveling. Some graphical representations of the change in the position of the benchmarks can be obtained directly from the results of repeated geodetic surveys, without their preliminary processing. Mathematical modeling methods are also widely used to interpret data from repeated leveling measurements.

One of the most common ways of representing the horizontal movements of the earth's surface in the study area is to obtain a vector of displacement points. Each vector is obtained from the results of two measurement cycles, the beginning of the vector coinciding with the point coordinates in the first measurement cycle and the end with the coordinates obtained in subsequent measurements.

One of the methods for determining the deformation of the earth's surface is by geodesically determined lengths.

A solid and homogeneous medium is capable of experiencing two types of deformation, a change in volume and a change in shape. Volumetric deformations are caused by the action of normal stresses and the change in shape by shear stresses. The relationship between stress and strain is assumed to be linear.

With the development of satellite methods, opportunities arise for frequent cyclic or continuous observations, thanks to which implementation finds another method for presenting the results of geodetic observations for ground motion - the method of animated images.

3. Methodology for studying the influence of geodynamic processes on geodetic measurements and networks.

A methodology has been developed to study the influence of geodynamic processes on geodetic measurements and networks, for which a technological scheme has been drawn up (Fig. 2).

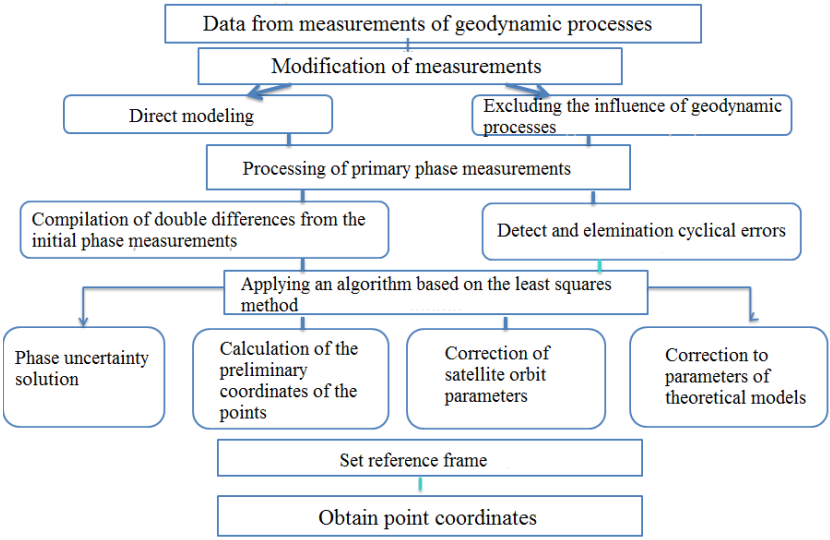

Fig. 2. Methodology for studying the influence of geodynamic processes on geodetic measurements and networks

For the high-precision determination of the coordinates of the points from the earth surface by means of the phase method of measurement and determining the influence of local geodynamic processes on the geodetic measurements and networks, it is necessary:

1. Establishment of stable observation points equipped with forced centering devices;
2. High-frequency dual-frequency geodetic equipment for receiving GNSS signals;
3. Carrying out cyclic (minimum 3 cycles) or continuous surveying;
4. Continuous (minimum 6 hours) simultaneous observations of 5 or more satellites, of 2 or more stations;
5. High-precision orbital parameters and corrections to satellite clocks distributed by IGS Global Centers;
6. High-precision models of the various geodynamic processes required to determine corrections;
7. World ITRS Earth Coordinate System based on the latest implementation of ITRF2008 (IGb08);
8. Specialized software for the subsequent processing of primary phase measurements;

9. Removal of influence from the tectonic movements of the lithospheric plates;

10. To determine the influence of local geodynamic processes on geodetic measurements and networks, to calculate the actual position of points with respect to each other in time and space;

11. Creating an adequate model for visualization of displacements and deformations registered in the study area;

Conclusion

The geodynamic processes and their subsequent geodynamic deformations and displacements cannot be directly measured, their identification is performed by analyzing the results obtained from monitoring geodetic measurements.

The creation of the International Land Reference Framework (ITRF) allows the results obtained by using different geodetic methods to be viewed in a single coordinate system. This provides an opportunity to study the absolute movements of the earth's surface.

The construction of a geodetic model of the movement of the individual blocks in the fault zones is an analysis of the speed of movement of the points from the surface obtained from the geodetic data.

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Author's name and academic degrees and titles: Chief assistant eng. Kiril Yanchev, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kiril_fy@abv.bg, k.yanchev@shu.bg

RESULTS OF MONITORING GEODYNAMIC PROCESSES USING MODERN GEODETIC METHODS IN THE AREA OF THE KRUPNIK GEODYNAMIC POLYGON

Kiril F. Yanchev

ABSTRACT: *The purpose of the study is to establish the impact of geodynamic processes on the geodetic measurements and networks. The present paper concerns research and analysis of the local geodetic network designed to monitor the movement of the earth's crust in the Krupnik region and conducting geodetic measurements using Global Navigation Satellite Systems (GNSS). The received results compared with the previous and subsequent measurements will help to obtain comprehensive reliable picture of the event and the nature of modern crustal movements in the area.*

KEYWORDS: *GNSS, GPS, BGS2005*

Introduction

One of the most active areas in terms of geodynamic on North-Aegean seismic zone is southwestern Bulgaria, the Struma fault zone and in particular the area of the intersection of Strymonikos and Krupnik faults. Undoubtedly this would attract the interest of a different experts from the Earth Sciences in their study, including surveyors. Early geodetic studies here started in 1970's, with a new levelling survey of part of the original levelling line Dospat-Sofia to establish a modern active major and minor faults and modern z-motions on them.

After this research widen and deepen with building of the complete geodynamic polygon near the intersection of Krupnik and Stryma faults, attracting new modern electronic and satellite equipment for surveying purposes and integration of results in the complex area of research. The determination can be done separately for horizontal and vertical or both three-dimensional movements and with higher precision, especially when using the modern electronic surveying equipment to measure and mostly GNSS.

1. Description of the object of research

The measurements were conducted in the area of the intersection of Stryma and Krupnik faults on the base of the built local precise three-dimensional network in the 1983's, from the Bulgarian Academy of Sciences

- Geotechnical Laboratory. The network is covering an area of about 16 and consists of 16 traverse points. They are stabilized with poles monitoring devices having forced centering and levelling ball-headed bolt from the side. The average length of the sides is 800 - 900m. At some of the points there are steep aligns due to the height difference.

The altitude at which the network is located 250m to 800m. In 1986 in the areas of the field, where the faults are clearly outlined there were built two small networks and of type geodetic square with an average length respectively 114-260m for the first and 52 - 124m for the second, they cover the two faults separatelty. The area is known as the epicenter of the largest known earthquake in the last 200 years in Europe with a magnitude 7.8. The event took place on the 4 April 1904 and was followed by secondary strong earthquake with reported magnitude 7.2.

After the analysis done and after the examination of the physical condition of the local points of precise three-dimensional network, has been established that seven of them were destroyed and unsuitable for use. The remaining 17 points are in good physical condition. For some of the points clearing (woody and bushes) is needed to provide GNSS usability of the station. Skeleton form of geodetic network designed to monitor the movement of the earth's crust is given in Figure 1. Skeleton form of smaller networks are shown in Figure 2 and Figure 3.

1.1. Classical method for observations of geodynamic processes

Until the emergence of global satellite systems, geodetic observations for horizontal displacement of points from the Earth's surface were mainly performed as linear measurements, transverse to the fault in the form of triangular or three-lateral networks.

These nets consist of about 20 - 25 points and fully cover the deformable zone, as well as adjacent non-deformable sections of the crust. The most appropriate figure for identifying deformations and controlling displacements in these local sections of predicted geodynamic polygons is the geodesic quadrangle. It is positioned so that two of its sides are located on different blocks of the fault (Fig. 1)

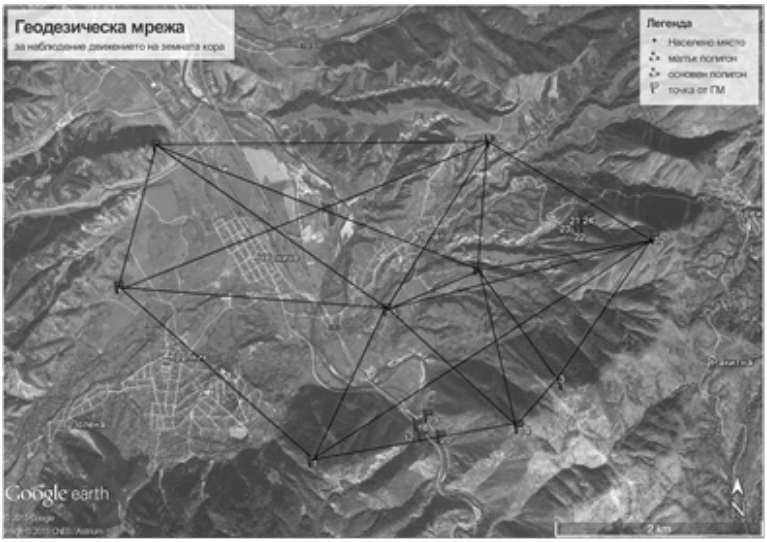

Fig. 1. Skeleton form of geodetic network designed to monitor the movement of the earth's crust

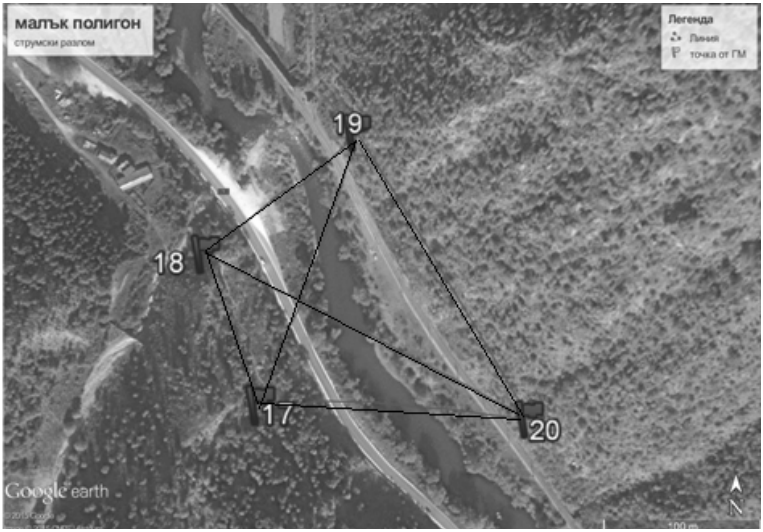

Fig. 2. Skeleton form of traverse of Struma fault M_1

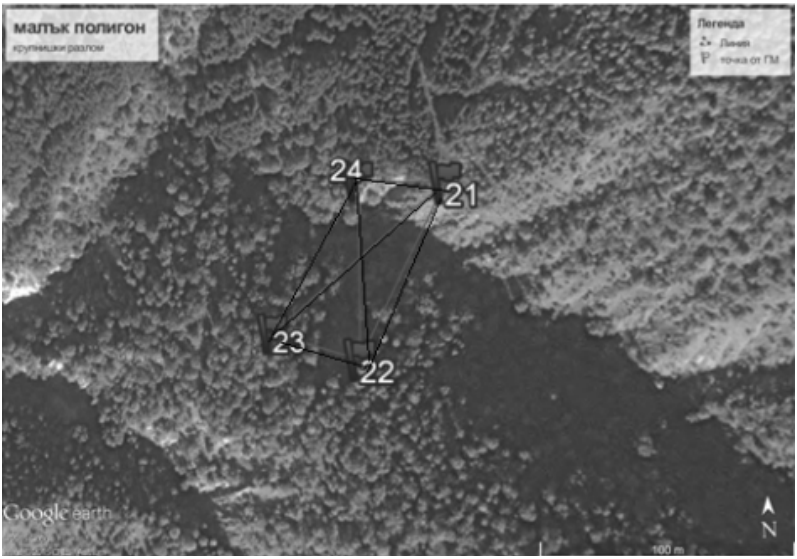

Fig. 3. Skeleton form of traverse of Krupnik fault M_2

All traverse points are located on a healthy, protected terrain and in 15˚ elevation angle, in a long distance from water pools, walls, roofs and other local items with significant reflective surface. In the region there are any transmitting antennas, radio magnetic emissions, electric co-channel interference and other wave radiation, that can elicit co-channel interference or block signals from satellites.

2. Performance of GNSS measurements

All traverse points of the geodetic network are measured using three dual frequency GNSS receivers, TOPCON "HyperPRO" and three dual-frequency GNSS receivers, TRIMBLE "R4" (Figs 4 and 5). To determine the position of all points is used static method. The period of observations is six hour and were conducted in daylight hours 9-17h. The measurements are recorded in 15-seconds time interval and minimum 10 ° elevation angle. Aligning of the points is accomplished by using special cone-clamp bolts. The height of the antenna is measured with a levelling device. During the field surveys the field record books of GNSS measurements are recorded.

Fig. 4. TOPCON measurements

Fig. 5. TRIMBLE measurements

3. Processing of the results of the measurements.

Processing of the measurement results to determine the coordinates of geodetic network is performed with research software Bernese 5.2, in accordance with the latest concepts and strategies in this range recommended by EUREF, namely:

- The European Terrestrial Reference System 1989 (ETRS89) is based on the latest release of International Terrestrial Reference Frame 2008 - ITRF2008 (IGb08) for the stable part of the Eurasian tectonic plate;

- We have data processing from highly-precise geodetic receivers - code and phase of both frequencies;

- It has simultaneously data processing of both single and double phase differences using ionospheric models;

- Five linear correlation are used for frequencies L1 and L2;

- In the processing observations are included from 30 European permanent stations, used for the realization ITRF2005 of ITRS, namely ANKR, BUCU, GLSV, GRAZ, JOSE, ISTA, SOFI, MATE, AUT1, BACA, COST, DEVA, DRAN, DUTH, EVPA, IGEO, KTVL, KUST, LARM, MDVJ, METS, NOA1, ONSA, PAT0, PAZA, SAND, SOFA, TROY, WTZR and ZIMM;

- In the process there are used absolute patterns of variation of antenna phase centers;

- A new set points are derived annual values of velocity of the model NUVEL 1A, thereby the movement of the earth stations is modeled because of tectonic movements, the tides in the solid crust and ocean tides;

- For each one of the stations is derived tropospheric model for estimating tropospheric gradient;

- Precise orbit data are used as well as homogeneous coordinates with the orbit coordinates of the poles of the Center for Orbit Determination in Europe (CODE);

- The clocks of all receivers and satellites are synchronized during the processing;

- Parameters dependent on time are modeled by linear continuous function. In assessing the troposphere (and gradient) parameters, the parameters of the orientation of the Earth and the removal of global ionospheric models are applied;

-In the process of resolving uncertainties consistent variable and fixed solutions of the era of measurement are received. Initially uncertainties are treated as unknown parameters and their values are assessed as real numbers, using previous statistical tests of the covariance matrices them.

- The strategy used to fix the uncertainties (Ambiguity Resolution Strategy, ARS) is the so-called quasi-ionosphere strategy (Quasi Ionospheere Free, QIF);

- The coordinates of the stations involved in the decisions and pole models are brought in the era of measurement in advanced.

- The systems of normal equations of daily decisions are combined, thereby the received coordinates of the stations have been brought to the average age of the campaign on 10/28/2015 12:00:00 hours;

- Received mean square errors in determining the coordinates of the points are given in Table 1.

Table 1. Mean square errors in determining the coordinates of the points

Point number	mean square error (m)		
	U	N	E
1	0.00153	0.00037	0.00031
6	0.00094	0.00026	0.00022
7	0.00108	0.00028	0.00024
11	0.00100	0.00027	0.00023
12	0.00094	0.00026	0.00022
13	0.00099	0.00027	0.00023
14	0.00093	0.00025	0.00022
15	0.00150	0.00034	0.00037
16	0.00105	0.00027	0.00025
17	0.00241	0.00062	0.00066
18	0.00160	0.00045	0.00035
19	0.00167	0.00035	0.00042
20	0.00191	0.00038	0.00050
21	0.00184	0.00033	0.00038
22	0.00237	0.00036	0.00050
23	0.00186	0.00038	0.00043
24	0.00136	0.00031	0.00032

- The coordinates received in the era of the implementation are transformed to output coordinate system ETRS89, on which is based BGS2005. Thus obtained coordinates are similar with BGS2005 and are achieved through ETRS89, realization ITRF2005, eph. 2005.0;

Conclusion

The geodetic measurements carried out in one of the most neuralgic geodynamic regions in the country - the crossing of Stryma and Krupnik fault, are aimed to determine the impact of geodynamic processes on the geodetic measurements and networks.

The results received, compared with the previous and subsequent measurements, outline opportunities and are essential for obtaining accurate overall picture of the occurrence and nature of modern crustal movements in the area. They are an important contribution to the complex study of an area of particular scientific, social and public importance and their continuation is vital.

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Author's name and academic degrees and titles: Chief assistant eng. Kiril Yanchev, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kiril_fy@abv.bg, k.yanchev@shu.bg

ANALYSIS OF GEODYNAMIC PROCESSES OCCURRING INSIDE THE EARTH AND THEIR INFLUENCE ON GEODETIC MEASUREMENTS

Kiril F. Yanchev

ABSTRACT: *The subject of the study is the dynamics of Earth's rotation in the solar coordinate system.*

The main geodynamic processes causing these movements are polar motions, the unsteady rate of daily rotation or change during the day, tidal geodynamic processes, changes in the position of the mass center and axis of inertia, changes in the sea level, changes in the elements of the gravity field. on Earth, etc. To study these movements, the model of the absolutely solid Earth is taken as a starting point.

KEYWORDS*: geodynamic process, geodynamic network, geodetic measurements, geodetic networks.*

Introduction

Planetary scale geodynamics is characterized by variations in the parameters of the geocentric geodetic coordinate system, the geocentric gravity model, and the Earth's inertia tensor. Changes in the shape of the Earth and the various deformation processes occurring in its body cause movements in the Earth's crust and the Earth's surface, which influence geodetic measurements and networks.

1. Daily rotation

The volatile rate of daily rotation or change over the course of the day is studied by astronomical methods, the accuracy of which is greatly enhanced after the invention of atomic frequency standards and then of hydrogen molecular generators. The age-old rotation delay of the earth $(-2.37 \pm 0.55) \cdot 10^{-8} m$, representing the sum of the braking effect of tides in seas and oceans $(-2.72 \cdot 10^{-8}) m$, and the age-old acceleration of rotation $(1.18 \cdot 10^{-8}) m$, whose mechanism has not yet been determined, have been determined. Studies of variations in day length for periods of two weeks to one year are caused either by seasonal movements of air and water masses, or by tides of amplitude to $(0.6 \cdot 10^{-8}) m$. There are also irregular variations of unknown origin in the range of 2 to 18 years, reaching up to $(2 \times 10^{-8}) m$.

2. Tides

Tidal geodynamic processes are investigated using high-precision steady-state continuous measurements. Tidal effects are observed in the deviations of the artificial satellites on Earth from their precision orbits. Laser measurements of the altitude of the satellite over the ocean record the tidal displacements of water masses, which allows the determination of tides in solid Earth and oceans separately.

Tidal geodynamic processes seek to stretch the planet in a direction connecting the mass center of the Earth and the Moon, in which it returns. In such a cycle, each point in the earth's crust describes an almost closed trajectory, but never returns to its original position.

Residual deformation accumulates in the elastic-plastic medium. This mechanism turns the tidal movements slow, causing displacements in the Earth's crust up to several centimeters.

The change in the position of the mass center and the inertial axis of the Earth relative to its physical surface is due to the displacement of masses into the Earth's body. Movements of masses into the atmosphere cause changes in the position of the mass center of the order of several millimeters.

3. Polar movements

The polar motions which mean the displacement of the axis of rotation of the Earth into its body have an amplitude of the order of $3{\cdot}10^{-6}$ m from the radius of the Earth. D'Alembert proves that the rotation of a solid around its fixed point can be regarded as a sequence of infinitesimal rotations about instantaneous axes passing through the fixed point.

In this way, the instantaneous axes consistently change their position and describe a conical surface (precession) with a peak at a fixed point. The causes of precession are the effects of the moon, sun and planets. The full turnover of the cone axis is made for a period of 25817 years.

The axis of the cone (fixed axis of precession Zo) is perpendicular to the plane of the ecliptic and forms an angle with the earth axis in the modern era equal to 23.4 °(Fig. 1).

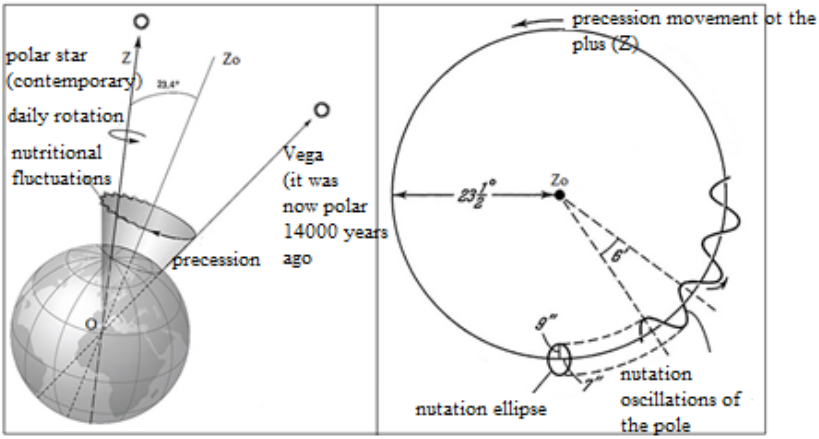

Fig. 1. Scheme of motion of the axis of rotation of the Earth

Simultaneously with the prolonged precession displacement, the instantaneous axis moves in a small cone (nutation) around the earth axis (OZ), thus moving the small cone along the larger one. These displacements of the instantaneous axis have a period of 18.67 years. As a result of the precession, the equinox point moves along the ecliptic against the Earth's motion by 50.2 " per year. The angular ellipse of nutation is described by deviations of 7 "and 9 ". There are also short-term nutations with a period of 14 days or less. Along with the precessional and nutational motions of the poles, there are also slight periodic displacements about the mean positions of the poles, due to the mismatch of the axis of rotation of the Earth and the main inertial axis of the Earth's body. The instantaneous pole oscillates in a circle around its mean position not more than ± 0.3 ". These are non-polar periodic and non-periodic motions of the pole.

The centuries-old motions of the pole run along the meridian of 70° west longitude at a speed of 10 cm / yr, and according to other data 15-20 cm /yr. The error in determining the instantaneous pole can reach 0.4 m.

3.1. Earth's crust

The modern slow movements of the Earth's crust represent the tectonic movements leading to the emergence of the relief, its changes and the appearance of the modern lithospheric structure of the Earth's crust. They flow into the hyperogenic envelope of the earth and into the deeper layers of the lithosphere. The hypothesis of the tectonic layering of the dense lithosphere implies different displacements and different velocities of the

individual layers. The sliding of the lithospheric layers towards each other leads to a complex and understandable geodynamic model. Orogens and their adjoining platforms represent a single geodynamic system controlled by the spatiotemporal patterns of slow oscillatory and fast seismic movements of sections in the lithosphere. They cause changes in the absolute position of the points from the earth from 0.001 cm/yr to 10 cm/yr.

Strong earthquakes with M>7 occur on Earth at a frequency of about 100 times in one year. Their locations are limited as seismic zones and represent 1/6 of the earth's surface. Measurements were made within 2-3 weeks after the Shikotan earthquake with M = 8.0, which occurred on 04.10.1994, 70 km east of Shikotan Island, a decrease in the earth's surface by 0.5-0.6 m, with horizontal deformations 5- 10 cm/km. On March 5, 1989, an earthquake of M = 4.0 took place in the southeastern part of the Baytice valley. During this time, there is a leveling of a leveling line in the valley of the Ala-Archa River, and for three years before the earthquake the benchmarks slowly rise. After the earthquake, they dropped sharply, with the benchmark rising 20 mm in the epicenter and sharply falling 13 mm after the earthquake. Elevations of the earth's surface up to 1m before the earthquake and lowering were then recorded in Uzbekistan and Dagestan.

Conclusion

The real Earth is not absolutely solid and its mass center is not permanent.

Because of the displacements of masses in its body and on its surface, the instantaneous axis of rotation does not coincide with the principal central axis of inertia, which changes its position in accordance with changes in the position of the mass center.

Additional variables influence the earth's axis of rotation, forcing it to move in the earth's body and in space.

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Author's name and academic degrees and titles: Chief assistant eng. Kiril Yanchev, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kiril_fy@abv.bg, k.yanchev@shu.bg

ANALYSIS OF INFORMATION ON THE RELATIONSHIP BETWEEN THE PARAMETERS AND THE STRUCTURE OF THE FAULT ZONES

Kiril F. Yanchev

ABSTRACT: *The subject of the study is the availability of information on the structure and parameters of the fault zones.*

Due to the lack of generally accepted criteria for determining the boundary of the zone of influence in the fault, various features are used, such as: the distance at which the degree of fracture becomes close to the density of cracks in a given array. Depending on the properties of the array, the patterns of change in the density of cracks change substantially and allow for the observation of regularities.

KEYWORDS*: geodynamic process, fault zone, geodetic measurements, deformation.*

Introduction

Fracture zones are complex structured objects consisting of interconnected separate elements, which in turn include one or more slip planes, zones of intense deformation, cracks and other structural elements. Individual faults can undergo strong structural changes over short distances. The architecture of the fault zones depends on many parameters - the deep formations, the properties of the rocks, the tectonic setting, etc.

1. Fracture structure

Different researchers are involved in the study of major faults, adopting the same model of their construction (Fig. 1).

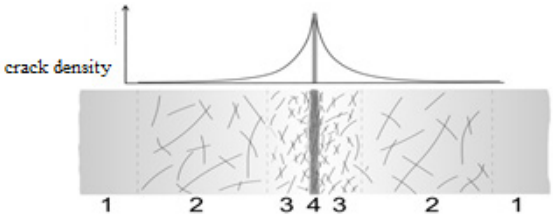

Fig.1. Structure of the fault in cross section: 1- calm zone, 2 - zone of influence, 3 - central part of the fault, 4 - highway mixer

At the periphery of the fault lies the zone of influence, the thickness of which extends from several meters to hundreds of meters. The zone of influence is characterized as a zone of increased crack density compared to the quiet zone. The structure of this zone contains secondary ruptures and cracks caused by the origin, propagation and long evolution of the fault zone. This area is sometimes divided into late intensive and enlarged breakouts. Cracked fragments of the material forming the array are activated in the central part of the fault. Unlike the area of influence, which is mainly characterized by cracks, the central part of the fault is characterized by the presence of friction. In rare cases, they are separated from the transition zone, which is characterized by the presence of different minerals compared to the area of influence. In the central zone of the fault, the major part of the deformations is manifested. Depending on a number of factors, the deformations can be distributed either evenly and perpendicularly to the central part of the fault or localized in one or more zones of the main mixer (principal slip zone). In the fracture zones, the central part of which is composed of parallel trunk mixers, the aseismic ruptures often occur in the same surface formed by ultracapacities formed in previous stages of deformation. An exception is the areas where fractional friction occurred in the seismic motion. The greater the friction force in these sections, the more cracks appear around them.

2. Observations of deformities

After the beginning of the instrumental observations of the deformations of the Earth's crust, it became clear that the release of excess stress accumulated in the tectonically active regions is obtained not only by the sudden displacement of certain sections in earthquakes, but also by continuous aseismic slip along the fault. The earthquake is interpreted as a fragile destruction of the rock masses and the slip as a plastic deformation.

With the accumulation of actual materials and the refinement of measuring instruments, qualitative differences between seismic events of the same scale are established. The seismic energy emitted by earthquakes with the same seismic moment can differ in several parameters. High-sensitivity seismographs and surveying instruments periodically record displacements and deformations at velocities greater than normal but significantly smaller than earthquake velocities. The relatively low density of measuring instruments does not allow the results to be summarized further, since scientists concentrate mainly on the study of pre-seismic and post-seismic deformities.

With the construction of GNSS networks and widely sensitive high frequency seismic stations, the situation is changing. They give rise to new

types of interblock tectonic movements, which can be considered as a transition from slip to earthquake. The discovery of these processes greatly alters the understanding of how the energy accumulated in the crustal deformation process is released.

According to the peculiarities they exhibit, the new types of deformation processes are given different names:

- silent earthquakes - episodic tremor and slip (ETS);
- episodic creep events - slow slip events (SSE);
- low-frequency earthquakes (LFE);
- very low-frequency earthquakes (VLF).

3. Speed of distribution

The characteristic rate of propagation of the displacement in slow events is determined by the ratio:

$$V_r = \frac{\lambda}{T_0}, \qquad (1)$$

where λ - the characteristic length of the displacement, T_0 and the duration of the inter-block movement.

The observations made during the last decade allow the different deformation events to be divided into several groups (Fig. 1):

- normal earthquakes - their parameters are consistent with the concept of emission during dynamic rupture;
- low frequency earthquakes (LFE) - events in which the burst propagation rate is significantly slower than normal earthquakes;
- very low-frequency earthquakes (VLF) - unlike the first two, the amplitude of the seismic signal emitted during these earthquakes does not increase practically;
- slow sliding (SSE) - deformation events that have such a low rate of interblock displacement along the fault that their seismic emission is not recorded by existing instruments.

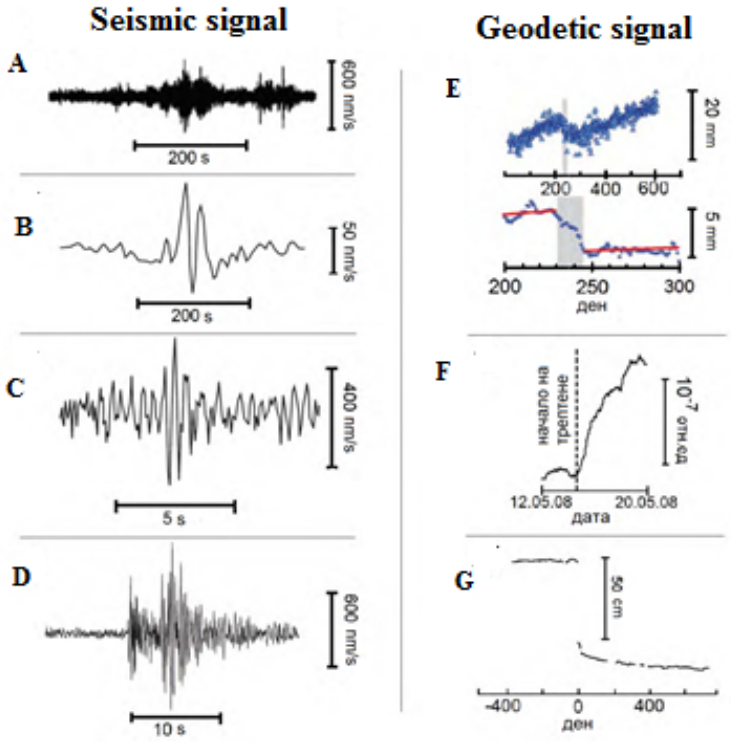

Fig. 2. Examples of slow slip signals

a - oscillation (the signal is at a frequency of 2-8 Hz); b - VLF (the signal is frequency 0.005-0.05 Hz);

c - LFE (registered in Japan); d - earthquake with M = 1.9 recorded in eastern Washington; e - "up" daily shifts (registered according to GNSS data on Vancouver Island), "below" average GNSS record with identified SSE and red-line movement trend (0 - corresponds to 1.1.1999 г.); f - episodic slow glide on seismometer data (registered in eastern Washington), the initial stages of rapid deformation coincide with the increased activity of the seismometer; g - Relocation of the GNSS AREQ station in azimuth 55º relating to South America during the Peruvian earthquake by M = 8.4 on 23.06.2001., moment "0" in time corresponds to the moment of earthquake.

Conclusion

The degree of localization of interblock displacements depends essentially on the type of deformation process.

A significantly higher degree of deformation localization is observed in the seismically active fault zones where a large part of the deformations have a presumed aseismic character.

The formation of large fault zones is the result of the expansion and unification of very small ones.

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Author's name and academic degrees and titles: Chief assistant eng. Kiril Yanchev, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kiril_fy@abv.bg, k.yanchev@shu.bg

ANALYSIS OF THE METHODS FOR ESTIMATING THE DEFORMED STATE OF SECTIONS OF THE CRUST

Kiril F. Yanchev

ABSTRACT: *The subject of the study are the models of motion of the Earth's crust.*

The movement patterns also reflect the actual state of the earth's crust. If we assume a model in which the earth's crust is continuous, then the speed of movement of this surface must be continuous.

KEYWORDS*: geodynamic process, crust, tectonic fault*

Introduction

Modern movements are understood to mean any movement of points from the earth's crust, individual blocks or elements from the surface. Different methods of surface observation are used to study modern motions, which ultimately boil down to determining the velocity vector at individual points or their projections. In this situation, to evaluate if a model of the behavior of individual blocks or sections of the earth's crust is adopted, it is possible only under additional assumptions based on different models of geodynamic manifestations.

1. Models

From these ideas the approach to the interpretation of the manifested movements and the prediction of the geodynamic state in depth may significantly depend. In the case of the representation of the crust as a mosaic block system, the velocity field can be represented as a vector system with its peculiarities within each block. The real geological environment can also be represented in a combined model. For this reason, the approaches to presentation and the methodology for conducting observations are quite different. In addition, the observations always imply the tracking of changes in the motion parameters in the space-time coordinate system, with a compulsory separation of the observable field into its constituent factors. In the Caspian depression, the field of the surface is a superposition in the movement of the Eurasian continent as a single whole block of the Earth's crust on a planetary scale, on which a relative movement of small blocks is imposed. These movements overlap in the rock layers and as a result of the many movements under certain conditions modern deposits are formed. In order to separate all these movements, it is necessary to introduce a separate

system for their accounting based on the classical representation of the movement as a process of relative character. It should be noted that only under conditions of continuous elastic medium, the stress tensor is connected to the strain tensor by a system of elastic coefficients having the form of a component of it. Depending on the model of the medium, some components of the elastic tensor may be equal to or equal to zero. The nature of the velocity distribution of the surface of the observed model cannot be determined uniquely from direct measurements. Moreover, the actual velocity distribution can be significantly misled by measurement errors. In this regard, it is important to present a methodology and approach for presenting the measurement results that show the physical nature of the area studied.

2. Slow motion

The slow movements of the Earth's crust in the fault zones are one of the most important manifestations of tectonic movements on Earth. One of the most striking examples of such a movement can be seen in the San Andreas fault. When studying in detail the relocation of beds of watercourses in the Wallis Creek Valley, Sieh K. E. finds that for the last 3800 years the total displacement of the San Andreas fault is 130 m and each individual displacement is about 10 m. Similar shifts have been reported on several faults in Japan. It is clear that the average tectonic line, the length of which reaches 500 km, is the largest active fault in the Japanese Islands. Such displacements reaching up to several hundred meters are also found in major faults in southern and southeastern Kazakhstan. In turn, displacements in the central zone can cause changes in the strain rate in the impact zone. In the Almaty seismic zone, half of the observed cases recorded changes in the rate of deformation a few days before the earthquake.

In Analyzing the Results of Single-Breaking Moving in Real-world Conditions and Attempting Rock Patterns, American Scientists Byerlee J. D. and Brace W. F. come to the idea that the physical model of the process of destruction at the outbreak of an earthquake is a shear motion with a sharp voltage drop and a decrease in speed due to friction. This movement may be preceded by a significant slow motion (stable-sliding).

Observing activity prior to the disruption, results were obtained that show a slowdown and no impulses at any given time before the earthquake. A similar phenomenon was found in mines before the collapse of rock masses and before the earthquake. In the study of earthquakes, Kiyoo Mogi concludes that a strong earthquake can be preceded by an aseismic slip along the existing fault. In 1964, analyzing the Niagara earthquake, Fuji Y. found

that there was an aseismic slip in the area of destruction before the earthquake.

3. Modern tectonic movements

Studies of modern tectonic movements show that faults represent areas of complex interior construction with characteristic dimensions. The fracture zone is also characterized by the possible development of shear deformations, leading to a significant displacement of the fracture banks. The inner part of the fault consists of fragmented rocks characterized by low strength. This is evidenced by the nature of the propagation of seismic waves in and beyond the fault. Fractures exhibit their elastic properties at high loads and are held as a dense liquid under the action of constant or slowly varying stresses. A simple, highly elastic model of such a body is the body of Maxwell.

Let's look at a mathematical model of a tectonic fault at the boundary between two blocks in cross section. And suppose the material in the fracture zone is under diffusion or compression slip conditions and is a high-density fluid. Thus, the numerical-analytical method, by solving the second-order integral equations, allows to determine in the image the degree of stress in the fracture zone and the speed of aseismic slip depending on the visible displacement, the effective viscosity of the rocks in the fracture zone, the model of motion of the fracture zone, blocks, coordinates and time.

From the results of the numerical analysis it follows that under constant visible motions the voltage in the axial seismic slip zone decreases and in the friction zone the average stress level increases. Moving rocks in the area of tectonic faults lead to deformations that can be considered as movement of dense fluids. Aseismic slip slip causes a redistribution of stress in the fault zone and may precede fracture. The modern assessment of the deformed state of sections of the earth's crust is carried out through GNSS observations, mathematical modeling and map production of the area. "Observations" means the collection and analysis of GNSS data from global, regional and local networks, soil structure and construction data, density data and seismic observations. "Mathematical modeling" means the consideration of the physical model of the process and its construction by means of equations.

Conclusion

The slow movements of the Earth's crust in the fault zones are one of the most important manifestations of tectonic movements on Earth.

Studies of modern tectonic movements show that faults represent areas of complex interior construction with characteristic dimensions.

Moving rocks in the area of tectonic faults lead to deformations that can be considered as movement of dense fluids.

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Author's name and academic degrees and titles: Chief assistant eng. Kiril Yanchev, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kiril_fy@abv.bg, k.yanchev@shu.bg

METHODOLOGY FOR ESTABLISH A LOCAL MODEL OF GEOID (QUASIGEOID) IN MOUNTAIN AND HIGH MOUNTAIN AREAS

Krasimira K. Kirilova

ABSTRACT: *The subject of the study is to develop a methodology for creating a local geoid (quasigeoid) model in extreme regions, and to compute an algorithm for calculating the geometric model of the geoid in mountainous and highland regions for the territory of the Republic of Bulgaria.*

The established methodology for local geoid modelling (quasigeoid) allows us to generalize and apply the possibility of the right combination of satellite solutions with terrestrial data to obtain the optimal solution for determining the local geoid in mountainous and highland areas.

KEYWORDS*: GNSS/levelling, geoid, quasigeoid,*

Introduction

Attempts to bring the geoid into mountainous areas with a pronounced relief suffer from one common disadvantage - lack of sufficient gravimetric, leveling and other data and their good surface distribution. The vast practical measurements and theoretical developments regarding the determination of the global gravitational field overshadow to some extent the determination of regional and local geoids. Especially in mountainous areas where topographic effects are completely dominated by local variations in the gravitational field, such local geoid determinations are difficult to implement.

1. An overview of geoid modeling methods

There are two methods of studying the shape of a geoid:

1) geometric (or astronomical-geodetic), performed by measuring the relative position of points from the Earth's surface and the direction of the vertical line (triangulation and astronomical definitions);

2) physical (or gravimetric), is accomplished by measuring the acceleration of the force of gravity.

These methods differ significantly from each other: The geometric method makes it possible to study and determine the shape of the geoid only on the basis of measurements made on a limited area of the earth's surface, and to study the figure corresponding to that area, and the physical is applicable only when known values of the acceleration of the force of gravity

at all points on the earth's surface, thus obtaining the whole figure of the geoid.

The application of both methods to studying the shape of a geoid faces practical difficulties. This begs the question of their combined use.

The methods of geoid modeling considered historically are well grounded in theory.

1.1. An overview of current methods of studying the Earth's gravitational field and their capabilities

In recent years, satellite observations have contributed to the remote gravimetric determination of the geoid. The idea of using satellite information to determine the absolute geoid is based on the ability to interpret the perturbation of the satellite orbit in terms of gravitational disturbances of the earth's gravitational field. These disturbances can then be forwarded to the Earth's ellipsoid and turn into disturbing potential and finally into geoid heights.

1.2. Geometric method for determining the geoid.

The geometric method allows the application of technical methods aimed at obtaining results with higher accuracy, as well as eliminating instrumental, meteorological and other sources of error. Taking into account these circumstances limits the practical importance of some options and may not extend the method. Only the shape of the physical surface of the Earth and its external gravitational field can be studied geometrically.

In terms of cost and productivity, geometric leveling is inferior to geodetic heights when compared to the use of satellite equipment. This is especially noticeable in hard-to-reach areas. Therefore, the problem of replacing geometric leveling with the method for determining normal altitudes from geodetic altitudes obtained from satellite measurements is one of the most urgent problems facing geodetic production.

1.3. Gravimetric method for determining the geoid

The gravimetric method is one of the most accurate methods in studying the Earth's external gravitational field. The gravimetric method allows to identify such parts of the gravitational field that cannot currently be found by another method, although there is a more modern method - the satellite dynamic method for studying the basic characteristics of the field. The lack of reliable and complete gravimetric information, evenly distributed over the earth's surface, hinders the independent use of the Stokes method for geoid determination.

1.4. Combination of Heights

A number of important geodetic application areas that will benefit from the optimal combination of the heterogeneous height data include (but

are not limited to): modernizing regional vertical datums, unifying national/regional vertical datums for a global vertical datum, transforming between different types of height data, and refining and testing existing gravimetric geoid models. As we move towards an increased use (and in some case, exclusive use) of space-based data acquisition technologies for coordinate/and height information the ability to correctly combine traditionally obtained measurements with newer measurements becomes an essential tool. In particular, the study of long-term geodynamic trends requires the use of heterogeneous data to provide the time series for interpolation and extrapolation over time.

2. Methodology for creating a local geoid model in mountainous and highland areas

A methodology for creating a local model of geoid (quasigeoid) in extreme regions has been developed. After analyzing the existing global geopotential model, a calculation algorithm has been drawn up for the construction of the geometric model of the geoid in mountainous and highland regions for the territory of the Republic of Bulgaria.

Technological diagrams have been drawn up to illustrate the methodology (Fig. 1).

Fig. 1. Metodology for creating the local geoid model

To verify the validity of the model, a methodology is proposed for analyzing and evaluating the presence of systematic errors, the presence of gross errors, the law of distribution of modeling results and their errors by comparing GGM data and actual gravimetric measurements (Fig. 2).

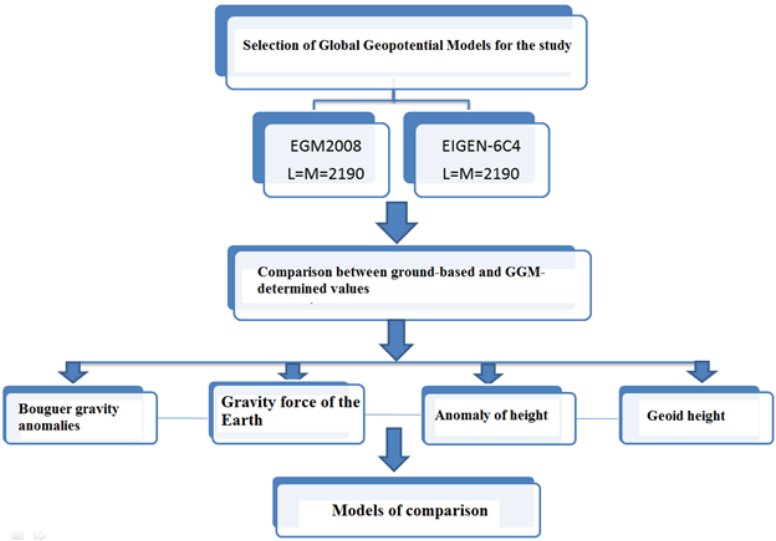

Fig. 2. A block-diagram of the comparison of the geometric geoid model comparison with GGMs

To accurately estimate the accuracy of local geoid modeling, it is necessary to compare the values of the values related to the geopotential: Bougue anomaly, height anomaly and height of the geoid.

The ICGEM (International Center for Global Earth Models) website gathers information from freely distributed global geopotential models as well as software for calculating geopotential values. Using the calculation application, it is possible to calculate the pure and mixed gravity anomaly, calculate the height of the geoid, of the Boogie anomaly, as well as many other dimensions.

Conclusion

Attempts to bring the geoid into mountainous areas with a pronounced relief, suffer from one common disadvantage - lack of sufficient gravimetric, leveling and other data and their good surface distribution.

The application of the methodology allows to create a local model of the geoid using the GNSS/levelling method, taking into account the influence of the gravitational field by applying the Bougue anomaly and reduction due to the relief.

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Author's name and academic degrees and titles: Chief assistant eng. Krasimira Kirilova, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kuneva_krasimira@abv.bg, k.kirilova@shu.bg

ANALYSIS OF THE ACCURACY OF THE GLOBAL GEOPOTENTIAL MODELS FOR THE RILA TERRITORY

Krasimira K. Kirilova

ABSTRACT: *The subject of the study is to analyze the accuracy of the Global Geopotential Models for the Rila mountain by comparing the values of the Bouguer gravity anomalies interpolated by the gravimetric map for all points where GNSS/levelling measurements were made with the Global Geopotential Models - EGM 2008, EIGEN-6C4.*

The analysis of the results obtained for the differences in the values of Bouguer anomalies when working with the global geopotential models, allows to conclude that the accuracy when working with the combined models is insufficient for practical applications in high mountain areas. Global geopotential models may only be used in mountainous and highland areas for research of a global nature.

KEYWORDS*: Global geopotential models, Bouguer gravity anomaly.*

Introduction

Global models of gravitational field are needed in solving various problems of space geodesy, geodynamics, geophysics, the theory of the figure of the Earth, etc. Obtaining global models of Earth's gravitational field (EGF) using only satellite measurements does not provide the necessary accuracy, since higher-order spherical harmonics are reliably determined by ground-based measurements. If there are uniformly distributed points across the Earth's surface with known gravity anomalies and quasigeoid heights, as well as satellite data, then the use of satellite and terrestrial measurements is preferred when designing EGF models - combined methods.

1. Introducing Global Geopotential Models (GGMs)

GGMs describe the Earth's gravitational field, which can be divided into the following groups:

- Satellite GGMs derived from satellite data only;

-Combined GGMs resulting from the combination of satellite, ground, altimetric and aerial data. In the recent past, the accuracy of combined GGMs was limited, but with the advent of the CHAMP, GRACE, GOCE project, the accuracy of the combined models has improved significantly.

- Special GGMs that are derivatives of existing GGMs (satellite or combined) together with local gravimetric data.

In recent years, foreign specialists have created a number of models of Earth's gravitational field with improved accuracy characteristics for determining the harmonic coefficients of the geopotential field, such as EIGEN-5C, EIGEN-6C, EIGEN-6S, EIGEN-6C2, EIGEN-4C (European Improved Gravity Model of the Earth by New Techniques (GOCE models using new technologies), GOCE models and more. Particularly important among these models is the EGM 2008 model up to 2190th degree of spherical harmonics, created with the leading role of the US National Geospatial Intelligence Agency to replace the EGM 96 model and the EIGEN-6C4 model up to 2190th degree, created by Scientific - research geocenter in Potsdam.

The data from global models contain a limited set of dimensionless normalized harmonic coefficients $\overline{S_{nm}}$, $\overline{C_{nm}}$, which make it possible to calculate approximately different functions of the Earth's gravitational potential in outer space. The harmonic coefficients in the models are calculated from the results of observations of satellite gravimetry in combination with marine, terrestrial and aerial gravimetry. Satellite data are essential in determining low order and coefficient coefficients, giving the so-called longwave characteristic of the earth's gravitational field.

2. Global assessment of the accuracy of the GGMs

Today, there are more than 100 models of the Earth's gravitational field (GGMs) that express the gravitational field of the Earth and therefore the height of the geoid through the functions of spherical harmonics. The International Center for Global Land Surface Models (ICGEM) compares heights of geoids in accordance with data obtained from GNSS-levelling models in the US, Canada, Europe, Australia, Brazil, Japan.

Table 1. Part of the list of GMMs presented on the ICGEM webside

ГГМ	Година	Степен	Данни
1	2	3	4
GGM05G	2015	240	S(Grace, Goce)
GOCO05s	2015	280	S(see model)
GO_CONS_GCF_2_SPW_R4	2014	280	S(Goce)
EIGEN-6C4	2014	2190	S(Goce,Grace,Lageous),G,A
EIGEN-6S2	2014	260	S(Goce, Grace, Lageous)
GOGRA02S	2013	230	S(Goce, Grace)
GOGRA02S	2013	230	S(Goce, Grace)
GOCO03S	2012	250	S(Goce, Grace...)
GO_CONS_GCF_2_DIR_R3	2011	240	S(Goce, Grace, Lageous)
GO_CONS_GCF_2_TIM_R3	2011	250	S(Goce)
GO_CONS_GCF_2_DIR_R1	2010	240	S(Goce)
EIGEN-51C	2010	359	S(Grace, Champ), G, A
AIUB-GRACE02S	2009	150	S(Grace)
EGM2008	2008	2190	S(Grace), G, A

Based on the results of the comparison made by the ICGE International Center, the top five models of terrestrial gravity field can be identified, which are presented in Table 2.

Table 2. Mean square values of geoid heights obtained by GNSS/ levelling minus GGMs (m)

ГГМ	Nmax	САЩ 6169 точки (m)	Канада 2691 точки (m)	Европа 1047 точки (m)	Австралия 201 точки (m)	Япония 816 точки (m)	Бразилия 1112 точки (m)	Всички 12036 точки (m)
1	2	3	4	5	6	7	8	9
EIGEN-6C4	2190	0.247	0.126	0.121	0.212	0.079	0.446	0.235
EIGEN-6C3STAT	1949	0.247	0.129	0.121	0.213	0.078	0.447	0.236
EIGEN-6C2	1949	0.249	0.129	0.123	0.214	0.08	0.445	0.237
EIGEN-6C	1420	0.247	0.136	0.128	0.219	0.082	0.448	0.238
EGM2008	2190	0.248	0.128	0.125	0.217	0.083	0.460	0.239
GIF48	360	0.319	0.209	0.229	0.236	0.275	0.474	0.305
EIGEN-51C	359	0.335	0.234	0.248	0.234	0.312	0.476	0.321
EIGEN-5C	360	0.341	0.278	0.266	0.244	0.339	0.524	0.342
EIGEN-GL04C	360	0.339	0.282	0.309	0.244	0.321	0.541	0.346
GGM03C	360	0.347	0.337	0.301	0.259	0.316	0.513	0.356

Analyzing the data given in Table 2, two geopotential models can be identified - EGM2008 and EIGEN-6C4, which will participate in the local assessment of model accuracy and the assessment of the ability to use models to determine the local geoid model for the territory of research.

Figure 1 shows the discrepancies between EGM 2008 and EIGEN - 6C4 global gravity models.

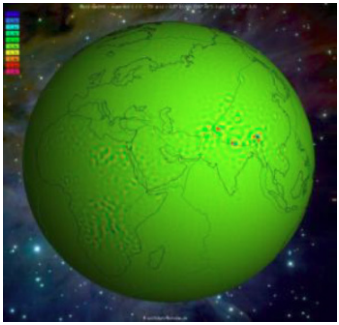

Fig. 1. Comparison of EGM2008 and EIGEN-6C4 Global Gravity Models (max 2190)

2.1. Calculation and comparison of Bouguer gravity anomalies interpolated by gravity map for all points where GNSS/levelling

measurements were performed with Global Geopotential Models - EGM 2008, EIGEN-6C4.

The ICGEM International Center for Global Earth Models website http://icgem.gfz-potsdam.de/ICGEM/ICGEM.html collects information from freely available global geopotential models as well as software for calculation of geopotential values. Using the calculation application, it is possible to calculate the pure and mixed gravity anomaly, calculate the height of the geoid, the Bouguer anomaly, and many other dimensions related to geopotential.

The following parameters are entered as the input data when calculating Bouguer anomalies using ICGEM:

- reference system-GRS80;
- long-period models;
- calculated magnitude - Bouguer anomaly (gravity_anomaly_bg);
- tidal system – tide free;
- using the zero degree of the model;

Since the Bouguer anomalies calculated by GGMs refer to a simple spherical layer, the topographic corrections for near and far areas must be subtracted for correct comparison of the data from the gravimetric map interpolated values. For all calculations and comparisons, the difference in the source systems in which the anomalies are determined is taken into account. The *ETOPO1* global orthometric relief model was used for all the GGMs.

The comparison algorithm is as follows:

1) the required value of the Bougue anomaly at the nodes of a spatial lattice of dimensions $1" \times 1"$ from the given Global Geopotential Model is calculated. The calculations were performed to the extent 2190 with a calculation period of 5min to 12h depending on the value sought. ICGEM software outputs a * .gdf file of calculation results. This format is divided into two parts: a header block and a result block.

2) extract * .shp file from ICGEM software and enter into Arc GIS environment;

3) with input plane coordinates (№, NUTM, EUTM) of GNSS points in the same Arc GIS environment, in which the results of the calculations from the ICGEM software are obtained, information is extracted on the Bougue anomaly values for all GNSS points by grid interpolation;

The comparison was made by distinguishing between the interpolated values of the Bouguer anomalies from the gravimetric map with the values of the anomaly interpolated for the same points in a spatial lattice of dimensions

$1" \times 1"$ from the given GGM. The results of the differences in the values of the three models are shown in Table 3.

Table 3. Comparison of the obtained values of the differences between the interpolated Bouguer anomalies from the map with those calculated by the global geopotential models

Global geopotential model	Minimum difference value [mGal]	Maximum difference value [mGal]	Average of differences [mGal]	SD [mGal]
$\Delta g_B^{GRM\_18} - \Delta g_{изч.}^{EGM08}$	21.621	-73.951	-13.790	20.552
$\Delta g_B^{GRM\_18} - \Delta g_{изч.}^{EIGEN-6C4}$	21.545	-73.497	-12.926	20.528

For the calculated values of the differences of Bouguer anomalies for the study area, the difference between and - a minimum value of 21 mGal, a maximum of -74 mGal was obtained. Negative Bouguer anomalies are obtained due to the high altitudes.

The analysis of the results confirms the conclusion that the maximum differences in the values of Bouguer anomalies between the models are in the areas of the Eastern part of Rila mountain, and the minimum are located in the lowest parts of the four separate parts of Rila. The accuracy obtained from the calculation of Bouguer anomalies from the combined models (standard deviation of the order of 20 mGal) is insufficient for precise practical applications in hard-to-reach areas, such as the study area.

Conclusion

Topography-related density anomalies include the direct gravitational effects of continent topography, ocean bathymetry, the influence of ice cover, and isostatic compensation. Taken together, these effects are a major part of the change in the earth's gravitational field, especially at shorter wavelengths, where the directly calculated topographic effects only counteract the effect of isostatic compensations to a low degree.

In mountainous areas, topographic effects are completely dominated by local variations in the gravitational field, so local topographic reductions are required to eliminate this height dependence - in general, gravimetric stations are determined at different altitudes rather than at one average altitude for the area.

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Author’s name and academic degrees and titles: Chief assistant eng. Krasimira Kirilova, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kuneva_krasimira@abv.bg, k.kirilova@shu.bg

ANALYSIS AND ESTIMATION OF THE ANOMALOUS QUANTITIES CHARACTERIZING THE DIFFERENCE BETWEEN THE REAL AND NORMAL GRAVITATIONAL FIELD OF THE EARTH

Krasimira K. Kirilova

ABSTRACT: *The object of the study is to analyze and evaluate the anomalous quantities characterizing the difference between the real and normal gravitational field of the Earth.*

The gravitational field of an ellipsoid (normal gravitational field) is of fundamental practical importance because it is relatively easy to work with it mathematically. The differences between it and the real Earth's gravitational field are so small that they can be assumed to be linear quantities. The division of the real Earth's gravitational field into normal and anomalous greatly facilitates its determination.

KEYWORDS*: normal gravitational field, the real gravitational field, geoid, quasigeoid, anomalous quantities*

Introduction

Knowledge of the Earth's gravitational field is an essential component in studying the physical system of the Earth. Inside the masses, the field interacts with many other fields, depending on complex processes of physical and chemical nature, the study of these phenomena being the subject of geophysics. Outside the masses, the gravitational field is in harmony with the "harmonious" nature of gravity, while maintaining, especially near the earth's surface, the characteristic feature of internal processes. The study of the gravitational field at the boundary surface and in the outer space is the object of geodesy - in particular physical geodesy.

1. Problem in determining the external gravitational field and the shape of the Earth

Knowledge of its potential is required to determine the shape of the Earth W. At present it is not possible to calculate the gravity potential of formula (1), since it involves the attraction potential V, which depends on the density δ. The exact law of the change of density in the Earth is not yet known. Therefore, when studying the gravitational field of the Earth, certain hypotheses about its internal structure must be used.

$$W(x,y,z) = V + \Phi \tag{1}$$

In 1849, the eminent English scientist Stokes completely relieved the theory of the need to include any hypotheses about the Earth's internal structure when studying its shape. He proved that the Earth's outer potential can be determined independently of density.

Stokes's theoretical studies are based on his well-known theorem, which can be formulated as follows: if the total mass of the planet, the angular velocity of its rotation, and the shape of the outer level the surface of the potential of gravity are fully known, all attracting masses, then the potential of gravity and gravity itself are uniquely determined.

In summary, for an arbitrary level-surface, the Stokes problem, given its extreme difficulty, has not yet been resolved. There are solutions to the Stokes problem for some of the simplest surfaces, especially the rotary ellipsoid.

Stokes solves the inverse problem of determining the shape of the outer surface-level and the outer potential, provided that the angular velocity of rotation of the Earth, the values of gravitational force and the potential of the surface-level are known.

The solution was obtained by Stokes assuming that the required external potential W is close enough to some auxiliary potential U, called the normal potential. Normal potential is selected to be close in value to real potential.

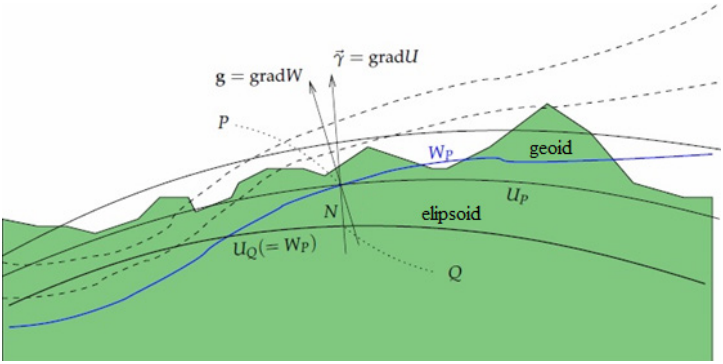

Fig. 1. Equipotential surfaces of the real gravitational field (W) and normal (U)

Strictly speaking, to determine the Earth's potential and the shape of the geoid, the Stokes solution cannot be used since, first of all, the geoid does

not satisfy the conditions of the Stokes theorem, it is not an external surface-level and masses of continents rise above it, and second, gravity is measured on the physical surface of the Earth, not the geoid.

That is why Molodensky (1945) proposes not to associate the tasks of Geodesy and the theory of the figure of the Earth with the problem of determining the figure of the geoid.

To solve the problem formulated above, Molodensky assumes that the Earth's outer potential W is close to the known normal potential U. As with the Stokes problem, in this case the small magnitude is determinable $T = W - U$. This quantity T has been called the Earth's disturbing potential.

2. Analysis and evaluation of the Earth's normal gravitational field

The main differences between the real figure of the Earth and its gravitational field and the Normal Earth are characterized by the coefficients of decomposition of the Earth's gravitational potential in a row of spherical functions and the height of the quasigeoid above the total terrestrial ellipsoid.

The concept of Normal Earth and its associated notion of normal gravitational field are largely conditional, depending on how they are used in solving problems in geodesy, geophysics, astronomy and other scientific fields.

In geodesy, the Normal Earth is represented in the form of a body whose outer surface is a common terrestrial ellipsoid - a rotational ellipsoid, which is an equipotential surface for normal potential. The value of the force of gravity determined by the potential along this equipotential surface is called the normal value of the force of gravity.

When measuring the Earth's gravitational field, it is always referenced, i.e. against a given value of the force of gravity considered normal. If the Earth was a "liquid" rotating planet, it would be sufficient to know the value of the external potential of gravity to determine its shape; then the Earth's surface would be a smooth surface whose equation is determined by the outer potential of the planet's surface.

When using the Normal Land as a reference frame, its parameters are allowed to be chosen approximately, provided that there is no difficulty in linearizing the limit values. In many cases, however, it is convenient to find specific solutions that match the choice of normal Earth parameters that are most appropriate for the real Earth. Thus, it is of interest to determine, as far as possible, the exact values of these parameters.

3. Analysis and evaluation of the anomalous quantities characterizing the difference between the real gravitational field of the Earth and the normal

Assume that the real surface of the Earth is flat and coincides with the normal potential of gravity at the ellipsoid level: in other words, $W_0 = U_0$ and the disturbing potential T = 0. In this case, at all points on the earth's surface, the direction of the vector of real gravity determined by the astronomical coordinates coincides with the direction of the lines of gravity of the normal gravitational field determined by the ellipsoid of the geodetic coordinates B, L, i.e. $\varphi = B$ и $\lambda = L$. Then the deviations of the vertical line, such as the angles between the directions of the vectors of the real and the normal directions of the force of gravity, will be zero. Given the equality between normal and real potentials, the measured value of the force of gravity g at any point on Earth will be equal to the normal γ, i.e. calculated by the normal formula for gravity. In this case, the heights of the Earth's points will also be zero everywhere.

In fact, the described picture is not observed on the measurement results. Comparison of astronomical and geodetic coordinates, even at the best orientation (position) of the reference ellipsoid, shows deviations of the vertical line that are much larger than errors in astronomical and geodetic measurements. The measured values of gravity g do not coincide with normal values γ values, they are many times larger than the errors in gravimetric observations. These discrepancies $g - \gamma$ are anomalies of gravity. They play an important role in studying the shape of the Earth along with the results of geodetic and astronomical measurements. It is now easy to conclude that the obtained discrepancies in the astronomical and geodetic coordinates, the differences in the measured and normal values of gravity are the result of the inequality of the real and normal gravitational potentials of the Earth, i.e. actions of the *disturbing potential T*.

The disturbing potential T cannot be directly determined. Therefore, it is normal to try to obtain from experimental data - by deviation of the vertical line or by the anomaly of the force of gravity, and then determine the true potential *W* of the force of gravity. Knowing *W*, one can determine the basic theoretical dependencies of the various characteristics and magnitudes of the actual gravitational field on Earth that are required for theory and practice, such as: determining the geodetic heights of points from the earth's surface, calculating the corrections of astronomical coordinates for the influence of the deviations of the vertical line at any point on the earth's surface, determining the effect of gravity on the Earth in the calculation of rocket flight and art Enita satellites of the Earth and others.

Theoretically, the gravity anomalies and the vertical line deflection (ξ,η) are suitable for determining the *disturbing potential T*. In practice, gravity anomalies are preferred for the following reasons:

1. The deviation from the vertical line with the required accuracy is determined by the comparison of the results of geodetic and astronomical observations, which at any point require many times more time and labor than gravimetric measurements. Determining in any territory the deviation of open lines at a certain frequency will require tens of times more labor, means and time than extracting the gravity anomaly from gravimetric measurements.

2. Gravimetric measurements can be carried out not only on land but also at sea. This advantage is fundamental because theoretical assumptions require measurements to be made over the entire surface of the Earth. Vertical line deviations with existing methods and measuring instruments can be obtained on land, i.e. only about 3/8 of the entire earth's surface.

Conclusion

The local properties of the earth's gravitational field play an essential role in determining the elevation of the points from the earth's surface. Numerous locally measured parameters of the Earth's gravitational field need to be converted to other parameters, providing additional information about the field and the ability to interpret it through modelling.

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Author's name and academic degrees and titles: Chief assistant eng. Krasimira Kirilova, PhD
Workplace: Faculty of Technical Sciences, Department of Geodesy, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: kuneva_krasimira@abv.bg, k.kirilova@shu.bg

OBTAINING ACCESS TO CONFIDENTIAL INFORMATION USING KEYLOGGER SOFTWARE TOOL IN THE COMPUTER NETWORKS AND SYSTEMS

Petar Kr. Boyanov

ABSTRACT: *In this paper obtaining access to confidential information using keylogger software tool in the computer networks and systems is made.*

KEYWORDS*: Antivirus program, Cybersecurity, Keylogger, Port, Service, Vulnerability.*

1. Introduction

Information Systems cyber-attacks are a number of specific malicious software programs that are used to provide unauthorized access to the information resources of the victim's machine in a public or private organization. The malicious perpetrators exploit vulnerabilities in the ports and services on the victim's machine in order to install an agent to monitor and track all activities on the victim's machine of the employee in particular organization. After installing special malware agents without the knowledge of the employee, all recorded data over the public space Internet to the machine of the cybercriminal is transmitted.

2. Main text

Cyber-attacks recording every key pressed on the keyboard (keyloggers) are mainly divided into hardware spyware tools and devices and software spyware [1], [2], [3], [4], [7], [9]. The hardware spyware tools used by the cybercriminals are devices embedded into the motherboard of a personal computer or notebook, a keyboard with printed circuit boards built for recording each pressed keystroke, Bluetooth keylogger, Wi-Fi keylogger, USB flash keylogger, VGA, HDMI, DVI keylogger and more other electronic devices.

It should be known that software programs that record each keystroke on the keyboard, record all current messages, take pictures (screenshots), monitor the use of the victim's machine resources for each running program, send reports with recorded data via email, remotely manage and share file via FTP servers, record microphone sounds, generate web HTML reports, manage user accounts and shut down software programs [5], [6], [8], [10], [11], [12], [13], [14].

3. Experiment

The experiment on a Local Area Network of 9 hosts in a computer lab at the Faculty of Technical Sciences at Konstantin Preslavsky University of Shumen is made. The operating system installed on the computer victim is Windows 7 Ultimate x64, version 6.1.7601. The operating system installed on the attacking computer is Kali Linux 4.12.0-kali-amd64 #1 SMP Debian x86-64 GNU/Linux.

The purpose of the science experiment is to record every key pressed on the victim's keyboard in order to steal usernames and passwords. The HatKey software toolkit for this purpose will be used. This software tool was developed by Farzin Enddo in order to record every key pressed on the keyboard of a particular host. This is shown on fig.1.

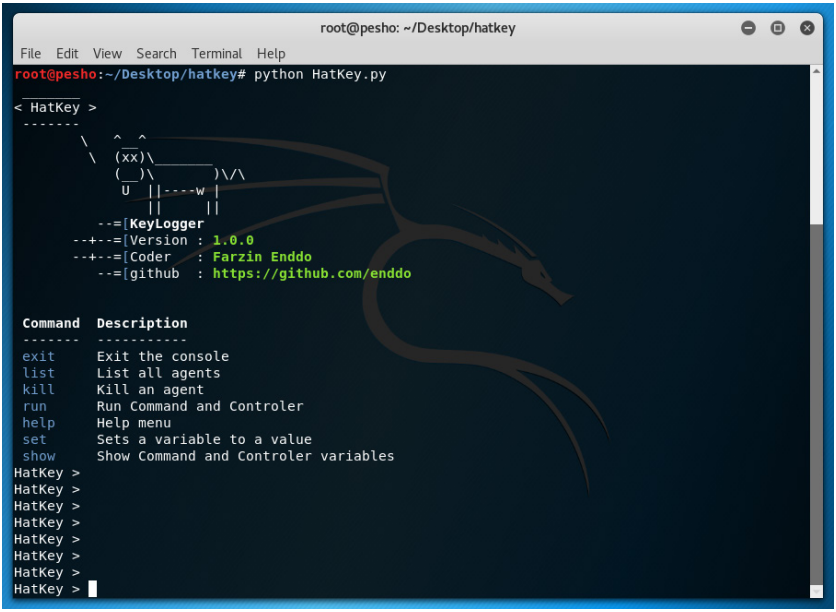

Fig. 1. Initial screen of the toolbox HatKey

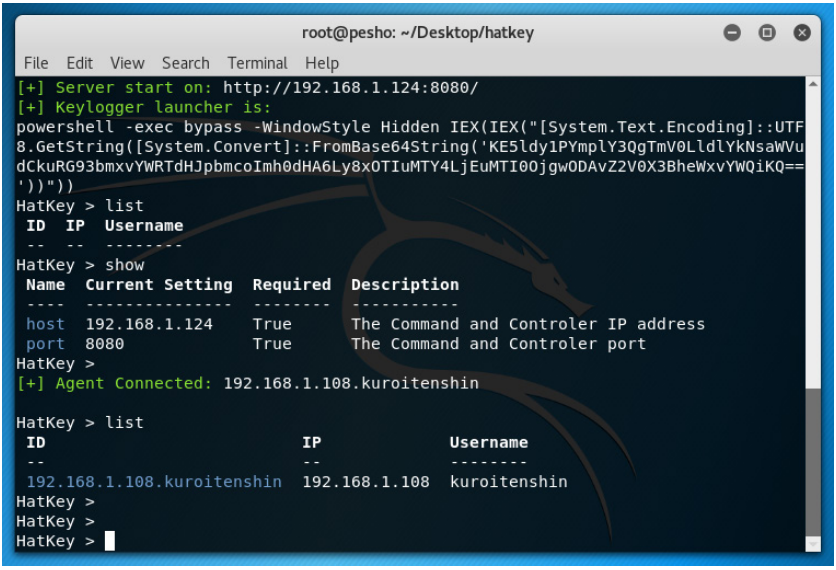

Fig. 2. Initial screen of the toolbox HatKey

After selecting “Set” option the program asks for the IP address of the keylogger server that will connects with keylogger launcher agent on the victim's computer. The IPv4 address of the attacking machine is 192.168.1.124. If this attack is carried out over the Internet, the public IP address is entered. When using a public network and a router, the port to be used for the connection will need to be routed from the router to the attacker's private address. The last parameter that must be entered is the keylogger launcher script - “powershell -exec bypass -WindowStyle Hidden IEX(IEX("[System.Text.Encoding]::UTF8.GetString([System.Convert]::FromBase64String('KE5ldy1PYmplY3QgTmV0LldlYkNsaWVudCkuRG93bmxvYWRTdHJpbmcoImh0dHA6Ly8xOTIuMTY4LjEuMTI0OjgwODAvZ2V0X3BheWxvYWQiKQ==')))")”. This is shown on fig.2.

After that keylogger agent server is running on port 8080 and listens for new network connections. When everything is configured, then the victim’s computer is expected to execute the powershell script but without knowing that it was malicious software code.

4. Results

When the victim’s computer enters its information, then it will appear on the screen in plain text format on the attacking machine. This is shown on fig.3.

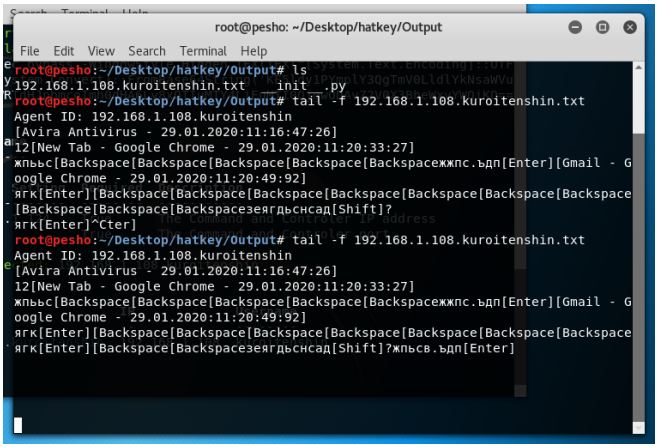

Fig. 3. The recorded information after every pressed key on the victim's machine

After running the antivirus program, it is found that the malicious script in the directory "C:\Windows\System32\WindowsPowerShell\v1.0\" is installed. Then antivirus software successfully wiped the malicious threat, although the important victim's information is sent to the attacking machine. This is shown on fig.4.

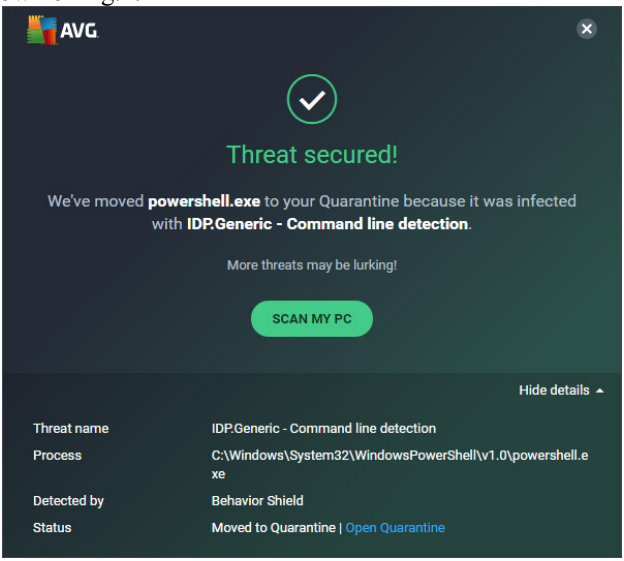

Fig. 4. Successfully wiped the malicious threat

NOTE: All of the scientific experiments and studies in this paper were conducted in a specialized computer lab at the Faculty of Technical Sciences at the Konstantin Preslavsky University of Shumen, consisting of several hosts. Everything illustrated and explained in this paper is for research purposes and the authors are not responsible for any misuse.

5. Conclusion

Networks security officers and the security administrators must take and take the following security actions, such as:

- Always after the end of the working day the employee in the organization is obliged to lock the door of his office.
- The employee and system administrator must regularly check the computer machines for unauthorized attached spying devices to the peripheral devices.
- Changing the usernames and passwords of the employees in the organization every 15 days.
- Using a virtual software keyboard from the operating system in order to avoid execution of malicious programs that track every pressed keystroke on the keyboard.
- Regular scanning for suspicious and malicious files and directories as well as every downloaded file from the Internet with antivirus software.

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Author's name and academic degrees and titles: assoc. prof. eng. Petar Krasenov Boyanov, PhD
Workplace: Faculty of Technical Sciences, Department „Management of security systems", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: peshoaikido@abv.bg, petar.boyanov@shu.bg

IMPLEMENTATION OF THE DOPPLER EFFECT ON THE CORRELATION PROPERTIES OF COMPLEX RADIO SIGNALS

Petar Kr. Boyanov

ABSTRACT: *The correlation properties of the radio signals determine greatly the capacity and speed of information transmission in modern wireless communication systems. Therefore, in this paper implementation of the Doppler effect on the correlation properties of complex radio signals is made.*

KEYWORDS*: Complex signals, Correlation, Doppler effect, Frank-Zadoff-Chu sequence, Periodic function.*

1. Introduction

Currently, the mobile communications industry is developing set of standards and solutions needed for the next steps in the evolution of mobile networks. Complex radio signals are the basis of 3rd, 4th and 5th generation mobile communication systems. An important requirement for complex radio signals is that they have optimal correlation properties to provide high capacity and high speed data transmission in the wireless communication system.

2. Analysis of the correlation properties of complex radio signals

The normal operation of wireless communication systems is significantly hampered by the Doppler effect, as a result of which the carrier frequency of the received signals differs from the nominal value perceived in the system. In this case, the variation of the carrier frequency of the radio signal is determined by the speed of movement of the communicating objects [1], [2], [4], [5], [6]. To research the impact of the Doppler effect on the correlation properties of complex control signals, a special program in the Matlab programming environment was developed. The computer program for the calculation of the periodic and non-periodic correlation functions of signals with a suitable user interface is designed [3], [7], [8].

3. Computational part and functional test of the computer program

As it is known in the modern mobile communication systems, the signals from Zadof and Chu as control signals are used. It should be noted that sequences with ideal periodic autocorrelation function are of great

importance for radar and radio navigation equipment. Therefore, several methods for synthesizing these sequences are proposed. In fact, these are multiphase sequences, also referred to as Frank-Zadoff-Chu sequences. In particular, the sequences of Frank and Zadoff by the following algorithm are obtained. Let [7]:

$$\omega = \exp\left(\frac{2\pi js}{Q}\right) \tag{1}$$

is a primitive Q-root of the unit as s and Q are relatively prime numbers. Then the sequence [3]:

$$\Omega = \left\{\omega^{0.0}, \omega^{0.1}, ..., \omega^{0.(m-1)}, \omega^{1.0}, \omega^{1.1}, ..., \omega^{1.(m-1)}, ..., \omega^{i.0}, \omega^{i.1}, \omega^{i.(m-1)}, ..., \omega^{(m-1).0}, \omega^{(m-1).1}, ..., \omega^{(m-1).(m-1)}\right\} \tag{2}$$

containing the Q^2 element has an ideal periodic autocorrelation function. Chu's algorithm is similar to that of Frank and Zadoff. In general, the disadvantage of Frank, Zadoff and Chu's algorithms is that the size of the resulting reference matrices by the complexity of the used phase manipulation is determined. Thus larger sequences only as a result of the used sophisticated apparatus are formed.

3. Experiment

The carrier frequency f_o of the complex radio signal is entered. The range is from 100 MHz to 10000 MHz. The duration of elementary impulses forming a complex radio signal is set upped. The signal length is with value 10 set upped. The signal that is expected to be received by the receiver is entered. The initial value of the control signal is [1 1 1 1 1 1 1 1 1 1 1 1 1]. The actually received signal from the receiver is entered. The initial value of the received signal is [1 1 1 1 1 1 1 1 1 1 1 1 1]. The minimum possible speed of movement of the object to 55 km/h is set. The maximum possible speed of movement of the object to 100 km/h is set. The step of changing the velocity of an object is introduced in investigating the effect of the Doppler effect on the processing of complex control signals. The step of change of velocity of the object under investigation of the influence of the Doppler effect on the processing of complex control signals is set upped. Its value is 30 km/h. The next step for the type of the studied correlation function is related. It can be periodic or non-periodic correlation function.

The difference between the non-periodic and the periodic correlation is that in the case of the non-periodic correlation, the length of the reference and the received signal may be with different length, while in the periodic

correlation the length of the reference and the received signal must be with the same length. If periodic correlation is selected and different signal lengths are entered, the program displays an error message. For this reason, signal lengths must be correctly entered when this software program is used.

When a non-periodic correlation is selected, the following values are displayed:

- The result of calculating for the non-periodic correlation when approaching.
- The absolute value of the non-periodic correlation when approaching.

When a periodic correlation is selected, the following values are displayed:

- The result of calculating for the periodic correlation when approaching.
- The absolute value of the periodic correlation when approaching.

The impact of the Doppler effect on the correlation properties of complex control signals on fig.1 is shown.

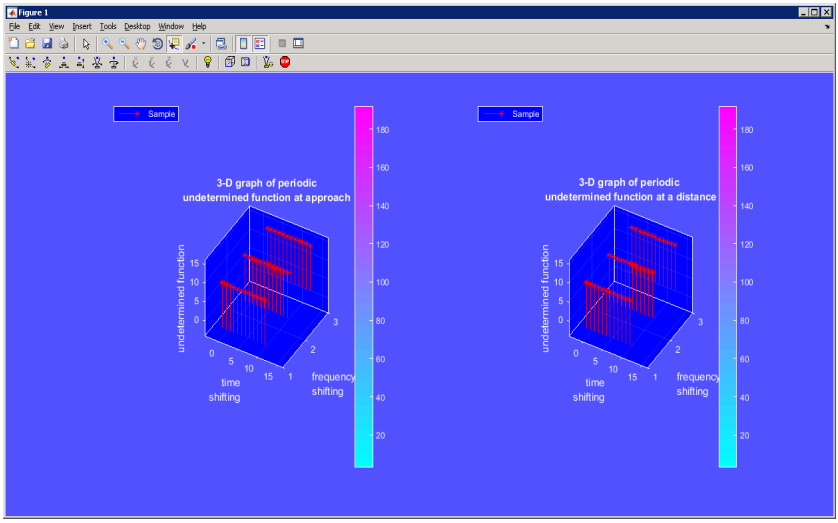

Fig. 1. The impact of the Doppler effect on the correlation properties of complex control signals

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several hosts. Everything illustrated and explained in this paper is for research purposes and the authors are not responsible for any misuse.

5. Conclusion

Thanks to the obtained results with the parameters of the control signals in the 4G and 5G mobile communication systems, it becomes clear that the processing of control signals is not difficult and the these mobile communication systems are working normally. The highest performance in these mobile communication systems is achieved at communication speeds of 15 to 120 km/h. Therefore, the system can maintain normal communication at a maximum speed of 400-500 km/h. The rate of transmission of information also depends on the bandwidth of the used radio signals.

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Author's name and academic degrees and titles: assoc. prof. eng. Petar Krasenov Boyanov, PhD

Workplace: Faculty of Technical Sciences, Department „Management of security systems", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria

E-mail: peshoaikido@abv.bg, petar.boyanov@shu.bg

IMPLEMENTATION OF PROTECTION MECHANISMS OF INFORMATION RESOURCES IN THE LOCAL AREA NETWORKS

Petar Kr. Boyanov

ABSTRACT: *In this paper protection mechanisms of information resources in the local area networks are made.*

KEYWORDS*: ACL, Information resources, LAN, Security, Switch, Router, Vulnerability, WAN.*

1. Introduction

Most of the committed cybercrimes on vulnerabilities and weaknesses in the field of computer and network systems are based. In this way, the most important skills of network security analysts and system administrators to configure special access control lists are related. The network security analysts and system administrators use these lists to block or allow only certain network traffic.

2. Main text

Most of the system administrators use these access control lists to stop all network traffic or to allow only certain network traffic through the local computer network. The network architects and system administrators use software and hardware based firewalls in order to protect computer networks from unauthorized access to the information resources of large companies, academic institutions and plain users. In fact, firewalls are software or hardware solutions that are able to enhance the built network security policy. In this way, the firewalls filter unauthorized and potentially dangerous packages from across the local area network [1], [2], [4], [7], [9], [10]. The access control lists are a sequence of permission and prohibition commands that determine what security policy will be built. The access control list configuration is applicable to all dynamic routing network protocols. The most important reason for configuring and implementing these access control lists is to provide enhance security mechanisms for the entire network against different modern types of cyber-attacks that may compromise the host victim [11], [12], [15], [17], [20], [21], [22], [24], [25].

These lists can prohibit or allow network traffic to a specific host or large group of hosts along with their logical IPv4 network addresses. They can also filter network traffic on a specific TCP or UDP port.

Some of the most important network port numbers are:

- TCP 1863 - MSN Messanger.
- TCP 8008 - alternative HTTP.
- TCP 8080 - alternative HTTP.
- TCP 21 - (FTP).
- TCP 23 - (Telnet).
- TCP 25 - SMTP (Simple Mail Transfer Protocol). It is used to forward and send mail messages between servers.
- TCP 80 - HTTP (Hypertext Transfer Protocol).
- TCP 194 - IRC (Internet Relay Chat).
- TCP 443 - HTTPS (Secure HTTP).
- UDP 1812 - RADIUS Authentication protocol.
- UDP 5004 - RTP (Voice and Video Transport Protocol).
- TCP/UDP 53 - DNS (Domain Name Services) and etc.

The packet filtration, also called static packet filtration, aims to control network access by analyzing incoming and outgoing packets across the local area network. The access control lists can extract some important information from the packet header and thus decide whether to skip or deny the packet [3], [6], [8], [13], [14], [16], [18]. All these decisions are based on:

- The source IP address;
- The recipient's IP address;
- The ICMP message;
- The TCP/UDP source port;
- The TCP/UDP port of the recipient.

By default, the routers do not have any configured access lists and thus no network traffic can be filtered. The network traffic entering the router is routed to the information entered in the routing table and all packets can be routed freely from one router to the next network segment [19], [23], [26].

In practice, the access control lists in the computer networks perform the following important tasks [1], [2], [4], [5], [6], [9], [27], [28], [29], [30]:

- Network traffic restriction in order to increase performance. As an example may be given the limitation of video traffic at the expense of voice traffic.
- Controlling the areas of access that a user or client can access.
- Applying special rules for users that allowing or denying the access to the FTP and HTTP services.

Standard and extended access control lists are most commonly used. The standard access control lists allow network traffic to be allowed or prohibited from the source IP address. The extended lists filters IP packets based on multiple attributes as:

- The type of protocol;
- The source IP address;
- The recipient's IP address;
- TCP/UDP source port;
- TCP/UDP port of the recipient and etc.

3. Experiment

The local area networks in the programming environment of Cisco Packet Tracer version 6.2.0.0052 are simulated. This is shown on fig.1. As is known, each router has a number of network interfaces. In our communication scenario, Router “PhD 2” has a FastEthernet (Fa0/0) interface with Net ID 192.168.30.0/24 and serial (Se0/0/1) interface with Net ID 10.2.2.0/29. The network 192.168.30.0/24 consists of Cisco 2811 Modular Router and a single Cisco Switch C2960-24TT. Two personal computers are connected to this switch. The network with the number 192.168.30.0/24 is a private local computer network and its default gateway (IPv4 Default Gateway) is 192.168.30.1/24. This is the configured network address of the FastEthernet interface (Fa0/0) in the router "Router PhD 2". The maximum capacity of this network is 254 real hosts. The connection between the switch “PhD” and the hosts “Peshosan” and “Mitko” with copper straight-through UTP cat.5e cable is made. The network with the number 10.2.2.0/29 consists of router “PhD 2” and router “Centralen router”. These network devices with serial smart DCE DB60 cable are connected. The network with the number 10.2.2.0/29 is public network and connects the routers „Centralen router” и “ISP” (Internet Service Provider). The host „Anonymous host” with IP address 209.165.202.158 is to router “ISP” with copper cross-over UTP cat.5e cable connected.

The purpose of this research is to allow the host "Peshosan" with private IP address 192.168.30.10/24 to have a network access anywhere in the local area network. The hosts “Mitko” with IP address 192.168.30.128/24 must have network access only to the network 192.168.30.0/24. The result of successfully established connection between two the hosts (192.168.30.10 and 209.165.202.158) on fig.2 is shown. The result of successfully established connection between the hosts “Peshosan”, “ISP”, “FTN Server” and “Anonymous Host” on fig.3 is presented.

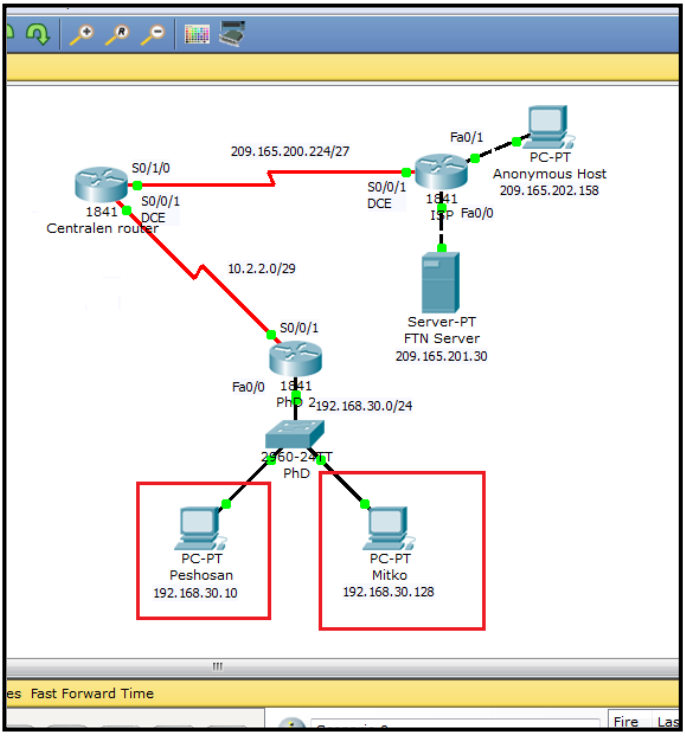

Fig. 1. The simulated computer network

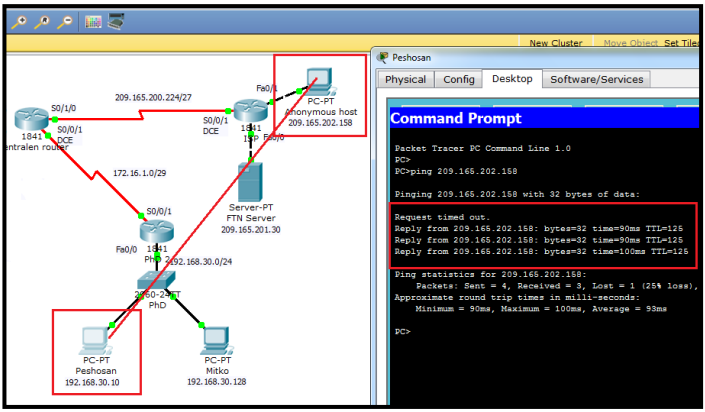

Fig. 2. Successfully established connection between two the hosts (192.168.30.10 and 209.165.202.158)

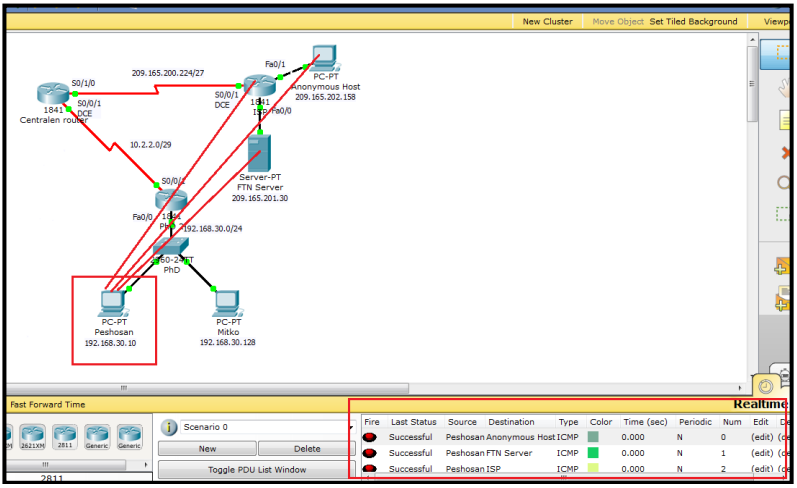

Fig. 3. Successfully established connection between the hosts "Peshosan", "ISP", "FTN Server" and "Anonymous Host"

NOTE: All of the scientific experiments and studies in this paper were conducted in a specialized computer lab at the Faculty of Technical Sciences at the Konstantin Preslavsky University of Shumen, consisting of several hosts. Everything illustrated and explained in this paper is for research purposes and the authors are not responsible for any misuse.

4. Conclusion

Thanks to the implemented security policies it ensures greater reliability, security and performance of communication processes and services in the research local area network. The building and maintaining of secure access control lists is critical to maintaining the integrity and confidentiality of user's information resources. It is advisable to configure access control lists by specialized system and network administrators in order to protect the transmitted network traffic against various types of malicious cyber-attacks. The control lists are extremely useful in the workflow of many large and small companies, corporations, government institutions, universities and schools.

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Author's name and academic degrees and titles: assoc. prof. eng. Petar Krasenov Boyanov, PhD
Workplace: Faculty of Technical Sciences, Department „Management of security systems", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: peshoaikido@abv.bg, petar.boyanov@shu.bg

BUILDING A GEODETIC WORK BASE BY USING GNSS

Plamen M. Mihaylov

Abstract: *The subject of the research is to review how the building of a GWB has changed over time with the use of GNSS. There is a comparison between the two main methods of measuring – static with following processing and real-time kinematic (RTK) – in the process of development of GNSS technologies. Previously, the main difficulty was due to the necessity to transform results for transfer between the systems WGS84 and Krasovsky. By comparing the time that was needed before and now, it is clear that the performance is improved 4-5 times!*

Keywords: *GNSS, GPS, RTK, Fast static, transformation*

State GPS network

The use of GPS surveillance opportunities started towards the end of the 80s –for improving the state geodetic network (SGN) and designing a new National geodetic network. With the active participation of the Bulgarian academy of science and the Military topographic service and in collaboration with the Institute of applied geodesy in Germany, the work on introducing the European referent system (EUREF) and the first attempts to create the new national geodetic network started.

At present, the territory of the country has a developed, measured and equalized State GPS network. The latter was created by implementing decree 140/04.06.2001, which defines the Bulgarian geodetic system 2000 and serves as a radical update of the State geodetic network of Republic Bulgaria.

Table 1. Points from the main GPS network

№	Type of points	Number	Notes
1	Points from the BULREF	15	Of those 2 SGN I and II
2	network	2	class
3	Points from EUVN	25	
4	SGN points I and II class	46	2 points from BULREF
5	SGN points III and IV class	22	
6	New points	2	
	Points with special status		
	Total	112	

The state GPS network of the country is based on:

- Permanent GPS stations from the European Permanent Network and the International GNSS Service respectively.

- The network of EUREF points in Bulgaria or BULREF as a realization of the European coordinate system ETRS89 in Bulgaria.

Table 2. Additional points

№	Types of points	Number	Notes
1	Connecting	24	
	- to BULREF points	10	
	- others	14	
2	Duplicates		
	- to BULREF points	14	
	- to points with special status	2	
	Total	38	

The state network consists of two classes of points united in Main and secondary network. The main network is created in order to realize, distribute and support the European coordinate system ETRS89 with accuracy 10 mm by location and 15-20 mm by height by using GNSS technologies on the territory of the country. The main network consists of 112 main and 40 additional points, 152 in total. The points of the secondary GPS network are 344, split as follows:

Table 3. Points with special status

№	Point	Location	Description	Duplicate point
1	TROY	Troyan	Division 24430	8318
2	VVUA	Shumen	Military school	

Table 4. Points of the secondary GPS network

SGN points I and II class	SGN points III and IV class	Local geodetic networks with local designation	Gravimetric points	New points	Total
25	226	3	1	89	344

The responsibilities for the building, measuring, processing, distribution of the results and maintenance of the State GPS network are realized by implementing decree 1/06.01.2005 for distribution of the geodetic and cartographic tasks of national importance.

The obtained point coordinates are in coordinate system ITRS, realization ITRF2000, age 2004.8 (the middle of the surveillance campaign). The point coordinates in the coordinate network ETRF2000 have been

obtained as well and have been transformed from ITRF2000 to coordinate system ETRF2000, age 2004.8. The results from the processing of the two classes of the State GPS network have been reported and accepted at the annual EUREF symposiums (Riga, Latvia, 2006 and London in 2007).

By the way, the state geodetic network as we know it no longer exists. In accordance with regulation № H-7 from May 20th 2014 for the State geodetic network, the latter includes:

1. The geodetic points from the State GPS network, separated in two classes: main and secondary;

2. Special geodetic points that are stabilized in accordance with the requirements of article 9 and are defined in accordance with section II of chapter 2 of the abovementioned regulation.

The purpose of the present exposition is to review the changes in building of a GWB has changed over time with the use of GNSS.

As a rule, the building of a geodetic work base (GWB) consists of stabilizing the points, performing the necessary GPS measurements, equalization of the measurement results and obtaining the coordinates of the points in the selected plane coordinate system.

Particular emphasis will be placed on the work sequence of the GPS measurement performance and the obtaining of results. Initially the use of GPS in geodetic work was more difficult. The main difficulty stemmed from the necessity to transform the results for a transfer between the systemsWGS84 and Krasovsky.

The main points in it are the following:

1. Transformation of ellipsoid coordinates and height (B, L, H) in plane rectangular coordinates in coordinate system 1970.

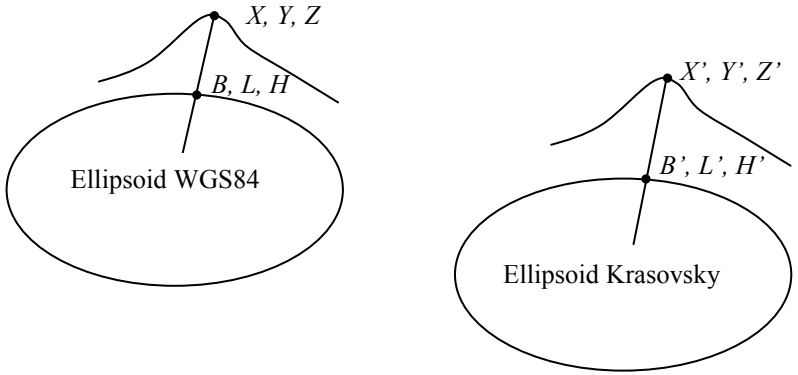
2. Obtaining of the normal heights (altitudes) of the points.

As a rule, this transformation is not very complicated or at least it shouldn't be. If the two coordinate systems are based on the same ellipsoid (WGS84), only a transition from space Cartesian coordinates (*X, Y*, *Z*) to ellipsoid coordinates and height (*B*, *L*, *H*) would be needed, which is not an issue. After that, the transition from ellipsoid coordinates (*B and L*) to plane rectangular coordinates in the corresponding projection should be made.

People create the main difficulty themselves because the parameters for transition from a 70s coordinate system to ellipsoid coordinates are still secret! Because of that, we have to look for different methods to solve this issue. There are at least two ways for solving it, or even three.

The latter can be classified based on whether the parameters for transition from 70s coordinate system to ellipsoid coordinates are available or not.

a) If the parameters are available; Professor Minchev has developed such a transformation. According to him, an S-transformation is applied in the following order: from the coordinates of the anchor points in the 70s coordinate system a transition is made to ellipsoid coordinates B, L, H in a Krasovsky ellipsoid. From ellipsoid coordinates *B', L', H'* a transition is made to plane rectangular coordinates *X', Y', Z'*. With the coordinates of the anchor points *X, Y, Z* in the WGS84 system and the coordinates of the same points *X', Y', Z'* an S-transformation is done and the transformation parameters for transition between systems WGS84 and Krasovsky are ready.



The ***S***-transformation is presented in the following way***:***

$$\begin{bmatrix} X' \\ X' \\ Z' \end{bmatrix} = \begin{bmatrix} X_0 \\ Y_0 \\ Z_0 \end{bmatrix} + m. \begin{bmatrix} 1 & \varepsilon_Z & -\varepsilon_Y \\ -\varepsilon_Z & 1 & \varepsilon_X \\ \varepsilon_Y & \varepsilon_X & 1 \end{bmatrix} . \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \quad (1)$$

As a matrix, the S-transformation can be presented in the following way:

$$X' = T + m.R_{(XYZ)}.X, \quad (2)$$

Where ***X'*** is the vector of the coordinates in the Krasovsky system, ***X*** – the vector of the coordinates in the *WGS84* system, ***T*** is the translation vector, ***m*** is the scale vector, and ***R*** is the rotation matrix. The translation vector represents the coordinates at the beginning of one of the systems against the beginning of the other. The matrix R is an orthogonal rotation matrix, i.e. $R^T * R = E$ and consists of three consecutive rotations around the axes X, Y and Z.

It is visible that with this kind of transformation a scale factor ***m*** is brought out on the three axes. Three scale factors can be introduced – one per every axis and then the transformation will have 9 parameters.

In order to bring out the seven transformation parameters from identical points we need at least three points, common for the two systems. If

there are more than three common points, we have to apply equalization using the method of least squares.

With this we can transform the coordinates of all points of the network or the detailed points in the Krasovsky system - *X', Y', Z'*. By reversing this, we can make a transition to coordinates on the ellipsoid *B', L', H'* and from there to rectangular coordinates in a 70s coordinate system. Using a geoid model (quasigeoid) to obtain altitudes (normal heights) of the points is the most likely scenario and this will be covered later on.

b) If the parameters are not available: this method is used by Professor Valev and the author. The case of the latter is more special as he has managed to empirically obtain the same parameters and in this sense the transformation is close to the abovementioned, with the difference being that he uses **S**-transformation with two scales for the two half axes of the ellipsoid.

We are going to get acquainted with the work of the author now. The main points are:

1. Transformation of ellipsoid coordinates and height (*B*, *L*, *H*) in plane rectangular coordinates.
2. Transformation of the plane rectangular coordinates in coordinate system 1970.
3. Obtaining of the normal heights (altitudes) of the points.

Each of the points will be briefly covered.

A) Transformation of ellipsoid coordinates (*B*, *L*) into plane rectangular coordinates

For this purpose is used transverse Mercator projection (Gauss–Krüger projection) in a 6-degree zone in the basis of the parameters of the WGS84 ellipsoid. The formulae appear below and are available in the GPS textbook:

$$x = S(B) + \frac{1}{2}N.cos^2B.t.l^2 + \frac{1}{24}N.cos^4B.t.(5 - t^2 + 9\eta^2)l^4 + \cdots \quad (3)$$

$$y = N.cosB.l + \frac{1}{6}N.cos^3B.(1 - t^2 + \eta^2)l^3 + \\ + \frac{1}{120}N.cos^5B.t.(5 - 18t^2 + t^4)l^5 + \cdots \quad (4)$$

Where:

S(B) - length of the arc along the meridian from the equator;
N - radius of curvature in first vertical;
$l = L - L_0$ - difference of the lengths in radians;
L - geodetic length of the point;
L_0 - length of the axial meridian;

$t = tan\ B$ and $\eta^2 = e'^2 cos^2 B$ ... Auxiliary variables

The length of the arc along the meridian $S(B)$ is the ellipsoid distance from the equator to the point and is calculated with the following formula:

$$S(B) = \alpha.(B + \beta.\sin 2B + \gamma.\sin 4B + \delta.\sin 6B + ...) \quad (5)$$

where:

$$\alpha = \frac{a+b}{2}\left(1 + \frac{1}{4}n^2 + \frac{1}{64}n^4 + \cdots\right);$$

$$\beta = -\frac{3}{2}n + \frac{9}{16}n^3 - \frac{3}{32}n^5 \ldots.;$$

$$\gamma = \frac{15}{16}n^2 + \frac{15}{32}n^4 + \cdots.;\ \ \delta = \frac{35}{48}n^3 + \frac{105}{256}n^4 - \cdots;$$

and $n = \frac{a-b}{a+b}$ (6)

B) Transformation of plane rectangular coordinates in a 1970 coordinate system

For the purpose of this is used an affine transformation with six parameters. Two equations are made up for each point with available coordinates looking like this:

$$Xpr = Xи.a_1 + Yи.b_1 + c_1 \quad (7)$$

$$Ypr = Xи.a_2 + Yи.b_2 + c_2 \quad (8)$$

Approximate values of the parameters $a_1 = 1;\ b_2 = 1$ are inserted and two equations for the corrections are made up for each point:

$$V_X = Xи + Yи + 1 + 0 + 0 + 0 + f_X \quad (9)$$

$$V_Y = 0 + 0 + 0 + Xи + Yи + 1 + f_Y \quad (10)$$

With free members, the difference between the calculated and the real value of the corresponding coordinate.

In this case are needed at least three points with available coordinates for the problem to be solved. It would be better to have more points in order to have control. The equalized values of the parameters are obtained after equalization with the method of least squares. With the thus obtained transformation parameters, the coordinates of all the points in a 70s coordinate system are transformed.

C) Obtaining normal heights (altitudes) of points

For the solving of this problem, we use as basis the relation between normal and ellipsoid heights of the points.

$$H^e = H^n + \zeta \quad (11)$$

where

H^e – geodetic height (the height above the international ellipsoid);

H^n – normal height (excess);

ζ (zeta) – anomaly of the height.

The issue is that we do not know the anomaly of the height for the particular region. This can be solved by introducing a simplified geoid (quasigeoid) model, which can be applied for a certain area, small in size, for example,

$$\zeta = C_0 + C_1.\Delta X + C_2.\Delta Y \quad (12)$$

where

- X and Y are the rectangular coordinates of the point from the region;
- X_0, Y_0 – the rectangular coordinates of a middle point for the territory.
- C_0, C_1, C_2 are coefficients which are characteristic of the region;
- $\Delta X = X - X_0$; $\Delta Y = Y - Y_0$ are coordinate differences.

Based on (11) and (12) we can write about the geodetic height of a given point:

$$H^e = H^n + C_0 + C_1.\Delta X + C_2.\Delta Y \quad (13)$$

From here, we can write about the equations of the measurements:

$$\zeta = C_0 + C_1.\Delta X + C_2.\Delta Y = H^e - H^n \quad (14)$$

However, since we do not have the equalized values of the unknown values, (14) looks like this:

$$\zeta_0' + V_\zeta = C_0' + d_{C_0} + (C_1' + d_{C_1}).\Delta X + (C_2' + d_{C_2}).\Delta Y \quad (15)$$

Where: V_ζ - correction of the measured anomaly of the height;

C_0', C_1' and C_2' are approximate values of the parameters from the geoid model, and

d_{C_0}, d_{C_1} and d_{C_2} are increments added to them.

From this the result for the corrections is:

$$V_\zeta = d_{C_0} + d_{C_1}.\Delta X + d_{C_2}.\Delta Y + f_\zeta \quad (16)$$

f_ζ - a free member, the difference between the anomaly of the height ζ_0 calculated with the approximate values of the parameters and the 'measured' anomaly of the height ζ' (the difference between the values of the geodetic and the normal height of point i).

$$f_\zeta = \zeta_0 - \zeta' = \zeta_0 - (H^e_i - H^n_i) \quad (17)$$

The thus created equations of the corrections of the type (9) take part in an equalization using the method of least squares and as a result are obtained the increments of the approximate values of the parameters. The anomaly of the height for each point is calculated according to (12) and keeping in mind that:

$$H^n = H^e - \zeta, \quad (18)$$

we can obtain the equalized values of the geometric (normal) heights of the points of the model and after that of all the points in the region.

The problem can be solved unambiguously if at least three points are available with known heights of the two types, but in that case, we wouldn't have any control. Thus, we need at least four points with known normal heights.

According to the Instruction for introduction of BGS 2000 (2005), the same problem can be solved via polynomic transformation based on identical points:

$$H^n = H^e + C_0 + C_1.X + C_2.Y + C_3.X^2 + C_4.XY + C_5.Y^2 + .. \quad (19)$$

where:

H^n – normal heights;

H^e – geodetic height (the height above the international ellipsoid);

X, Y – plane rectangular coordinates of the point;

C_0, C_1, C_2, C_3, C_4 and C_5 – parameters.

As the parameters are six in total, in order to perform the transformation we need at least seven identical points (one is necessary for control!).

In addition, we established that in this case the transformation does not work (the members X^2, $X.Y$ and Y^2 are too big), so a middle point was introduced for the model and the formula changed to:

$$H^n = H^e + C_0 + C_1.dx + C_2.dy + C_3.dx^2 + C_4.dx.dy + C_5.dy^2 .. \quad (20)$$

where: dx and dy are the differences against the middle point for the model.

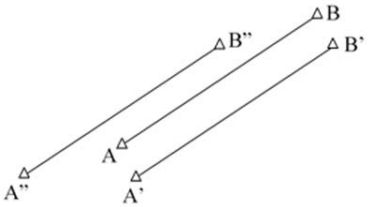
The problem can be solved unambiguously when at least six points are available with known heights of the two types but we would not have control. Thus, we need at least seven points with known normal heights.

The results from the transformation and the defining of the heights are combined and the coordinates for each point are obtained in coordinate system 70s as well as its normal height.

Assuming that the transformation problem is now solved, what is left is reviewing the work sequence during measurement and measurement processing. Originally, single frequency receivers were used, only the GPS system was used and the measurements were processed after finishing the fieldwork. The anomaly of the height of each point (respectively – normal heights) is calculated according to (13) and are needed at least 4 points with known coordinates (anchor points). Just in case, more points are marked – five or six. It would be best if the points are from the SGN – 3, 4 or 5 class at least, located around the region of development of the GWB. Two referent points need to be marked in the region directly in development of GWB. All the chords between the referent and the anchor points have to be measured as well as between the anchor points. Static methods are used, implemented with single or double frequency phase measurements with

following processing. The duration of the measurements is between 45 and 60 minutes depending on the distance between the anchor points.

Before we move to equalization, we have to standardize the coordinate systems, that is, to have a united coordinate system. As the State GPS network was not available yet, as a starting point was taken one of the anchor points, whose coordinates are transformed from coordinate system 70s to WGS84 coordinated system. This is necessary because GNSS measurement means an accurate measurement of the mutual location of the two points of the chord (their relative location) but the same cannot be said about their absolute location. In other words, during a repeated measurement, each time the coordinates of the points turn up in a coordinate system with a different start as shown on the scheme below. Their mutual location (Δx, Δy, Δz), however, remains the same.



After the successful equalization of the GPS network, the next step is measuring the points from GWB. For this purpose is necessary to measure all the chords between the two referent points and the points from GWB. Static methods are used, implemented with single or double frequency phase measurements with following processing. The duration of the measurements is between 5 and 10 minutes depending on the distance between the referent points and the points from GWB as well as the terrain.

What follows is equalization of the points from GWB against the referent points and thus is completed the link between the local coordinate system and the WGS84 coordinate system. The equalizations themselves are done with firmware or whatever software is available and for this purpose, it is necessary to transform all measurements in RINEX format so they can be input in the corresponding program.

Next step is performing the transformation and defining the coordinates and the heights of the points from GWB in coordinate system 70s. For this purpose, the author has devised the program GpsTrans that does the entire processing. An input file has to be prepared which contains the coordinates of the anchor points and their heights in the two systems and continues with the coordinates and the heights of the detailed points (the points from GWB). The result is saved in a .kpt or .kor file, TPLAN format.

Let's make an approximate calculation how much time this would take. Let's assume that we have five anchor points, 2 referent and 100 points from GWB.

Just the measurement of the anchor and referent points can take at best 2-3 days depending on the season and the number of GPS receivers. For the points from GWB – 10 minutes per point and the same time for movement, so if the workday is 10-hour, that makes around 30 points daily. If there are only two receivers, the time doubles.

It doubles once more because the coordinates of the points from GWB are defined against the two referent points. That means 5-6 more days or almost a week. The total time spent is around 10 days including the processing.

In time and due to the development of technologies, the situation has changed. After 2012, the Russian system GLONASS started to be used, the so called GNSS infrastructure appeared as well. With their help the defining of coordinates in RTK (Real Time Kinematic) mode is like a piece of cake. These are permanent GNSS points with known coordinates. The GPS receivers of the points accept signals from the satellites and define their new coordinates.

The difference between the two types of coordinates is a differential correction. In this mode, by using the internet the GPS receiver, located on the point, connects to the closest point from the permanent network and receives differential corrections from it, thus avoiding largely the influence of the ionosphere.

There is a second type of RTK, which uses two receivers connected with radio connection. The operating principle is similar to the first mode but in this case the distances between the receivers are smaller and the obtained differential corrections reflect more accurately the influence of the ionosphere. Thus, the obtained point coordinates are more accurate as well. This is the so-called user base station.

Fig. 2. GNSS network GEONET

Conclusion and future work

In accordance with instruction № RD-02-20-25 from September 20th 2011 for defining of geodetic points with the help of global navigation satellite systems, in order to develop a geodetic work base the points are defined with: the use of kinematic methods in real time (RTK), performed with dual-frequency phase measurements; or static methods, performed with single or dual frequency phase measurements with following processing. The minimum duration of measurement for each definable point is 30 seconds and the recording interval – 1 second in RTK mode.

When using static methods with following processing, the duration of the measurements is between 5 and 10 minutes, depending on the distance from the referent station and the terrain.

Solution type – fixed, mean squared errors by location and height – up to 5 minutes.

We can immediately make a comparison between the time that was necessary before and now. If the points are defined by using kinematic methods in real time (RTK) at 30 second per point, including movement, that makes around 5 minutes per point. Which means that for a day or two we can now complete work that took 10 days 7-8 years ago.

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Author's name and academic degrees and titles: assoc. prof. eng. Plamen Mihaylov Mihaylov, PhD
Workplace: Faculty of Technical Sciences, Department „Geodesy", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: pl.mihaylov@shu.bg

REGULATORY-RULE OF LAW BASIS TO SOLVE THE PROBLEMS OF PRESERVATION OF CULTURAL HERITAGE

Sabin I. Ivanov

ABSTRACT: *The report analysed the legal framework in the field of cultural heritage, both at local, national and international level.*

KEYWORDS*: Cultural heritage, Legal framework, Cultural values.*

1. Introduction

In international practice there is a tendency to develop and adopt a unified legal framework for the preservation of the world natural and cultural-historical heritage. Numerous normative documents for its conservation have been developed and adopted by UNESCO (UNESCO-United Nations Educational, Scientific and Cultural Organization).

2. Exposure

The first international legal framework protecting world Heritage dates back to 1972, when the General Conference of UNESCO in Paris adopted the "Convention for the Protection of the World Cultural and Natural Heritage, ratified by 182 countries . In the list of UNESCO World Heritage sites recognized as unique of world importance are divided into two groups: monuments of culture and natural sites.

Another important document is the Charter of Cultural Tourism (http://www.icomos.org/charters/tourism_e.pdf), which aims to promote the natural and cultural heritage among the society and emphasizes the need to protect it.

Other documents of international character are: UNESCO Convention for the Protection of the underwater Cultural heritage, UNESCO Convention on the Safeguarding of the intangible cultural Heritage, the European Convention on the Conservation of archaeological heritage and others. They affect a certain type of cultural heritage – underwater, archaeological, intangible cultural heritage, etc.

With the first ratified documents, Bulgaria declares participation in international efforts to preserve cultural values. In fact, many of the conventions and international documents adopted in Bulgaria are linked to the world cultural heritage and relate to sites of such rank.

In contrast to the international level and experience, the preservation and integration of the cultural heritage is far below the European and world level. In Bulgaria, for the first time is regulated the need to collect, protect and preserve the cultural and historical heritage with the adoption of "Law on tracing of antiquities and for the support of scientific and literary Enterprises" in 1890 in 1911 was adopted "Law on Old age ", which aims to register all objects of cultural and historical value, later follows a" law to preserve the ancient buildings in settlements "(SG No. 135 of 20.06.1936). As a result of these laws are published "lists of Old age" (Official Gazette No. 69 of 29.06.1927, PC. 221 of 28.12.1927, PC. 89 of 21.07.1928, issue 33 of 12.05.1934 and issue 37 of 17.02.1939), and for the town of Koprivshtitsa, a plan for the city of Bulgaria. Tryavna, City Plan Nessebar is an established plan in order to preserve ancient buildings and streets in them (Changullev VL, 2014).

Other laws, regulations and regulations, which are relevant for the preservation and preservation of the cultural monuments are: Law for the Bulgarian Trade and Industrial Museum (DV No 99 of 10.05.1907); Law on military graves, cemeteries, tombs, bone-mausoleums and monuments (SG no 165 of 29.07.1942); Rules of Procedure for national, special, commemorative museums in national councils and offices (SG No 44 of 04.07.1965); Ordinance on the device and the work of scientific research groups in the museums to the folk councils and departments; Regulations for the use of architectural monuments (SG No 34 of 28.04.1953); Rules for the removal and maintenance of the underwater monuments of culture and natural attractions of aquatic fauna and Flora (SG no 53 of 07.07.1967); Law on cultural Monuments and Museums of 1969 (with the last am of SG. 30/2006); Ordinance No 5 on tracing, studying and documenting the real monuments of culture (SG 6 of the 19.01.1979); Ordinance No 6 on the use and presentation of the Real Monuments of culture (SG. 30 of 13.04.1979); Ordinance No 17 on determining the boundaries and the regime for use and preservation of real monuments of culture outside the settlements (SG 35 of the 04.05.1979); Ordinance No 11 on the procedure for acceptance of carried out conservation and restoration works on the real Monuments of culture (SG. 25 of the 29.03.1983).

Today, there is still insufficient attention to be paid to preserving the cultural heritage, although it is present in our daily lives. Society is less interested in cultural values, and cultural heritage owners are not motivated to protect them. Cultural heritage located in an urban urbanized environment and a modern, dynamically evolving society is difficult to protect due to economic interests. Only for this reason we can explain how the interior of a

hotel turns out to be a monument of culture of the 11th century of global importance, which is legally, according to the current regulations.

The existing practices for conservation and management of the natural and cultural heritage are not adequate to the modern conditions in Bulgaria. The purpose of the normative system is to protect the cultural values of the country. However, there are a number of examples of illegal exports of cultural goods that prove the real dangers to preserving our cultural heritage. They are a signal of the lack of adequate legal framework and that the current system for the protection of cultural heritage is almost ineffective. This is also the main reason for the accumulated problems during the years of transition in this area.

For the preservation of the national cultural and historical heritage in Bulgaria in 2009 was adopted "Law on cultural heritage" (with the last AM, SG. 52 of 8.07.2016 G), but very little was made for registering the sites and their digitalization. So far, the rich cultural heritage of Bulgaria is not available for online users, precisely because of the lack of an information system. At the same time, discussions on the issues related to the preservation of cultural heritage in Bulgaria continue to be conducted. This unequivocally speaks about the huge gap in the information space regarding the cultural values of Bulgaria.

For Bulgaria the list of cultural monuments of world importance includes: The Old Town in Nessebar (1983), The Boyana Church (1979), The Madara Horseman (1979), The Rila Monastery (1983), The Ivanovo Rock Churches (1979), the Thracian tomb in Kazanlak (1979), the Thracian tomb in Sveshtari (1985) (http://mc.government.bg/page.php?p=46&s=27&sp=32&t=33&z=0). Detailed information about the Bulgarian monuments entered in the list of World cultural and natural heritage of UNESCO is given by the MK of http://mc.government.bg/page.php?p=46&s=27&sp=32&t=33&z=34. Sites of national importance are described in the "lists of immovable cultural values" ((http://mc.government.bg/page.php?p=58&s=244&sp=246&t=0&z=0).

3. Conclusion and future work

In order to build a common concept of heritage conservation, it is not enough just to adopt new normative documents and a strong scientific interest. Firstly, it is necessary to reach the point at which the preservation of cultural heritage will be "understood" and thought to reap the benefits of its existence. Society is poorly motivated for the preservation of cultural values and their future development, and treasure-keeping in a weak economic environment occupies alarming proportions. First of all, we must realise that for every nation it is important that the preservation of the cultural heritage

Bequeused by civilizations lived before us. Integrating the national immovable and movable cultural treasures into the system of European and World heritage is an important strategic resource for the future and a factor for the economic growth of our country.

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Author's name and academic degrees and titles: assoc. prof. eng. Sabin Ivanov Ivanov, PhD
Workplace: Faculty of Technical Sciences, Department „Geodesy", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: s.ivanov@shu.bg

SPATIAL PLANNING AS A TOOL FOR THE CONSERVATION AND MANAGEMENT OF CULTURAL HERITAGE

Sabin I. Ivanov, Krasimir St. Davidov

ABSTRACT: *The report examines the theme of cultural heritage and its conservation as part of the public and professional debate on the development of the regions and their future. Also, the spatial planning of modern settlements as a duty of the specialists is the recording of history in the modern urban structure and spaces.*

KEYWORDS*: Cultural heritage, Legal framework, Cultural values.*

1. Introduction

The problems in the management of territories occupied by cultural monuments are dictated rather by the lack of uniform and sustainable practice, valid for all sites, which ensures security and sustainable development with balanced protection of the interests of all Affected (Ognyanov D. and Collective, 2011).

2. Exposure

Construction or town planning norms must not contradict cultural monuments. Their protection is not only our moral obligation, but also gaining knowledge of the past, because cultural heritage reflects the development of society and the age of which it belongs. The preserved historical buildings, the open spaces (arenas, squares, gardens, etc.), the different cultural strata reveal the past most often of today's major cities and contribute significantly to their value and identity. Often the locals are proud of their heritage and create a positive image and significance of the settlement. This is of course important to preserve the identity of cultural heritage, and to enhance the future sustainable development of cities. The significance of the locality is a major factor in global competition to attract tourists.

Research on the cultural heritage, its location and importance for the development of modern cities are becoming more and more relevant not only in Bulgaria but also at European and global level. The preservation and "entry" of the inheritance in the process of modern and unavoidable changes in the cities is achieved with an acceptable balance between conservation, reconstruction and integration. This balance is also necessary for the development of the modern city and the urban environment. This should take

into account not only the planners, whose main task is to protect the character of the urban environment and its "spirit". But also to keep in mind the views of the inhabitants-those who live in the city and for which it represents a living environment.

The problem of preserving and socialisation of the cultural and historical monuments in the conditions of modern urban development is particularly acute today in Bulgaria. The major cities of the country are developing very intensively. Their central territories are saturated with cultural and historical monuments from different eras, which should be preserved and at the same time must perform numerous functions peculiar to urban life. On the other hand, the dynamic increase in tourist flow increases the interest in these values, which cities acquire a different identity and a new vision. All this creates numerous and serious problems in preserving the different types of cultural and historical heritage that cities possess. In our country are not yet fully exploited the opportunities of territories that are carriers of cultural values and identity.

The legislative framework, which regulates the rules and norms for the management of territories with a concentration of cultural monuments are: the Spatial Planning Act (SG 1/2001), Ordinance No 4 of 2001 on the scope and content of the investment projects (SG. 51/2001), Ordinance No 8 of 2001 on the volume and content of the structure schemes and plans (SG issue No. 57/2001), Ordinance No 7 of 2003 on rules and regulations for the spatial planning of different types of territories and development zones (SG. 3/2004).), Cultural heritage Law (SG No. 19/2009), Ordinance no N-12 of 2012 for the procedure for identification, declaration, granting of status and for determining the category of immovable cultural valuables, for access and subject to registration of the circumstances in the National Register of Immovable Cultural valuables (SG. 98/2012), Ordinance on the scope, structure, content and methodology for elaboration of the plans for the conservation and management of single or group immovable cultural valuables, pursuant to Decree No 45 of 25 February 2011 of the Council of Ministers (SG. No. 19/2011), Cadastre and Property Register Act (published SG. 34/2000), Law for transliteration (published SG. 19/2009), regulations with specific rules and regimes for cultural values issued by the National Institute for Immovable Cultural Heritage, and Ministry of Culture.

The spatial plans, which determine the territorial development of the urban areas with cultural heritage are: the plan for Conservation and management of cultural values, the municipal development plan, the General spatial plan of the city, the detailed zoning The cultural heritage area and the specific rules and norms.

Past practice relating to the conservation and management of cultural heritage, to the extent that it existed, has always been linked to the planning of the Territories in which there are cultural monuments. Most often, the territorial attribute is a separate settlement, complexes, separate structures. For the easy management of such territories, it is established that the cultural heritage is monitored and therefore restored and preserved by the municipalities. The issue of imposing such a model other than financial is related to the political will of the government.

According to art. 17. (1) The ZCN empowers the "Mayors of municipalities to organize and coordinate the implementation of the policy for preservation of cultural heritage in the territory of the respective municipality" and the municipal councils to "adopt a strategy for the preservation of cultural The territory of the respective municipality in accordance with the national strategy under art. 12, para. 2.

The lists of immovable cultural valuables with the category "National significance" are drawn up in areas and settlements and are maintained by the Ministry of Culture. So far, there is only the said information system "Archaeological map of Bulgaria", introduced in 2011 with a description only of the archaeological sites in the country. On the data of the automated information system on our territory are known more than 16 000 archaeological sites with a tendency to increase their number. Unfortunately, here the word "card" is not suitable because the information system is not a type of GIS to represent the spatial location of the sites that represent cultural heritage.

3. Conclusion and future work

Here it is important to emphasize the need to create specialized maps of the QIN. The presence of a representative, accessible and easy to read by the public, including all the persons concerned, digital information would not allow the "legal" building of "illegal" for the purposes of the SPATIAL planning, especially when they threaten Cultural monuments.

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Author's name and academic degrees and titles: assoc. prof. eng. Sabin Ivanov Ivanov, PhD
Workplace: Faculty of Technical Sciences, Department „Geodesy", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: s.ivanov@shu.bg

Author's name and academic degrees and titles: assoc. prof. eng. Krasimir Stoyanov Davidov, PhD
Workplace: Faculty of Technical Sciences, Department „Engineering logistics", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: k.davidov@shu.bg

2D AND 3D COMPUTER MODELING

Sabin I. Ivanov

ABSTRACT: *The report analysed the legal framework in the field of cultural heritage, both at local, national and international level.*

KEYWORDS*: Cultural heritage, Legal framework, Cultural values.*

1. Introduction

The report examines modern technologies, enabling the detection, restoration and preservation of cultural monuments. For this, the digital cards and especially 3D models, as well as the so-called virtual models.

2. Exposure

It is known that historical methods provide a wealth of information about the monuments and landscapes before their damage, destruction or deletion from the surface of the Earth due to the impact of natural processes and weather. Modern technologies allow for their detection, restoration and preservation. Again, with the help of new technologies, it became possible for tourists to explore and improve the presentation of cultural objects in their authentic form. For this, the digital cards and especially 3D models, and so on virtual models, are many examples. The application of this knowledge in the present for an urbanized environment depends on the objectives of restoring cultural sites and the state of the landscape.

The creation of digital models of objects and surfaces is an area that is constantly evolving and improving. New techniques and tools are created to facilitate the preparation of the models.

2D and 3D computer models are the result of the processing of the technologies described here – photogrammetric, satellite, laser scanning, very often combined with the GNSS to determine the exact location of the sites and the invaluable help of the GIS with opportunities for Their storage and visualization.

2D images and maps provide a lot of information about historical events and monuments and surrounding space. However, the viewer must rely on the legend of the map and the scale that determines the details, as well as other information to imagine the historical environment. In 2D images, the majority of card readers must intuitively detect objects compared to 3D visualizations.

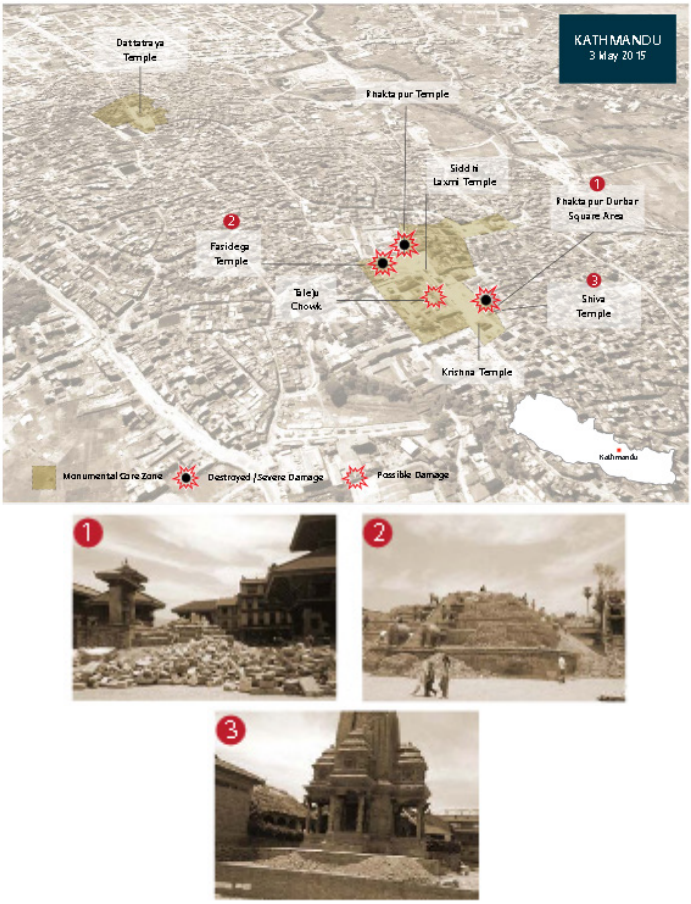

Fig. 1. 2D image of the destroyed cultural heritage sites in the Kathmandu Valley, Nepal: 1) Bhaktapur Durbar Square; 2) Temple Fasidega; 3) The Shiva Temple
Source: Digital Globe WorldView 2 © 2016, 3 May 2015. Image analysis: UNITAR-UNOSAT.

In Fig. 1 is an example of using a satellite image to assess the damage to the cultural heritage located at the foot of the Himalayas. The 2015 earthquake heavily affected most of the cultural heritage sites in Nepal, especially in the Kathmandu Valley (http://en.unesco.org/system/files/full-chs-report_28062016_final.pdf). World Heritage was entered in UNESCO in

1979. This area includes seven monuments of culture: the Durbar Squares or the city centers with their palaces, temples and public spaces of the three Cities Kathmandu (Hanuman Doha), Patan and Bhaktapur, the two Hindu centers of Papaspatinate and Chang Narayan and the two Buddhist center Swayambunath and Boudhanath.

UNOSAT is a program of UNITAR (United Nations Institute for Training and Research) for UN operational satellite applications. With the efforts between UNOSAT and UNESCO, a study was carried out on the destruction and damage of world cultural heritage in Iraq, Syria and Yemen as a result of the ongoing armed conflicts and devastating earthquake that affected Nepal in 2015.

The monitoring of cultural heritage in affected areas by conflicts or natural disasters, through the use of satellite imagery, is an important step in preserving the memory of our past.

The creation and use of three-dimensional models, their accuracy, detail, attractiveness and virtuality are subject to theoretical research and research developments in the field of Fotogrametriâta and laser scanning technology in Recent years. Their actuality nowadays is unmistakable and the speed of development is characterized by increased dynamics due to the opportunities offered by the technologies.

More important areas of application of 3D digital object models in the field of the QIN consist in: preparation of specialized documentation for each cultural monument; Creating photo plans of facades (Fig. 2a); Creation of architectural plans and drawings (Fig. 2b); Restoration of details and facades.

a) b)

Fig. 2. Examples of 3D digital models of architectural monuments

3D models of sites with concentration of objects of cultural and historical heritage allow users to easily find the information they are looking for. 3d models combine the digital models of relief and cultural monuments

located on the Earth's surface. Thus they provide the best possible visual representation of them and the environment and are easier to navigate in the space (Fig. 3).

Fig. 3. The most notable monument "Colosseum" in Rome and its surroundings, Source: https://www.airpano.ru/files/Italy-Rome-Colosseum/2-2

The high accuracy of the three-dimensional digital models obtained on the basis of new technologies (for example, in laser scanning, photogrammetric photos performed with drones) provide all possible requirements for documenting the objects of Culture from a broader territory to the smallest details and ornaments with graph accuracy in 1:1 scale, such as incisions, murals and façade plans of buildings Fig. 4 and Fig. 5.

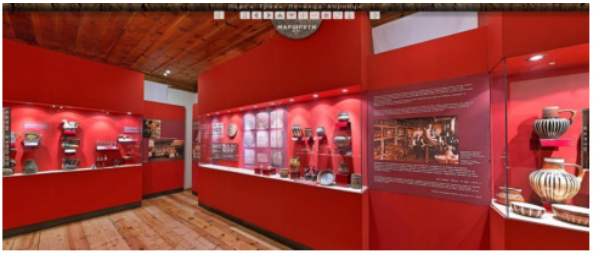

Fig. 4. Example of a three-dimensional interior modeling "Historical Museum, town of Apriltsi. Source: Koeva M., 2015

Fig. 5. Examples of 3d modeling of cultural objects in Bulgaria: 1) Church "St. Constantine and Helena" Archangel Michael ", Obzor Letnitsa 2) "Troyan Monastery", Obzor Troyan
Source: Koeva M., 2015

Combining 3D models with spatial databases (or 2D) complements the mapping image within the framework of environmental management.

3. Conclusion and future work

There are factors that limit the effectiveness of 3D visualization tools. For example, increasing the details in the information reduces the user's ability to interact with the visualization of the objects as a whole. Increasing the details also increase the cost of creating the 3D model. On the other hand, GIS data will require specialized software for 3D modeling for which new skills are needed outside the traditional GIS work and too much time and effort to create undoubtedly beautiful, realistic and tempting graphics for the user.

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Author's name and academic degrees and titles: assoc. prof. eng. Sabin Ivanov Ivanov, PhD
Workplace: Faculty of Technical Sciences, Department „Geodezy", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: s.ivanov@shu.bg

STRUCTURE AND CLASSIFICATION OF SECTS

Tihomir I. Solakov

ABSTRACT: *Different theological and religious schools use terms such as sect, totalitarian sect, cult, destructive cult, new religious movement, non-traditional religious movement, etc. to refer to different shades of the same phenomenon, the common thing among all concepts being that they are directed against traditional denominations. Moreover, each of the schools invests special importance in these concepts, since without exception all sects are hostile to orthodox denominations, no matter what specific denomination they represent. In carrying out their activity, the sects have a well-built pyramidal structure, which is what they all have in common. But the differences between all sects are manifested in their classification, based mainly on their distinctive features, such as outlook on life, lifestyle, cult, value system, etc.*

The purpose of this exposition is to review the structure and to classify the sects.

KEYWORDS: *Sect; Structure of the sect; Classification of sects.*

1. Introduction

Sects have a pyramidal structure at the foundation of their construction[1], ensuring strict control and uniformity in the organization[2], headed by the founder or leader (president, guru, priest or priestess, etc.) to whom a certain circle of immediate associates are subordinate (sub-leaders) who have other, younger assistants (students). And these, respectively, are leaders of even younger students - and so on to the very foundation of the pyramid - the regular members of the sect.[3] From a different perspective, administratively, the structure of the sect is strictly centralized

[1] Отдел по взаимодействию с Вооружёнными силами и правоохранительными учреждениями, „Что такое секта?“, http://v-pobeda.ru/index.php?option=com_content&view=article&id=62:2012-01-19-07-03-07&catid=40:2012-01-19-05-12-45&Itemid=66

[2] Полетаева Татьяна (Poletaeva Tatyana), „Православная культура. История и традиции. В 2 ч. Часть 1 3-е изд., пер. И доп.“, издательство Юрайт, 2018, page 38, https://books.google.bg/books?id=NWB2DwAAQBAJ&pg=PA38&lpg=PA38&dq=структура+секты&source=bl&ots=JkWGxDrVSn&sig=ACfU3U0fEPB7Vzyxq8WGTVsYTa7bIH2NTQ&hl=en&sa=X&ved=2ahUKEwjy47aojvDgAhVqwqYKHavsBsU4FBDoATAFegQIBhAB#v=onepage&q=структура%20секты&f=false

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and hierarchically constructed, with each member occupying a specific position within the sect and obliged to strictly fulfil his/her functional duties in order to ensure the successful activity of the whole organization. [4] Obedience to the guru and his assistants is unquestioned, implicit and subject to no criticism at all levels. [5]

Structure of the sects

Structurally, sects can be divided into two groups:

- first generation sects in which the founder(s) of the sect or group is(are) still operating;

- second (and more) generations sects in which the founder has retired from active missionary activity, and the sect is governed by his faithful followers. The main differences are in the permissible level of cynicism with regard to the creed in the circles of the leadership of the sect. Definitely in the first-generation sects this level is higher.

Hierarchically the sects are organized as follows:

a.) The leader of the sect (a person or a board).

If it is a first-generation sect, the head of the sect may be an atheist and a cynic who for one reason or another has created this sect, or a fanatic with a messianic obsession.

If it is a second or third generation sect, when the leadership comes from the lower levels, then those chosen and raised by the sect are moved to the top of the hierarchy because they have the highest abilities, but those abilities are guided by the sect in a direction favouring the sect.

b.) High level - adherents from the closest circles of the leader or leadership of the sect.

When it is a first-generation sect, the members of the so-called "high level" may be cynics and atheists, but among them there are already some uniquely educated individuals by the sect itself.

If it is a second-generation sect, we mean that these are potential candidates for future leaders and they are in fact responsible for everything that is going on in the sect.

c.) Middle level.

[4] Аникин Д.А. (Anikin D.A.), „История религии: конспект лекций“, https://www.e-reading.club/chapter.php/97498/71/Anikin_-_Istoriya_religii___konspekt_lekciii.html

[5] Полетаева Татьяна (Poletaeva Tatyana), „Православная культура. История и традиции. В 2 ч. Часть 1 3-е изд., пер. И доп.“, издательство Юрайт, 2018, page 38, https://books.google.bg/books?id=NWB2DwAAQBAJ&pg=PA38&lpg=PA38&dq=структура+секты&source=bl&ots=JkWGxDrVSn&sig=ACfU3U0fEPB7Vzyxq8WGTVsYTa7bIH2NTQ&hl=en&sa=X&ved=2ahUKEwjy47aojvDgAhVqwqYKHavsBsU4FBDoATAFegQIBhAB#v=onepage&q=структура%20секты&f=false

At this level there are only true believers who have already studied the doctrine of the sect. They carry out all the basic organizational work, they are "junior officers" - heads of gatherings, communities, local gurus and so on. Any adherent with more or less understanding can penetrate this level. They are the main pillar of the sect.

d.) Low level.

These are foolish adherents and/or those that are less engaged in the activities of the sect, or new recruits. Their activity mainly takes place at the level of rituals and gatherings. They are assigned the drudgery - invitation to the halls, meetings, sermons and clarification of the basics.

e.) New recruits and doubters;

These are adherents who have not yet been crushed in the meat grinder of the sect, that is, those who have just entered the sect but have not yet converted and are still in doubt. They are mainly manipulated through persuasion with repeated conversations during which "spiritual nourishment" and "divine truth" are poured on them. They are the eternally leaking foundation (in the sense of members turnover) at the base of the pyramid. [6]

2. Classification of sects

The term sect can be applied to thousands of communities, movements and groups. Each one of them has its own distinctive features: outlook on life, lifestyle, cult, value system and more. The classification of sects is an extremely difficult task because of the lack of a universal criterion according to which they can be classified. Each science that deals with them classifies them in its own way, according to what it studies (sociology, political science, psychology, social psychology, etc.). [7]

There is no single commonly accepted classification of sects. This is due to the difficulty of defining clear parameters, the presence of which would allow a type of community to be assigned to a particular group of sects. For example, Mormons call themselves Christians and talk a lot about Christ, while their doctrines are clearly occult in nature and incompatible with any form of traditional Christianity. Quite often, the same organization may have features that allow it to be classified into completely different categories of sects. Therefore, when assigning the definition of sect to one group or another, it is necessary to bear in mind a certain degree of

[6] In this context see http://shiza.demiart.ru/kuzmich/religion/sekta.shtml

[7] Божков Бисер (Bozhkov Biser), „Сектанство, сектите и Православната църква“ (Sectarianism, sects and the Orthodox Church), 29.08.2012, 2012/08/29/сектантството-сектите-и-православ

conventionality of the classification being made. For a general understanding of the problem, there are several types of classifications: [8]

2.1. Classification by origin and sphere of influence - within this classification, sects can be divided into: [9]

- **Western** - i.e. sects originating from Europe and America, which have Christian roots (e.g. Jehovah's Witnesses, Mormons);

- **Eastern** - i.e. sects based on manipulated and distorted Hinduism, Buddhism, Islam (for example, the Society for Krishna Consciousness, Brahma-Kumaris);

- **national** - operate only within a specific country - for example, Russian sects such as the Church of the Last Testament (Vissarions), the Mother of God's Centre;

- **transnational** sects (international). This includes sects that have a network of branches throughout the whole world (for example, the Moon sect, Jehovah's Witnesses).

2.2. Classification according to the principle of self-definition or imitation: [10]

- pseudo-Christian sects - define themselves as a Christian denomination. This type of groups is characterized by: distortion of the Holy Scripture's interpretation compared to traditionally established theological schools, the presence of their own "revelations", which are more important to the sectarians than the Divine biblical revelation, the heightened negative attitude to traditional Christianity, the proclamation of their specific conditions for salvation. Typical representatives of this type of sect are the Witness Lee Local Church, the Boston Movement, the Family (Children of God), the Faith Movement, the Mother of God's Centre, the Last Testament Church, the Mormons, Jehovah's Witnesses and more.

- pseudo-eastern sects - a stylization of science, a "game" in science. At the same time, there is a total absence of scientific criteria for solving problems. Bear in mind that the basic criterion of science is the experimental demonstration of approved provisions. The multitude of claims

[8] Севастополски Православен университет (Sevastopol Orthodox University), „Знаци и класификация на секти" (Signs and classification of sects), http://sev-orth-univ.ucoz.ru/publ/lekcii/sektovedenie/lekcija_2_priznaki_i_klassifikacija_sekt/13-1-0-140

[9] Севастополски Православен университет (Sevastopol Orthodox University), „Знаци и класификация на секти" (Signs and classification of sects), http://sev-orth-univ.ucoz.ru/publ/lekcii/sektovedenie/lekcija_2_priznaki_i_klassifikacija_sekt/13-1-0-140

[10] Севастополски Православен университет (Sevastopol Orthodox University), „Знаци и класификация на секти" (Signs and classification of sects), http://sev-orth-univ.ucoz.ru/publ/lekcii/sektovedenie/lekcija_2_priznaki_i_klassifikacija_sekt/13-1-0-140

contradicting the scientific, i.e. experimentally justified, conclusions can only be regarded as pseudo-science. In such organizations, there is only one criterion for the truth of each statement - the opinion of the head of the organization. Such groups can be called scientific in form and occult in content. Typical representatives of this type of sects are Brahma-Kumaris, the cult of Satya Sai Baba, Sahaja Yoga, the cult of Osho Rajneesh, Tantra-Sangha, the cult of Sri Chinmoy, the Society for Krishna Consciousness and others.

- **pseudoscientific** (parapsychology, Scientology, etc.) - a stylization of science, a "game" in science. Here too, there is a total absence of scientific criteria for solving problems. Here too, the criterion for the truth of each statement is the opinion of the head of the organization. Typical representatives of this type of sects is the sect of Scientologists.

- **health cults** - acceptance of the priority value of physical health and longevity is common to this group of sects; it is claimed that these can be acquired along the path of this movement. In this case, either the leader is deified, as is the case with the magician Porfiry Ivanov, or the method, such as rebration, is sacred, or a prophetic gift is attributed to the founder of the sect, as the founder of the Christian Science movement, Anne Morse Baker. Typical representatives are the followers of Porfiry Ivanov, rebirth (breathing psychotechniques), "Christian Science" and more.

- **occult schools** - claim to possess some "secret knowledge" that empowers the "powers of the universe", practices the system of "esoteric initiations", opening up supernatural abilities, the possibility of a new vision and understanding of the structure of the world. They have a developed philosophy of human worship. Typical representatives are agni yoga, theosophy, anthroposophy, astrology, magic, extrasensory perception, bioenergy, chiromancy and more.

- neo-paganism - aims at reviving pagan cults using occult “stuffing” and folk “clothing”. In order to confirm their historical legitimacy, the neo-pagans draw parallels between Slavic and Indian mythologies. Seeking to convey to their teaching the authority that it originates from antiquity, they proclaim that it preserves the sacred traditions of the ancient Slavs, who have come to us through secret adherents of paganism. In conclusion, it can be said that the neo-pagans form their own "religion", and most modern neo-pagan sects do not really have a real historical connection with ancient paganism. Typical representatives are Veda, Werewolf, Vyacha, Indianists and others.

- **commercial sects** - all organizations that have a pyramidal structure and place ideology at the foundation of trade. The business activity of organizations of this type is painted in mystical tones. A salvage idea is

declared, for example, for the salvation of humanity from obesity with the help of the "miracle product." A myth is created about the extraordinary appearance of the "miracle product", claiming the elitism of the members of the organization over the other members of the society. A typical example is the Herbalife organization.

2.3. Sects can be classified by type of religious leadership[11] into the following types:

1) **charismatic sects**, the emergence and activity of which are associated with the appearance of certain prophets, etc.; such religious organizations include, for example, certain sects of spiritual Christians;

2) **authoritarian sects** whose leadership is based on lasting traditions, customs related to origin, the genealogy of "leaders"; these sects include Doukhobors (Spirit warriors), Molokans and others;

3) **hierarchical sects** or sects of the church type; the members of these organizations are subordinate to the leadership, not because of the personal merit of the leaders, but as a result of the belief that they have been given their posts on the basis of the sect's charter (Mennonites, Baptists, Evangelists, etc.);

4) **theocratic sects** seeking to establish a religious-theocratic organization; Jehovah's Witnesses, among others, can be assigned to this type of sect.

2.4. Theologians classify sects according to the way in which they essentially formulate their doctrine and the outward ritual, classifying them into two main groups:

a) **Rationalist sects** — on matters of faith and salvation and in the interpretation of the Holy Scripture — their followers are guided not by the holy tradition and the authority of the Universal Church, whom they deny, but by the free human mind. Such sects are, for example, the Lutherans, Calvinists, Baptists, Adventists and more. [12]

b) **Mystical sects** - their followers, also denying the authority of the Church, consider the source of their creed to come from personal enlightenment or ecstasy, during which they supposedly receive the revelation of God's will directly from God through the Holy Spirit. Such sects

[11] https://psyfactor.org/sekta9.htm

[12] Калнев Михаил Александрович (Kalnev Mihail Aleksandrovich), „Щит на вярата“ (*Shield of Faith*), Hr. Chervenakov-Mitko Publishing house, Veliko Tarnovo, 1994, http://symvol.org/simvolnavqrata/index.php/religii/hristiqnski-eresi-i-sekti/protestantstvo?id=60

are, for example, the Quakers, Swedenborgians, Irvingians, Eunuchs, Russian Khlysts, the Universal White Brotherhood, Pentecostals, among others[13].

2.5. Another way of classifying new religious organizations is by the following criteria: by the time of their emergence; by the type of religious leadership; by their origin and sphere of influence; on the principle of self-determination or orientation; by field of activity; by source. [14]

2.6. The World Dictionary of Sociology states that there are two types of sects: Gnostic and conversion[15], this classification determines the classification of sects only by manifestations of a religious community within the ethnic communities.

2.7. Another type of classification is associated with the manifestations of sects within society[16] according to which they are:

- aggressive - sects seek to increase the number of their members at all costs by all means possible. Typical representatives of these sects in our country are the Insight Seminars, the Silva Method and Scientology;

- tolerant - the sects reject violence and have no particular social significance;

- Assimilating - sects which form concessions under pressure from the environment but retain their autonomy. A typical example of assimilating sects is the Church of the Last Testament/Vissarion and Anastasia;

2.8. Classification according to the degree of harm to society

Criminologist Y. Dumby[17] proposes a modern classification according to the degree of harm the sects cause, classifying them into three groups:

- illegal - prohibited by law. These sects openly encourage their followers to commit crimes;

- potentially illegal - not prohibited by law. These sects, when applying many provisions of their religious doctrine (rituals), require their followers to commit crimes and/or other offences;

[13] Калнев Михаил Александрович (Kalnev Mihail Aleksandrovich), „Щит на вярата“ (*Shield of Faith*), Hr. Chervenakov-Mitko Publishing house, Veliko Tarnovo, 1994, http://symvol.org/simvolnavqrata/index.php/religii/hristiqnski-eresi-i-sekti/protestantstvo?id=60

[14] Демидов А. (Demidov A), Dissertation paper: „Религиозные организации деструктивного характера и специфика предупреждения органами внутренних дел их криминальной деятельности“, Moscow, 2010, page 79, file:///C:/Users/user/Downloads/klassifikatsiya-netraditsionnyh-religioznyh-organizatsiy-po-stepeni-ih-destruktivnosti.pdf

[15] Abercrombie, N Hill, S Turner, Dictionary of Sociology, Burgas, 1993, page 277.

[16] Кръстев, Г. (Krastev G.), Религиозните общности как да ги разбираме (Religious communities – how to understand them), Сп. „Обществено възпитание” (*Public Education* Magazine), кн. 5, 1994, page 30.

[17] Смирнов Семен (Smirnov Semen), „Секти!“ (Sects!), 18.10.2016, https://rvs.su/statia/sekty#hcq=1Gl4Cir

- provisionally illegal - not prohibited by law. These sects cause mental and physical harm to the health of the followers of these associations.

In conclusion of this exposition, the following conclusions can be drawn here:

- there are various ways and manners of classifying sects, but the best approach in this case is to classify them according to the philosophical concept on which sects build their foundations, views and dogmas.

- from the point of view of national security, the most accurate classification in terms of the degree of harm that can be inflicted by the sects upon society is the one proposed by criminologist Y. Dumby.

3. Conclusion and future work

In summary of the foregoing, the following conclusions can be drawn:

1. Sects have a well-structured pyramidal structure, and regardless of which level the adherents are, they are obliged to observe the subordination and to obey the elders in the hierarchy, and especially the guru. The instructions and orders of the superiors on the subordination ladder are a law and compliance is strictly mandatory.

2. In view of the above, it can be concluded that there is no generally accepted classification of sectarian organizations, since the diversity of forms of non-traditional religiosity of the modern society does not allow us to describe it within any one or several of those classifications, even if we use the most sophisticated terms. This is due to the difficulty of defining clear parameters, the presence of which would allow a type of community to be assigned to a particular group of sects. The latter makes it possible to assume that sectarianism is a complex system of intertwined elements which, to a greater or lesser extent, associate them with a particular classification.

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Author’s name and academic degrees and titles: Tihomir I. Solakov, PhD
Workplace: Faculty of Technical Sciences, Department „Management of security systems“, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: tihi35@abv.bg

SECTS AND THEIR CHARACTERISTIC SIGNS

Tihomir I. Solakov

ABSTRACT: *In our world, along with traditional spiritual organizations, there are many sects. In its essence, a sect is a group or community of people who have been recruited with certain ideas, most often based on religious and spiritual grounds, to obey their leader, who in turn constantly "zombies" members of his sect, penetrating their conscious and subconscious mind, thus making them highly dependent people. The purpose of each sect is to raise money, to own apartments, cars, real estate. The more gain can be obtained from a member of the sect, the more attractive they become in the ranks of the sect, with special emphasis placed on attracting new members. Eventually, the sectarians themselves are so convinced that they are in the right place and on the right path that they try in every way possible to fill their ranks with relatives, brothers, sisters or just acquaintances they meet on the street.*

The purpose of this exposition is to look at the signs by which one can determine whether a religious teaching is a sect.

KEYWORDS: *Sect; Signs of sectarianism.*

1. Introduction

"Sect", translated from Latin, means all of the following: "path, rule, direction, teaching, way of thinking, false teaching, heresy, gang." Some of these meanings very accurately describe what modern sects are by definition. Joining the ranks of a sect, one rarely realizes exactly where they have ended. In the sect itself, the following terms are used to deceive newcomers or those who come to see out of curiosity: ashram, school, monastery, institute, brotherhood, etc.[1]

2. Main text

Quite often, an attractive message is posted at the entrance of your block of flats or at the bus stop, inviting anyone with the desire and time to attend an interesting yoga lecture, meditation seminar, or a collective psychology lesson. As a result, people intrigued by the message decide to attend the event. In the course of the lecture, some of the people who attend such a gathering for the first time begin to wonder if it is a sect or they have just found themselves at some innocent gathering of people. In view of the

[1] Саторин И. (Satorin I.), Психология PRO, Признаки секты, 02.12.2009, https://progressman.ru/2009/12/sekta/

latter, to determine whether or not it is a sect, there are several signs by which it is easy enough to accept or dismiss our doubts. Provisionally, the signs of a sect can be divided into two large groups: socio-psychological and doctrinal (ethical-theological).

Socio-Psychological

German religious scholars distinguish the following socio-psychological signs of totalitarian sects: „The secular interpretation of the concept of sect includes such aspects as the threat to the state and society in the context of criminal law, training of special staff obliged to obey orders with complete psychic self-denial, collective loss of sense of reality with particular attention to the community, personal humility and piety that violates fundamental human rights in the process of being treated as a member of an association.“[2]

Political structures also contribute to the indication of signs of sectarianism. For example, the French Parliament gave the following definition of destructive sects at its session on 10 January 1996: "Sects are groups identified by their manipulations aimed at the psychological destabilization of their adherents in order to obtain their unconditional obedience, by suppressing their critical thinking, breaking away from generally accepted recommendations (ethical, scientific, civic, general), thus presenting a threat to individual freedoms, health, education, democratic institutions. These groups use philosophical, religious, or therapeutic disguise to conceal the goal of gaining the power, influence, and exploitation of adherents.”[3] The foregoing is the outcome of report No 2468 of the Commission of Inquiry into the activities of the sects in the Parliament of France, which stated that "numerous and varied crimes committed by sects were identified in the course of the investigation. In the first place, these include crimes involving physical assault of a person, such as abuse, bodily harm, battery, unlawful imprisonment, denial of assistance to people in danger, or abuse of medicine. In addition, in many cases, sects have been accused of spreading false information, defamation, and violating the right to privacy.“ [4]

According to Alexander Dvorkin, a professor of church history at the Russian Orthodox University, sects have the following signs: "The signs of a sect are fraud in recruiting new members, psychological abuse, controlling all

[2] Мирошникова Е. (Miroshnikova E.) „Церковь“ и „секта“ в немецком религиоведении. Религия и право № 4- 5. М.: Religion and rights Institute, 1999 - page 34

[3] Московская Патриархия (Moscow Patriarchy), „Секты против Церкви“, 2000 - page 264.

[4] Секты против Церкви, the indicated collecten, page 495.

aspects of the life of its members and the existence of mechanisms for exerting such control, different levels of truth for different levels of the organization, deification of an existing leader or the organization itself and a number of other signs, easily recognizable and quite specific." [5]

On 12 February 1996 the European Parliament adopted a Decree aimed at restricting and abolishing the activities of sects on the territory of the Member States of the European Union. It states the following: "... certain sects, whose organized structures are not limited to a particular country and function throughout the whole European Union, are constantly violating human rights and committing criminal acts such as: abuse of people, sexual harassment, unlawful imprisonment, trafficking in human beings, incitement to violence, the spread of racist views, tax evasion, illicit transfer of capital, trafficking in arms and drugs, violation of labour law, illegal medical practices. ... We call upon the governments of the Member States not to automatically grant the status of a religious organization and, in the case of sects involved in illegal or criminal activities, to find a way of depriving them of their status as a religious association, which guarantees them tax relief and some legal protection" [6]

The special services of the French Ministry of Interior (Sûreté Générale - universal security), when dealing with the activity of sects in particular, have formulated ten signs[7] for the identification of sects:

- destabilisation of the mind;
- excessive financial claims;
- the imposition of a breakaway from the previous environment;
- deterioration of physical health; enrolment (recruitment) of children;
- anti-social statements; disruption of public order;
- court trial or investigation into serious charges;
- disruption of economic activity (concealment of funds);
- attempts to penetrate power-wielding institutions;

In identifying at least one of the above signs, the Special Services of France accept that there is a sect.[8]

In a published leaflet, the Government of the Federal Republic of Germany lists 17 signs of a totalitarian sect[9], which are:

[5] International scientific-practical conference "Totalitarian sects - the threat of the 21st century". Nizhny Novgorod, The indicated collection, 2001. p. 142

[6] International scientific-practical conference "Totalitarian sects - the threat of the 21st century". Nizhny Novgorod, The indicated collection, 2001. p. 24

[7] Прозрение. Православный информационно-просветительский журнал. N 2(5). M.: Moscow Patriarchy, 2000г. - page 48

[8] Бангерски Александър (Bangerski Aleksandar), „Франция объявила войну сектам“, 26.08.2002, http://jesuschrist.ru/news/2002/8/26/1894#.XG6JT2YzbIV

1. In this group you will find what you have been looking for in vain. The group knows what you miss.

2. The very first meeting gives you a whole new perspective on things.

3. The group's point of view is amazingly simple and explains every problem.

4. It is difficult to accurately characterize the group. You should not think or check. Your new friends say: "It's impossible to explain, you have to go through it - come with us to our Center now."

5. The group has a teacher, medium, leader or guru. Only he knows the whole truth.

6. The teaching of the group is considered to be the only true knowledge, forever and ever. Traditional science, rational thinking, reason are rejected because they are negative, satanic, unenlightened.

7. Out-of-group criticism is seen as proof of its correctness.

8. The world is headed for disaster, and only the group knows how to escape from it.

9. Your group - this is the elite. The rest of humanity is gravely ill and deeply lost: because they do not cooperate with the group or do not allow it to save you.

10. You must immediately become a member of the group

11. The group distinguishes itself from the rest of the world, for example through clothing, food, special language, strict regulation of interpersonal relationships.

12. The group wants you to break off from your old relationships because they hinder your development.

13. Your sexual relations are regulated externally. For example, the leader chooses the partners, prescribes group sex, or, on the contrary, complete abstinence.

14. The group fills up all your time with tasks: selling books or newspapers, recruiting new members, attending courses, meditations ...

15. It is very difficult to be alone, a person from the group is always with you.

16. If you start to doubt, if the promised success does not come, then you will always be to blame yourself because it is assumed that you are not working hard enough on yourself or do not have enough faith.

17. The group requires absolute and unconditional adherence to its rules and discipline, as this is the only way to salvation.

[9] Институт менеджмента и права, „Система мер предупреждения деятельности запрещённых сект в РФ“, Екатеринбург, 2017, http://elar.uspu.ru/bitstream/uspu/5479/1/15Sherstobitov2.pdf

Doctrinal (ethical-theological) signs of a sect

Believers' world outlook is based on the dogmas and the doctrinal position that are paramount to the followers of any religion, as they together form the believers' world outlook. They are, therefore, related to the whole structure of human life, including its psychological, mystical and ethical aspects. From the foregoing, it becomes clear that topics of dogmatic character are of great importance to the individual when referring to sects. In support of the foregoing, Western scholars give the following indications of sects: "From a theological point of view, the characteristics of a sect can be defined as: exaggerated attention to one aspect of religion, the role of teacher, leader, charismatic leader requiring unconditional obedience, the concept of exceptional salvation for members of the community."[10]

Based on the Holy Scriptures, the following signs of sectarianism can be distinguished[11]:

- The founders of the sects often present themselves as new incarnations of Jesus Christ (for example, Vissarion), or declare that they have come to complete the mission of Christ, which they do not consider fulfilled. Almost all sectarian movements seek to "correct" the Gospel or its interpretation. This is usually done for "good" purposes, that is, to purify the Gospel from the "false" interpretations of Christians.

- Pseudo-Christian sects often reject the orthodox dogmas of the historical church. For example, the teaching of the Holy Trinity: they either pervert it, such as the Mormon sect that preaches Tritism (the union of three gods), or reject it altogether, given paganism, such as the Jehovah's Witnesses sect. ".

- The occult sects emphasize personal mystical experiences, placing them at the heart of their creed.

- Sect leaders often claim prophetic gifts.

- Sects often escalate eschatological feelings among their followers, sometimes naming a specific date for the end of the world.

- In the occult sects there is a constant need to discredit the mind, preference is given to the methods of "intuitive" knowledge, rational thinking is declared wrong. The occultist's logic and rational thinking are secondary to mystical insights.

3. Conclusion and future work

[10] Религия и право (religion and law) №4-5, Указ. изд., page 34

[11] Питанов В.Ю. (Pitanov V. Yu.), „Введение в сектоведение", page 13, http://ter-hambardzum.do.am

Summarizing the above, it can be concluded that sects use deception to recruit followers, committing psychological violence to control all aspects of their members' lives, applying mechanisms for such control upon different levels of truth relevant to the different levels of the organization, and last but not least, deifying the existing leader or the organization itself, etc. The various public (including security and law enforcement) and spiritual institutions, according to the manifestation of sects in the respective country, define different signs of the sect according to their manifestation, impact, activity and orientation. Defining the above-mentioned signs, the respective country takes the necessary steps to bring them to the awareness of the people, in order to protect them, and especially the adolescents, from the destructive effects of the sects. Following the example set by France and Germany, signs of sects should be similarly identified in Bulgaria, and they should be brought to the awareness of the Bulgarian people, since sects are inherently a threat to national security.

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Author's name and academic degrees and titles: Tihomir I. Solakov, PhD

Workplace: Faculty of Technical Sciences, Department „Management of security systems“, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: tihi35@abv.bg

PROTECTION AND DEFENSE OF CLASSIFIED INFORMATION IN THE JUDICIARY IN THE EVENT OF WAR, MARTIAL LAW OR OTHER EMERGENCY, DISASTERS AND ACCIDENTS

Svetlin E. Stefanov

ABSTRACT: *In this paper Protection and defense of classified information in the judiciary in the event of war, martial law or other emergency, disasters and accidents is made.*

KEYWORDS*: Classified information, Disasters, Martial law, Protection.*

1. Introduction

Organizational units handling classified information must draw up a plan for conducting measures to ensure the protection of classified information in the event of a declaration of war, martial law or other emergency, disasters and accidents. Part of documents and materials containing classified information, computers [6], [7] from the registry of which classified information is created, and other tangible media are subject to protection.

A state of war, martial law or **a state of emergency** shall be declared by a decision of the National Assembly or by decree of the President of the Republic in the order established by the Constitution and shall be announced by all mass media. The act of declaring a state of war or martial law indicates the statutory acts whose action is suspended.

With the introduction of a state of war or martial law, or with the actual commencement of hostilities, the President of the Republic forms the Supreme Command. The defense of the country and the provision of the internal order are under the authority of the Commander-in-Chief and the bodies established by him for the defense leadership [1], [2], [3], [4], [5].

A state of war is declared in the event of an armed attack on the country or, if necessary, the immediate fulfillment of international obligations. The beginning and the day of the declaration of war or the time of the actual commencement of hostilities shall be taken as the beginning of a state of war. After declaring a state of war, the tasks under strategic, operational and wartime plans begin.

In the event of a sudden armed attack on the territory of the country, the Armed Forces shall take all necessary measures to repel the attack without waiting for a declaration of war.

Martial law is declared threatened by an armed attack or by war on all or part of the territory of the country. The beginning and the day of the declaration of martial law shall be considered as the beginning of the martial law, and the hour and the day for declaring a state of war or cancellation of martial law shall end. Following the declaration of martial law, the tasks under strategic, operational and wartime plans, or the part of them corresponding to the degree of threat, shall be started.

A state of emergency is declared in case of danger of involvement of the Republic of Bulgaria in a military-political crisis or in an armed conflict. The beginning and the day of its announcement shall be considered as the beginning of the state of emergency, and the hour and the day of its cancellation shall end [1], [2], [3], [4], [5].

The acting Bulgarian legislation defines a disaster as "an event or series of events caused by natural phenomena, incidents, accidents or other extraordinary circumstances that affect or endanger the life or health of the population, property or environment to an extent requiring action or participation special forces and the use of special resources".

An accident is a large-scale incident involving roads, highways and air traffic, fire, destruction of hydraulic equipment, incidents caused by sea activities, nuclear incidents and other environmental and industrial accidents caused by human activities.

An Incident is an unpredictable or difficult to predict, time- and space-limited, high-intensity force or human activity that endangers the life or health of people, property or the environment.

2. Protection and defense of classified information in the judiciary in the event of war, martial law or other emergency, disasters and accidents

The judicial authorities shall develop a plan for the protection of classified information in the event of war, martial or other emergency, disasters and accidents on the grounds of Art. 22, item 11 of the Law for Protection of Classified Information and item 4.11. of mandatory instructions of SCIS.

The purpose of the plan is to analyse and assess the risk of disasters occurring within the Office, identify preventive measures to mitigate the adverse effects of disasters, organize and coordinate actions to prevent or mitigate the effects of disasters.

The specific tasks of the plan are to prepare magistrates and employees for work in situations of war, martial law or other state of emergency and in the event of disasters and accidents; Timely disclosure of personnel; Analysis of possible accidents on the territory of the respective

municipality, which could have negative effects on the building and identification of measures for prevention and reduction of their consequences; Organizing the protection of classified information; Effective use of available resources; Coordination of the actions of the response forces.

The plan for the protection of classified information in the event of war, martial law or other emergency, disasters and accidents should also be linked to other approved plans and rules, such as the Rules on Security, Internal Order and Security in the Building; Safety, hygiene and fire safety rules; evacuation plans by the Regional Fire Safety and Population Protection Service and the judiciary; Plan of action of the United Unit for Security, disasters, accidents and terrorist acts.

Possible accidents on the territory of the judicial authority and adjacent territories

Earthquake. Bulgaria is located in the Aegean seismic zone, which is part of the Mediterranean earthquake. The earthquakes in Bulgaria are of tectonic origin, with more than 250 outbreaks, most of which are in southern Bulgaria. There are areas within the territory of the country that fall within the area of seismic zoning of Bulgaria, with the probability of earthquakes from the 7^{th} degree on the 12-speed micro seismic scale of Medvedev, Sponhoyer, Karnik. In view of this, it is necessary to analyze whether special measures have been taken for the anti-earthquake construction of the building, which is required for areas with seismic events above 7^{th} degree inclusive [1], [2], [3], [4], [5].

Flood. Floods are likely to occur in the event of prolonged heavy rainfall and the destruction of hydraulic installations. In this case, overcoming the consequences of the floods will be an integral part of the rescue work of the respective municipality. The ability of the sewerage system to absorb surface runoff and the likelihood of flooding the basement floors and basements of the building, which could affect archival files and the property there, should be assessed here.

Fire. A fire is an uncontrolled burning that causes damage. In order to have a combustion process, it is necessary to create a combustible environment and the presence of a source of ignition. In order to prevent the occurrence of fires, it is necessary to observe the rules and regulations for fire safety and to enhance the fire culture.

A fire in the area of the judiciary could occur in the event of natural phenomena and a breach of lightning protection; sparks when performing repair and welding work. The possibility of a local fire occurring due to non-compliance with fire regulations on site and due to carelessness.

Radioactive contamination. Radioactive contamination on the territory of the country could be obtained in case of an emergency at Kozloduy NPP or from transboundary radioactive contamination.

Hurricane wind. High winds are winds at speeds above 14 m / s. Winds at speeds above 20m / sec are especially dangerous. In the event of a hurricane wind that exceeds significantly the wind load in the dimensioning, the integrity of the constructed structures can be destroyed. Strong hurricane-force winds are the cause of a number of accidents and devastation along air lines, buildings and facilities, and in combination with ice deposition on them - in the event of distress.

Heavy snow. The specificity of the continental climate indicates that heavy snow and snowfall are possible both within the site and in the surrounding areas. This could lead to an accumulation of sleep, which will slow down the communication of the site, as well as the approaches to and outside it. This is most dangerous if an emergency occurs in the site, which will require the intervention of external forces and resources.

Conclusions from the likely situation and main tasks deriving from it

1. In Disaster

1.1 Earthquake. At earthquakes above 9th grade on the Medvedev-Schonhoyer-Karnik scale, buildings are destroyed. In the case of earthquakes of lower intensity, structures and equipment will withstand, but there is a potential risk of severe earthquakes that may exceed the upper bound. As a result of the seismic action, some of the buildings may suffer severe damage and damage. As a result, there will be injured or buried magistrates, employees and outsiders currently residing in the respective building. In case of pipeline breakage and violation of the integrity of the facilities, there may be gas leakage in the area of the building and water in the building itself in case of violation of the integrity of the heating facilities and the water supply system. If the water temperature in the heating system is above the body temperature, there are conditions for burning, as well as a possible explosive situation from gas leakage [1], [2], [3], [4], [5].

In the event of an earthquake of up to 10 seconds, persons located on the first floor of the building must be evacuated and move further away from the height of the building. After the first quake is rescued, people must evacuate more than the height of the building. In the presence of earthquakes, the activity is terminated, electrical, plumbing, etc. installations are shut down. Actions are being taken to leave the site / evacuate people / and to comply with the Civil Protection guidelines. In collapses, people immediately

begin to level themselves with fallen debris. Finally, it goes to cleaning up the debris.

Organizing the protection of classified information in a disrupted building in the event of disasters and accidents:

- the spare keys of the premises of the CI registry and the metal box located therein shall be provided with a handover protocol for storage in the security and guard unit duty room, according to an order of the head of the organizational unit. They are sealed in an opaque envelope, stamped with the personal stamp of the Head of the Registry for CIs and are used only in disasters and accidents [1], [2], [3], [4], [5].

- in the event of a disaster situation, the security officer immediately informs the Chief Registry Officer of the CI and in his / her absence the Information Security Officer or the Head of the organizational unit to take the necessary actions to organize the protection of classified information.

- an instruction to the employees of the Security Unit holding a permit for access to the CI for the export of the documents containing the CI from the registry.

- the exported documents must be loaded in a special escort vehicle with a locking system to prevent unauthorized access and transport to the place specified by an order of the head of the organizational unit.

- until the information is handed over, the security is to be performed by the employees of the Security Unit.

1.2 Radioactive contamination

The actions of magistrates and employees in the event of radioactive contamination must be subject to the general instructions of the competent authorities responsible for protecting the public against radioactive contamination.

1.3 hurricane wind

A hurricane wind that exceeds significantly the wind load in the sizing may endanger the strength of the buildings and, in certain circumstances, pose a potential risk of their destruction with all their consequences.

2. In the event of an accident

2.1. Fire in the area of the site

The level of technology, technical and technological equipment of buildings in practice minimizes the risk of a major accident. Purposeful orders give instructions for the fire-safe use of heating, heating and other electrical appliances, and determine the conditions for performing welding and fire work on the premises. If a local fire occurs, respond to fire fighting with the available fire fighting equipment. In the event of a fire, employees in the room should immediately place a wet cloth on their mouth and nose and

leave the room perpendicular to the gas cloud. The plans for fire or emergency evacuation approved by the rules and regulations for fire safety and to enhance the fire culture shall be followed.

If the fire cannot be extinguished with the available forces and means, assistance is sought from the specialized bodies, while at the same time actions are taken to ensure access to the burning site and to prevent the spread of the fire, both to neighboring sites and beyond the territory of the site.

2.2 Fire out of the area of the site

Fires outside the site represent a real hazard to the site itself. The main task of magistrates and employees in establishing a fire outside the site is to inform the relevant authorities about the situation and to work in conditions of increased preparedness for fire operations. If the fire fighting is not achieved and it is approaching the site, the magistrates and staff must stop work and take action to prevent the fire from affecting the site.

Maintaining constant and emergency preparedness will be done through:

1. Training of magistrates and employees with a minimum of knowledge of actions and behavior in disasters and possible emergencies on site and at other sites whose effects may affect them or others. During the introductory and recurrent briefings, the instructors are introduced to the potential hazards on site and how to respond in the event of disasters, accidents and catastrophes.

2. Conducting recurrent exercises with personnel. Exercise exercises should be conducted periodically in the context of a likely setting. This creates a certain attitude and works out some practical actions on the use of individual remedies, technique and behavior of magistrates and employees.

3. Provide the necessary materials and equipment. In order to carry out effective actions for protection against accidents, disasters and catastrophes, it is necessary that the magistrates and the employees are provided with logistical assistance with the necessary means. The type and amount of funding depends on the likely environment that is created specifically for the site in the various disasters, accidents and catastrophes.

4. It is obligatory to maintain contact with the competent and specialized bodies for the protection of the population in case of disasters, accidents and catastrophes.

Personnel announcement and readiness

Notification of magistrates and employees may be made orally by:

- a designated official;

- the person who has identified the danger;
- the person who has been informed by the accidents and disasters services;

Magistrates and staff, if necessary, are prepared to act on a preliminary plan. Accident, disaster and accident prevention activities are **managed** by the responsible official and, in his absence, by the person designated by him.

In the case of actions by specialized bodies, the management shall be provided to the Head of the emergency unit operating within the site.

Procedure for introducing the plan and informing the personnel.

The implementation of the plan shall be by intentional order of the responsible official of the site, at the direction of the competent authorities, or on the basis of findings for the occurrence of an accident at the site or a natural disaster. The order of the Administrative Manager must be issued in writing, indicating the specific danger to the site, specifying the condition of the site in the situation, what measures will be taken and who are responsible for the purpose.

Judges and staff are informed of the imminent danger by the competent and specialized disaster and emergency authorities. In case of danger of the site, the above-mentioned authorities - Headquarters for coordination of rescue and emergency disaster recovery works shall be notified immediately to the 112 Security Council on duty.

If, for any reason, telecommunication techniques cannot be used to inform the Headquarters and the specialized services, the communication shall be made in writing or verbally by a person sent by a responsible official of the site [1], [2], [3], [4], [5].

In case of rescue and emergency emergencies, an order for their termination shall be given by the head of the unit conducting the events, after consultation with the administrative head of the respective body.

When declaring a state of war, martial law or a state of emergency or receiving an alert for an accident, the Standing Commission for the Prevention and Elimination of Accidents within the relevant judicial authority shall meet and carry out the following activities

1. Announces magistrates and employees - according to the procedure applied by the employees of the Regional Security Unit of the Ministry of Justice, including by telephone;

2. Maintains continuous contact with the relevant Crisis Management Center;

3. Collects and analyzes information on hazards or accidents;

4. Plan the volume and type of rescue measures, depending on the type of emergency;

5. Assists rescue teams in limiting, managing and eliminating the accident;

6. Organize the provision of first aid to medical assistance to the victims and their transportation to hospitals;

7. Organizes strengthening of the physical security of the building.

3. Conclusion and future work

Plans for the protection of classified information drawn up by the judiciary provide specific measures to prevent the risks, dangers and threats to the physical security of the classified information in the relevant unit, as well as to establish a preliminary force management organization. The plans also provide a set of preventive measures to reduce the impact of adverse factors arising from a state of war, martial law or other emergency in the event of disasters and accidents.

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Author's name and academic degrees and titles: Svetlin Emilov Stefanov, PhD student
Workplace: Faculty of Technical Sciences, Department „Management of security systems", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: svetlin.stefanov65@abv.bg

PROCEDURE FOR DETERMINING THE LEVEL OF CLASSIFICATION OF COURT CASES CONTAINING CLASSIFIED INFORMATION AND THE GROUNDS FOR THEIR CHANGE OR REMOVAL

Svetlin E. Stefanov

ABSTRACT: *In this paper procedure for determining the level of classification of court cases containing classified information and the grounds for their change or removal is made.*

KEYWORDS: *Classified information, Classification, Court cases, Disasters, Martial law, Procedure, Protection.*

1. Introduction

The concept of state secret is contained in the text of Art. 25 of the Classified Information Protection Act (CIPA), and this contains the information specified in the Schedule under Annex No. 1, the unauthorized access to which would endanger or damage the interests of the Republic of Bulgaria related to national security, defense, foreign policy and constitutionally established order [5], [6].

The list under Annex No 1 (List of categories of information subject to classification as state secret), section II, item 6 – lists "information on used according to the legal provisions of the in accordance with the legal provisions of the Special Intelligence Means SIM (technical means and / or methods of their implementation). The State Commission on Information Security (SCIS), as a state body implementing the policy of the Republic of Bulgaria for the protection of classified information, has issued Mandatory Guidelines on the correct determination of the nature of the information acquired as a result of the use of SIM. According to these guidelines, each information should be classified according to its own content, which is the result of a complex judgment, the final stage of which is its marking with a security mark corresponding to the classification level. The reference to the legal basis for classification is an element of the security bar, with the relevant item in the List practically cited. In the case of information obtained as a result of SIM, the classification should also indicate the relevant other point, which identifies the real public relations related to national security that need protection to an appropriate extent [1], [2], [3], [4].

According to SCIS, the protection of used SIM (technical means and / or methods of their implementation) is ensured by point 6 of the List, which

has a specific purpose and purpose. In accordance with the general rules, the person entitled to classify the information as classified is the originator of the document or material containing the classified information. The final security stamp shall be affixed by the person entitled to sign the document. When using SIM, the applicant is this person who assesses whether the request contains classified information. With his/her participation, the abolition of the classification level should also be carried out [1], [2], [3], [4].

THE STATE COMMISSION ON INFORMATION SECURITY COMMISSION (SCIS) based on SCIS Decision No. 209-I of 23.11.2004, as amended. by Decision No. 68 - I / 25.10.2011 issued BINDING GUIDELINES for the classification of court and investigative cases to the subjects obliged under the CIPA for

1. Grounds for classifying cases and marking with security stamp;
2. Access to classified cases;
3. Procedure for handling classified information in court and investigation cases.

Based on the Compulsory Guidelines for the Classification of Court and Investigation Cases, courts in the country draw up their own rules regarding the grounds for classifying court cases, access to classified cases, duplication of court documents and court records, modification or removal of a security stamp, file storage, archiving and destruction of material containing Classified Information [1], [2], [3], [4].

2. Grounds for classification of court cases, access to classified cases and order for handling classified information in court cases

Grounds for classification of court cases

1. The basis for classifying a case is the inclusion in it of materials and / or documents containing classified information (CI) marked with a security stamp. They can be set up in the relevant organizational unit of the judiciary.

When classified information (CI) is included in the case with the oral statements of the participants in the hearing, its classification level shall be communicated in advance by the person who will reproduce the information. Persons who do not have access to the CI to be reported or commented (according to the need-to-know principle) are urged to leave the Chamber. Subsequent recording of the statements, marking of the protocol with a security stamp and its inclusion in the case file are grounds for classifying this case [1], [2], [3], [4].

Where material containing the CIs requested in a public case is received in the registry of the CI, the reports shall be reported to the respective chairman of the panel. The President of the Trial Chamber prescribes on the document for its application to the public case and an

instruction for the registration and registration of the case as classified as required by the Classified Information Protection Act (CIPA) and the Rules for the Implementation of the Classified Information Protection Act (RICIPA).

2. Classification

2.1. Classified information, which is a state secret, is classified at the following levels with the security classification "Top Secret", "Secret", "Confidential". Information classified as official secrecy is marked with a security label "For official use".

2.2. Information is classified according to its own content and not according to the classification of the information on which it is based or the information to which it relates.

3. Marking of cases with security stamp:

3.1. Any classified information constituting a state or official secret shall be marked with an appropriate security stamp.

3.2. Security bar contains: a classification level; date of classification; date of expiry of the classification period, when different from the expiry date of the periods under Art. 34, para. 1; the legal basis for classification.

3.3. The officer who signed the document may enter on it the following orders to the addressees: “The provision of information contained in the document without the written consent of the signatory is prohibited”, “Reproduction without the written consent of the signatory is prohibited”; “Copying without the written consent of the person signing the document is prohibited”; “Sampling without the written consent of the person signing the document is prohibited” [1], [2], [3], [4].

A court case involving documents and / or materials containing classified information is a collection of documents within the meaning of § 1, item 12 of the Supplementary Provisions of the CIPA. Pursuant to Art. 30, para. 3 of the CIPA it is marked with a security stamp corresponding to the highest classification level of the material or document contained therein. If the set of one court case combines two or more court cases as a result of the different stages of the court proceedings, in practice a “sum of documents” is obtained. The marking of such a sum shall be carried out in the same way as the individual sums therein, on the grounds of Art. 30, para. 3 of the CIPA - ie. a security mark corresponding to the highest classification of all sums shall be affixed.

On the cover of a court case (on the collection of documents) are placed the following markings

- top left - the registration number under which the court case (the collection of documents) is entered in the register under Art. 70, item 1 or item 2 of the RICIPA;

- under it - the nomenclature register number from the nomenclature list of types of registers;
- top right - Security stamp in accordance with Art. 30, para. 3 of the CIPA;
- in the middle - the case number of the case, which includes the latest registration number designations, eg C-11/2009.
- under it - data on the parties to the case and the matter are filled in;
- in the lower left corner - the date of initiation of the case;
- in the lower right corner - date of completion of the case;

4. Setting up a classified case file

4.1. In order not to impede access to unclassified materials, it is possible, at the discretion of the body hearing the case, to set up a clear and classified volume of the case. In the cases under item 4.1. the classified volume includes all materials and / or case files marked with a security stamp. The classified volume is marked according to the rules of Art. 30, para. 3 of the CIPA, with a clearing in the explicit volume. In cases of division of the case, the measures for protection of classified information under CIPA and its by-laws apply only to the classified volume.

5. Completion of classified court cases. An inventory of the documents containing the CIs and a checklist for acquaintance with these documents by the interested parties are compiled with each case (collection of documents), in compliance with the principle of 'need to know'. The inventory shall be prepared in duplicate, the second copy being kept separately in the CI registry and the first and control sheets shall be sewn at the end of the case, before the note on the contents of the total number of sheets in it. Where the case is a “sum of documents”, a list and a checklist must be available for both the individual sums and the sum total.

6. Classification of court acts and records of court hearings. Courts draw up court acts and court records that may contain CIs. The classification of court acts and protocols is carried out in accordance with Chapter 5, Section II of RICIPA, and in particular their marking with a security mark - in accordance with Chapter 4, Section I of the CIPA and Chapter 5, Section I of RICIPA. According to Art. 31, para. 1 of CIPA, the security stamp is determined by the person who has the right to sign the document containing the CI - by the chairman of the panel. Acts and minutes of court hearings shall be drawn up in a single copy, sewn to the case. If necessary, for the needs of the parties to the case, reproduction, certification and transmission of the relevant act shall also be carried out. When a court order is classified, only a party to the case can receive a copy of it. Individuals (complainants),

as well as their attorneys, may obtain a court certificate citing decisions from the stages of the court proceedings in the respective court without describing the reasons containing the classified information [1], [2], [3], [4].

7. Notification of the author of the document (the person referred to in Article 31, paragraph 1 of CIPA) or of his / her senior manager. The inclusion in the cases of documents and / or materials which, at the discretion of the magistrates and employees, contain classified information but are not marked with a security stamp, does not constitute grounds for classifying the cases. In this case, persons have the right to notify the author of the information or his / her superior about the need to mark the information with a security stamp. The relevant notification shall be drawn up by the Information Security Officer. Magistrates and employees who have been legally required to access security stamped materials and / or documents that, in their discretion, do not contain classified information, have the right to notify the author of the information or his / her superior. The relevant notification shall also be prepared by the Information Security Officer.

If at a hearing a material and / or documents with an incorrect (or without a reason) security mark have been submitted to the case, the chairman of the court panel shall order a procedure for notifying the author under Art. 31 of CIPA, thereby obliging him to comply with Chapter 5, Sections I and II of the CIPA, either removing the security mark or correctly designating it. The control over the execution of the procedure and the correspondence with the respective party to the case is entrusted to the Information Security Officer and the head of the CI Registry.

Upon entry in the registry for CIs of court cases or materials that are not completed, classified or sent in accordance with the requirements of the CIPA, RICIPA and Compulsory Instructions of SCIS, they are returned to the organizational unit from which they came, as the Information Security Officer attached to the set of notification letter signed by him.

8. Receiving and sending classified cases. Documents containing classified information that are sent to other recipient organizational units shall be prepared in at least two copies. The first copy, called the original, is stored in the registry of the organizational unit where the document was created, and the other copies are sent to the addressees. The transfer of materials containing classified information can be done through a special courier service [1], [2], [3], [4].

8.1. Expedition letters. According to Art. 94 of the RICIPA materials containing CIs, which are state secrets, are sent by dispatch letter.

8.2. Packaging, transmission, transfer and acceptance of materials containing CIs. The activities of sending, transmitting, transferring and

receiving material containing CIs are regulated in Chapter 5, Section V of the RICIPA.

8.2.1. Making packages of court cases. The formation of packages with court cases is carried out in accordance with Appendix No. 9 to Art. 85, para. 2 of RICIPA. Where the case is of relatively small volume, an internal and external envelope formed pursuant to Art. 94 of RICIPA. As some of the case files are of a size that does not allow the requirement of item 2.1 to be met. from Annex 9 to Art. 85, para. 2 of RICIPA (35 X 25 cm), it is advisable to use an inner envelope of size 40 X 30 cm and an outer envelope - 45 X 35 cm. If the case is large, one or more folding cardboard may be used packages of dimensions 36 x 28 x 10 cm, which are also formed in accordance with Annex 9 to Art. 85, para. 2 of RICIPA. In this case, the requirement for packing solid and opaque paper is eliminated, as folding cartons have the required strength and opacity. It is sufficient to comply with the requirement of an additional dressing to preserve the integrity of the shipment during transport [1], [2], [3], [4].

Access to classified cases

1. Lists of positions or tasks that require access to classified information. Pursuant to Art. 37, para. 1 of CIPA and Art. 23, para. 1 of RICIPA, the chairman of the respective Magistrate, in his/her capacity as head of an organizational unit, determines a list of positions or tasks (other than those with legal access), in the execution of which access to classified information constituting state or official secrecy, indicating the level of classification of the information. An updated list of the positions and persons holding them is sent to the SCIS. Additions to this list shall be sent to each new person and position. In the lists under Art. 37 of CIPA, respectively. 23 of RICIPA include the positions in which the access to classified information is required (Registrar - Protocol Officer, Clerk of Court, etc.). Copies of the lists shall be sent to the SCIS and the relevant research body.

2. Access to classified information in court cases.

2.1. Access to classified case files shall be granted subject to the need-to-know principle and subject to the following prerequisites:

(a) a credibility study (or permission granted to access the relevant classification level of information).

(b) completed training in the protection of classified information.

No credibility study (or permits for access to classified information) shall be conducted with respect to judges, jurors, prosecutors, investigators, attorneys and persons acting in or in connection with the exercise of their constitutional rights of defense. Such persons shall have the right of access to

the classified information contained in the specific cases in which they are involved or entitled to participate.

No reliability study shall be carried out (no authorisation for access to classified information shall be granted) in relation to access to information classified as professional secrecy.

3. Training in handling classified information. Training in the handling of classified information of magistrates and of all persons whose positions or tasks are included in the lists under item II shall be provided by the Information Security Officer of the relevant court issuing a certificate of completed training in the protection of classified information (Attachment No. 19 to Article 159, paragraph 3 of RICIPA) after a signed declaration by the persons (Attachment No. 18 to Art. 3 of RICIPA [1], [2], [3], [4].

The training of lawyers and persons acting in or in connection with the exercise of their constitutional right of defense who have not undergone training in the protection of classified information shall be provided by the Information Security Officer of the authority first examined the case that issues a certificate for completed training in the protection of classified

Reproduction of court documents and court records

1. General requirements. Duplication of documents containing CIs is carried out only at the premises of the registry of CIs. The document from which copies are made shall be prepared in advance in accordance with Art. 113 of the RICIPA.

2. Reproduction of documents containing CIs received from other organizational units. If there is no explicit disabling order, the same shall be done:

- for documents classified as "Top Secret" - upon written permission from the organizational unit from which the author of the document attached to the original is authored;

- for documents with the classification level "Secret", "Confidential" and "For official use" - after written permission of the Chairman of the Regional Court in Shumen or the information security officer;

3. Reproduction of documents containing CIs created in the appropriate court. It is carried out with the permission of the person who signed the document or the Chairman of the court, in case the person who signed the document is absent.

Modify or remove a security stamp

1. Changing the security stamp shall be made by deleting one horizontal line of each element of the bar in such a way that it can be read and then a new security bar shall be inserted. The new security stamp shall be

placed immediately next to the old one, indicating - the new level of classification, the date of the change, the new date of expiry of the period for protection of classified information, when it is different from the ones specified in the law, the legal basis for the change , position, name, surname and signature of the person making the change. Deletion, physical removal or blurring of a security stamp that is subject to change is not permitted.

2. When the classification of information is removed, the security bar shall be deleted, deleting each element of the bar with a horizontal line in such a way that it can be read without inserting a new security bar.

The removal of the classification shall indicate the date, the legal basis for the removal, the position, name, surname and signature of the person performing the removal. The change of the security stamp shall be reflected in the respective register under Art. 68, para. 1 of Ricipa [1], [2], [3], [4].

Filing, archiving and destruction of material containing Cis

The cases, or separate volumes of cases containing classified information, shall be stored in the registry for classified information functioning in accordance with the requirements of Chapter Five 'Documentary Security' of the RiCIPA.

After removal in accordance with the established order of the security stamp, the cases are submitted to the court archive. Files and documents submitted to the archive shall be kept within the statutory time limits. The Chairman of the respective court, by an order, appoints a committee for the preparation of a reasoned proposal for the destruction of materials - holders of classified information, or their submission in an archive in accordance with the requirements of Article 120 of RiCiPA and Art. 33 of CIPA.

At least once every two years, the Commission:

- evaluates and concludes which expired information is of historical, practical or reference importance and proposes to be archived;
- makes a reasoned proposal for the destruction of expired materials that will not be archived;
- makes assessment and proposal to SCIS for destruction of materials containing classified information under Art. 121, para. 1, items 2, 3 and 4.

Expicitly is prohibited the destruction of second and subsequent copies of materials containing classified information in the cases where the person under Art. 31, para. 1 of CIPA explicitly recorded such an order on the document. In order to destroy court cases, all the requirements of the CIPA and the regulations must be fulfilled.

3. Conclusion and future work

The strict observance of the Obligatory Instructions on the correct determination of the nature of the information obtained as a result of the use of Sim and the Obligatory Instructions for Classification of Judicial and Investigative Issues Issued by the SCIS, as well as the court's own rules, approved on the basis of these instructions, protects against unauthorized use of classified information and is an additional guarantee for the protection of citizens' rights in criminal proceedings.

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Author's name and academic degrees and titles: Svetlin Emilov Stefanov, PhD student

Workplace: Faculty of Technical Sciences, Department „Management of security systems", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria

E-mail: svetlin.stefanov65@abv.bg

MODELING AND CALCULATION OF PASSIVE AUDIO CROSSOVERS

Tihomir S. Trifonov

ABSTRACT: *A different approach for modeling and calculation of parameters of a passive audio crossovers is described in this paper. Using a computer program the complex mathematical equations describing the work of audio crossover filters are solved in a more simpler way. The program described gives values to the passive components (Capacitors and Coils) and calculates the desired frequency responses of the filters.*

KEYWORDS*: Audio Speaker System, Passive Audio Crossover, Matlab, Butterworth Filter, Linkwitz-Riley Filter, Two-Way Crossover, Three-Way Crossover. Complex Frequency Response.*

1. Introduction

A perfect crossover, in essence, is no crossover at all. It would be one driver that could reproduce all frequencies equally well. Since we cannot have that, second best would be multiple speakers, along the same axis, with sound being emitted from the same point, i.e., a coaxial speaker that has no time shift between drivers. This gets closer to being possible, but still is elusive. Third best are multiple drivers mounted one above the other with no time shift, i.e., non-coincident drivers adjusted front-to-rear to compensate for their different points of sound propagation. Each driver would be fed only the frequencies it is capable of reproducing. The frequency dividing network would be, in reality, a frequency gate. It would have no phase shift or time delay. Its amplitude response would be absolutely flat.

DSP digital technology makes such a crossover possible, but not at analog prices demanded by most users.

This paper describes a method for design and calculation of a 2-way and 3-way passive crossover which are more easily to implement than an active (analog or digital) crossover.

2. Passive crossovers.

The main rule in the theory of filters is: each order, or degree, of a filter increases the slopes by 6 dB/octave or 20 dB/decade. In a passive network the order of the filter depends of the number of reactive components (capacitors and inductors) used. For example: in a third order low pass filter it is necessary to use two inductors and one capacitor. Low order filters

require fewer components but their characteristics are such that the drivers are fed with more power from the frequency band the driver is not designed for. If the crossover consists of two or three filters the main problem is to match their characteristics so the overall frequency response of a speaker would be absolutely flat.

2.1. Two-way second order passive crossover

The schematic of the crossover [1] is shown in fig. 1

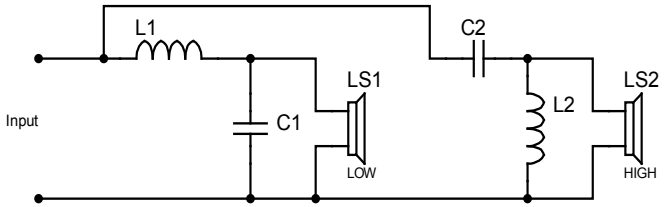

Fig. 1. Schematic diagram of a two-way crossover

As can be seen from the figure above it is parallel schematic. There are three primary filter alignments that can be used, and they differ only in the damping (or '*Q*') factor. *Q*, or 'quality factor' is an abstract term that is applied to many passive components in many applications, and is effectively the inverse of damping. Thus, *Q=1/d or d=1/Q*.

If the damping is $\sqrt{2}$ =1.414, and its inverse, 0.707 the filter provides 'maximally flat' frequency response. This means that the response in the pass band is as flat as it can possibly be, until the cut-off (-3dB) frequency is reached. This forms the classic Butterworth filter that has been the mainstay of nearly all crossover systems in common use.

A Bessel filter (*Q*=0.5 to 0.7) has a slower and 'sloppier' response, that starts to droop well before the cut-off frequency, but has the minimum phase shift (and best transient response), and one that is comparatively gentle. 6dB/octave filters are neither fish nor fowl - i.e. they may be thought of as a poor Bessel, Butterworth and Chebyshev all rolled into one, and have a *Q* of 0.5 - this cannot be changed by any topology, regardless of whether electronic of passive crossovers are used.

The Chebyshev filter (*Q*=0.8 to 1.2) is characterized by peaks and/or dips in its response, and usually has a (slight) rise in amplitude just before the

cut-off frequency, the magnitude of which is determined by the *Q*. The higher the *Q*, the greater the peak in the response.

The values of the components L and C for each filter are calculated using well known formulas [5]:

$$C = \frac{1}{2\pi f_c Z d};\ L = \frac{Zd}{2\pi f_c}, \text{ where} \quad (1)$$

f_c – cut-off frequency of the filter [Hz]; Z – impedance of the speaker [Ω] and $d = 1/Q$ – is the damping factor. The damping factor is different for the given alignment of the filter: for Butterworth *d*=1.414; for Bessel *d*=1.75; for Linkwitz-Riley *d*=2.

For the purpose of the design and calculation of the parameters of the filters and the overall characteristics of the crossover, a Matlab script is written. The main task of the script is to calculate the complex frequency response of each of two filters and to find the best possible match of the filters so the sum of the two complex transfer coefficients would be 1 for all the frequencies.

The complex gain is calculated as follows:

- for low pass section $\dot{K}_L = \frac{Z_1}{Z_1 + Z_2};\ Z_1 = j2\pi f L_1;\ Z_2 = \frac{-jX_{C1}R_L}{R_L - jX_{C1}};$ (2)

- for high pass section $\dot{K}_H = \frac{Z_1}{Z_1 + Z_2};\quad Z_1 = -jX_{C2} = \frac{-j}{2\pi f C_2};$

$$Z_2 = \frac{j2\pi f L_2 R_H}{R_H + j2\pi f L_2}. \quad (3)$$

The complex frequency responses of the two filters actually are summed acoustically, i.e. $\dot{K} = \dot{K}_L + \dot{K}_H$. The magnitude response is the modulo of the complex gain:

$$K = \left|\dot{K}\right|. \quad (4)$$

The impedance of the speakers is assumed to be active resistance for simplicity, so the speakers in the formulas is replaced by a resistor $R_L = R_H = 8\Omega$.

Experimenting with the program following results are obtained:

1. It was unable to find the best match (overall *K*=1) of the two filters when they are of Butterworth alignment but if the cut-off frequencies for low-pass and high-pass sections are different, it is possible to obtain very good results. It has been experimentally found that if the cut-off frequency of the high-pass filter is 1.603 times higher than the cut-off frequency of the low pass filter, the irregularity of the overall coefficient is minimal and its

maximum value is 1.072. This value calculated in decibels is +0.6 dB, which is perfectly acceptable.

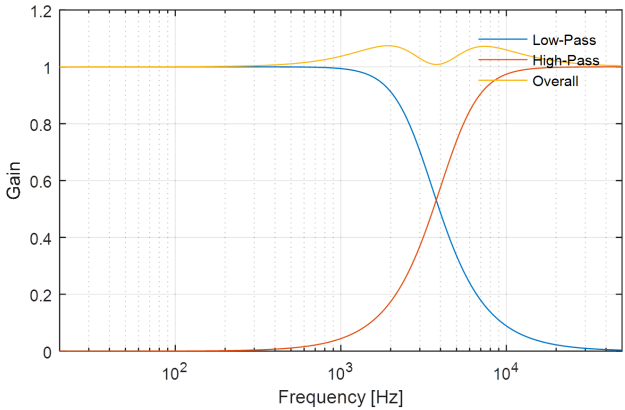

Fig. 2. Frequency responses of 2-way Butterworth crossover

The figure shows the frequency responses of the filters along with the overall response with low pass section cut-off frequency set to 3 kHz.

2. The results from the experiments with the Bessel filters with d=1.75 are similar. It has been found that if the cut-off frequency of the high-pass filter is 1.264 times higher than the cut-off frequency of the low pass filter, the irregularity of the overall coefficient is minimal and its maximum value is 1.009. The cut-off frequencies of Bessel filters are at level of 0.57 instead at 0.707 for Butterworth.

3. The best match of the filters is obtained when they are of the Linkwitz-Riley type (d=2). In this case the values of the capacitors (and also of the inductors) in low pass and the high pass sections are turn out to be equal. Another fact is that the cut-off frequency for the two sections is also equal, but it is at the level of half voltage, i.e. at -6dB instead at -3dB in general. Figure 3 shows the responses of the Linkwitz-Riley filters. As can be seen the responses are absolutely symmetrical and overall response is equal to one for all frequencies. The main disadvantage is that the filters slope is lower.

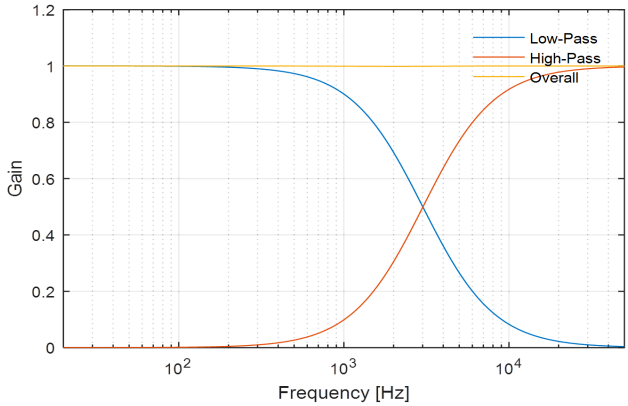

Fig. 3. Frequency responses of 2-way Linkwitz-Riley crossover

4. Due to specific phase responses of second order filters, in order to obtain as flat as possible overall response, it is necessary to inverse the polarity of the HF speaker. This statement is true for all three filter types. So the overall magnitude response should be $\left|\dot{K}\right| = \left|\dot{K}_L - \dot{K}_H\right|$.

2.2. Three-way second order crossover

The schematic of the crossover is shown in fig. 4. It is also parallel type and is obtained from the two-way schematic adding a middle band section which is a second order band-pass filter. There are known several configurations of the components of the filter but I preferred this typical one. In another Matlab script first the complex gain of the low-pass K_L and high-pass K_H sections are calculated using (2) and (3). Then the program gives values to the components of the band-pass filter and searches the best possible match for the three filters so the overall response should be flat.

The band-pass filter response is calculated as follows:

$$Z_1 = -j/2\pi fC_3,\ Z_2 = j2\pi fL_3;\ Z_3 = j2\pi fL_4;$$
$$Z_4 = \left(-jZ/2\pi fC_4\right)/\left(Z - j/2\pi fC_4\right); \quad (5)$$
$$Z_{234} = \frac{Z_2\left(Z_3 + Z_4\right)}{Z_2 + Z_3 + Z_4};\ \dot{K}_M = \frac{Z_{234}}{Z_1 + Z_{234}} \cdot \frac{Z_4}{Z_3 + Z_4};$$

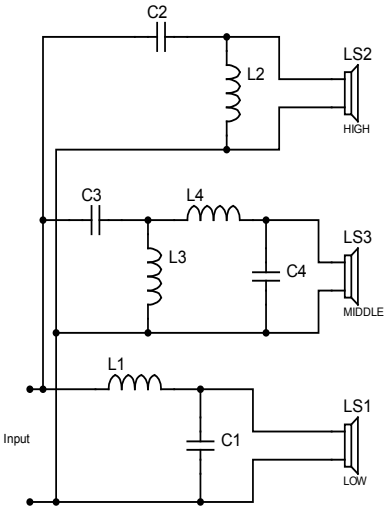

Fig. 4. Schematic diagram of a three-way crossover

The overall magnitude response of the 3-way crossover is:

$$K = \left| \dot{K}_L - \dot{K}_M + \dot{K}_H \right|.$$

Due to some overlap in the responses of the low-pass (LP) and high-pass (HP) filters, some attenuation in the Band-pass filter should be added to achieve a flat overall response. It has been experimentally found that the attenuation factor should be between 0.7 and 0.85 and the program finds the most appropriate value. The attenuator was placed in front of the middle band driver and it consists of two resistors. The resistors should be powerful enough (>10W) and they will produce heat, so their location in the loudspeaker box is very important. The input impedance of the network (Fig.5) must be the same as that of the driver.

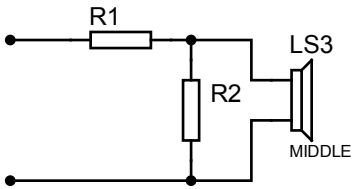

Fig. 5. Attenuator circuit in the middle section

The values of the resistors are calculated using following system of equations:

$$\begin{cases} R_1 + R_2 R/(R_2 + R) = R \\ \dfrac{R_2 R/(R_2 + R)}{R_1 + R_2 R/(R_2 + R)} = K_{Att} \end{cases}, \text{ where}$$

R is the resistance of the middle band loudspeaker and K_{Att} is the value of attenuation that must be added. For example, if K_{Att}=0.8 and R=8 Ω, R_1 and R_2 should be 1.6 Ω and 32 Ω respectively (using Matlab capability to solve symbolic equations):

```
>> syms R1 R2
>> [R1 R2]=solve('R1+8*R2/(8+R2)=8','(8*R2/(8+R2))/(R1+8*R2/(8+R2))=0.8')
```

The magnitude frequency responses of the 3-way crossover are shown in fig. 6. The LP and HP sections are of Butterworth alignment. The band-pass filter is determined by the program optimally so the overall response should be as flat as possible. In this case, the difference between K_{max} and K_{min} in the response is 0.059, which corresponds to +0.5 dB.

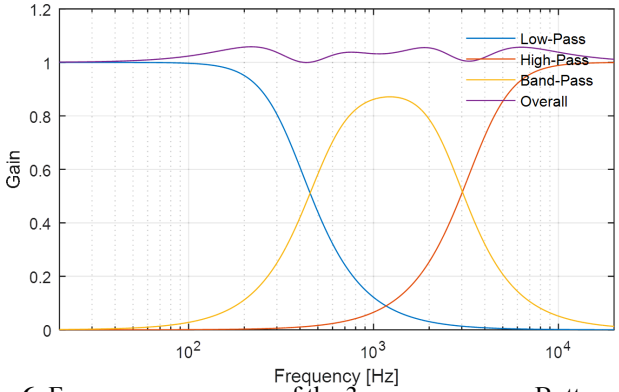

Fig. 6. Frequency responses of the 3-way crossover, Butterworth LP and HP

The most flat (nearly perfect) overall magnitude response of the crossover is derived when LP and HP sections are with Linkwitz-Riley alignment (Fig. 7).

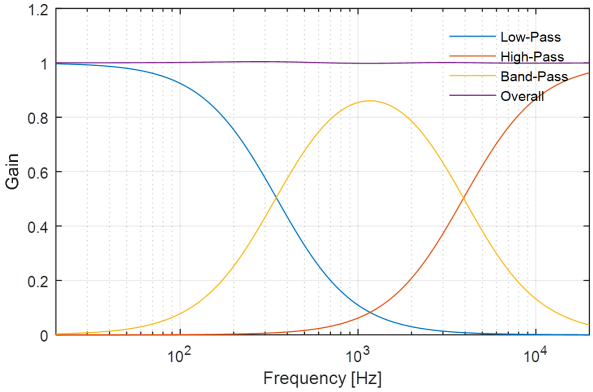

Fig. 7. Frequency responses of the 3-way crossover, Linkwitz-Riley LP and HP sections

In this case, the difference between K_{max} and K_{min} in the overall response is only 0.0064, which corresponds to +0.055 dB. Good results were obtained and when the LP and HP filters were of Bessel type (0.0146 or 0.13 dB).

3. Conclusion

The method described gives very good practical results. Specifying only the cut-off frequencies in the designed Matlab programs they can determine the values of components of 2-way and 3-way passive crossovers. Optimal overall magnitude frequency responses are obtained.

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Author's name and academic degrees and titles: assoc. prof. eng. Tihomir Spirdonov Trifonov, PhD
Workplace: Department of Communication and Computer Technologies, Faculty of Technical Sciences, Konstantin Preslavsky University of Shumen, Shumen, Bulgaria.
E-mail: trif.69@abv.bg

INTELLIGENT EDUCATIONAL STRUCTURE MODEL

Valentin T. Atanasov

ABSTRACT: *This paper extends conceptualization of a multi-component, logically composed educational structure with ability of self-organizing of distributed learning process. A model of intelligent educational structure is presented, based on conceptual model of digital transformed educational process.*

KEYWORDS*:* Smart education, intelligent educational structure , intelligent environment, intelligent educational cluster.

1. Introduction

The new concepts and technological trends considered and summarized in [1] in conjunction with the definition of structured information objects [2], based on technologies such as Internet of Everything, as well as the possibilities for programmable functionality on a wide range of devices, presupposed a new technological paradigm. In its field it is also included a specification of autonomous technological devices with functionality to initiate human-independent processes for sensory information processing along with the development of miniaturization. It should be noted here that, within the meaning of the term human-independent process, technological processes are considered as a collection, processing, storage, modification, exchange and presentation of information units. In the range of tasks, problems or researches a complex case studies on the conceptualization of intelligent structures was already included and based on that a future educational infrastructure could be built [2][3].

The model presented in [2] of an enhanced educational paradigm, based on the synthesis of the traditional educational model and the functionality of technological solutions of products in the domain of the 4th Industrial Revolution [4] appears to be an element of the integration of two scientific fields - engineering and pedagogy. Thus, the transition from *technology-aided* training to *initiating-intelligent-structures* training is determining.

The presented model of conceptualization of a intelligent educational cluster in [2] defines definitions that give clarity, logical conditioning and avoid ambiguity in the use of terms and concepts. The revised versions were presented below:

Intelligent Educational Cluster (IEC) - This is a complex of logically organized and distributed intelligent educational structures.

Intelligent Educational Structure (IES) - This is a structure built of intelligent educational environment elements. The IES is a core component of IEC.

Intelligent Educational Environment Element (IEEE) - Represents a complex of technology unit and intelligent agent building any IES.

Technology Unit (TU) - This is a functionally completed technology product with functionality for programmable behavior based on a hardware description language.

2. Problematic field.

The considered models of intelligent education environment represent, in general, only a certain infrastructural aspect of that environment [5]. In [6], an architecture was considered with partial approaches to the implementation of an intelligent educational environment, but information about the activity of trainees is based only on their online behavior, i.e. any other activity remains outside the scope of this architecture. In [7] is proposed a working framework for the development of an intelligent educational environment covering five categorical areas, adapted for the purpose of this study, that recommend a chronology of the development process:

- *Participatory organizational culture;*
- *User centricity;*
- *Didactical implementation;*
- *Hybrid learning space;*
- *Hybrid learning assistance.*

The proposed framework approximates the concept presented in this article in the part for the implementation of didactic models into IES along with the merging of two spaces - virtual and physical into intelligent space, but does not consider, deduce or predict the presence of intelligent agents as a parts of this system whose distinctive features include initiation and active role in the processes.

From above it can be concluded that conceptual models for building an intelligent educational structure covering different types of infrastructure, training areas, protected area, integration of intelligent agents and didactic models, virtualization of the learning process have not been considered in holistic. This includes also the active actors in it, social and other structure services.

3. Model conceptualization.

Enhanced educational paradigm

Through layered approach is building a model of IES. In order to achieve didactic integration via digital transformation of classic learning

process, in the proposed enhanced educational paradigm [2], all its subject related components obtain an "*active*" feature, which is one of the essential characteristics of a intelligent environment. The paradigm hierarchically represents the learning process at the abstract level (Figure 1).

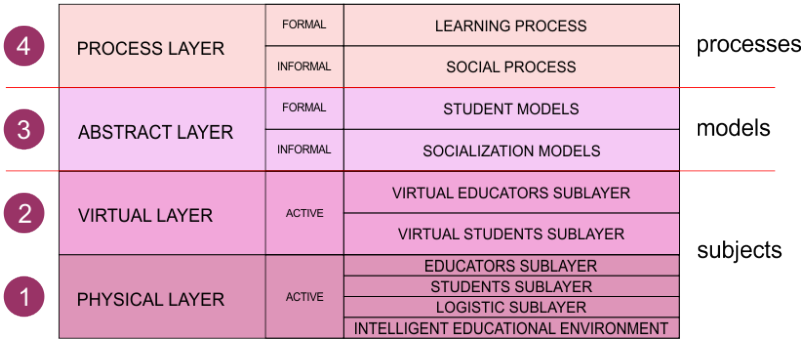

Fig. 1. Enhanced educational paradigm

One of the main rules of this paradigm is: *In any virtual learning process for every virtual student a separate virtual educator is assigned.*

Defined principles:

According to the principles embedded in the conceptualization of an intelligent educational cluster structure [2] and additions as follow:

- *Avoiding a single point of failure in critical IEEE;*
- *Full compatibility starting at level TU;*
- *Ubiquitous identification of subjects and objects;*
- *Security protocols;*
- *Didactic models implementation;*
- *Self-configuration;*
- *Protected area;*
- *Life support;*
- *Data and resource protection;*
- *Authentication and authorization;*
- *Educational services;*
- *Social services*

and the considered conceptual framework of a intelligent educational environment [3] this article propose an IES model. Using the object object-oriented modeling language a conceptual model of an IES was synthesized, through UML diagrams [8,9,10,11,12] as depicted below (Fig. 2).

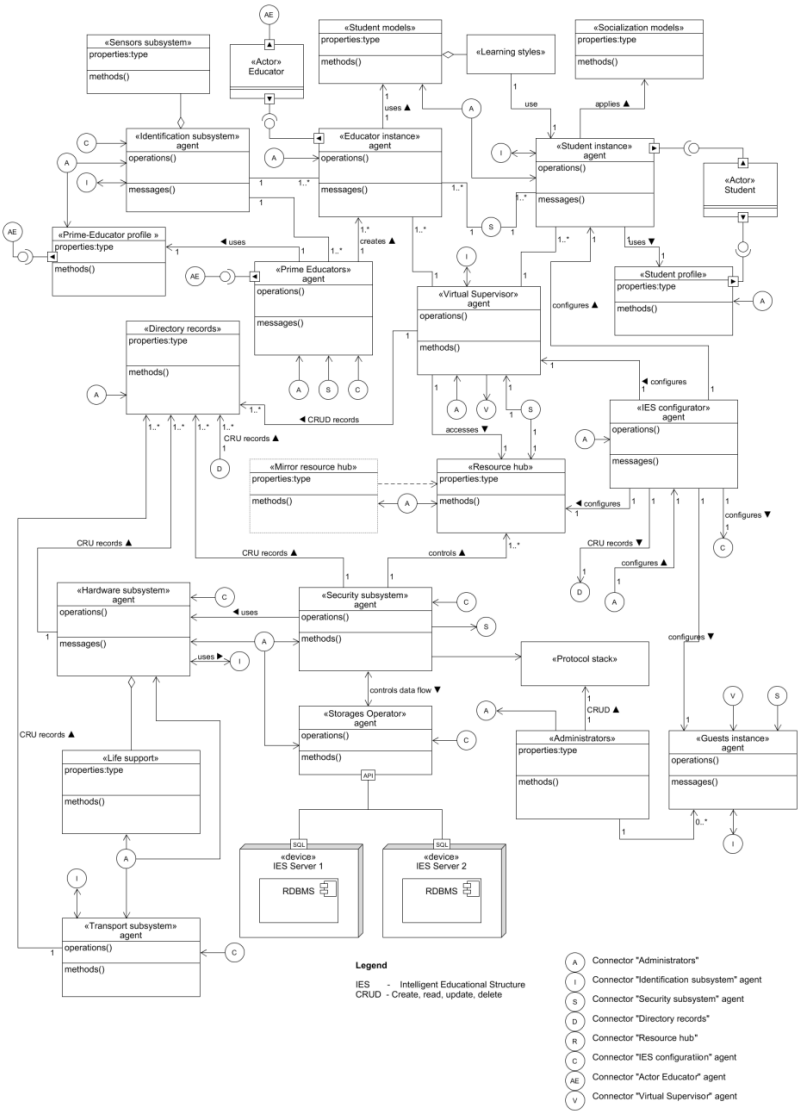

Fig. 2. Conceptual model of IES

The image above depicts model conceptualization at very abstract level. Since the main point of it is virtualization of learning process below is

given a formalization of it. Let s_i represents i^{th} instance of virtual student from set S of all registered students then:

$$s_i \in S = \{s_1, s_2 .. s_n\}$$

Where n is the number of all registered in the system students.

Let e is an instance of primal virtual educator from set E of all registered primal educators so $e \in E$. And let $s_i \rightarrow e$. Then here is proposal for virtual learning process if $e_j' \in E$

$$\text{so if } \forall e_j' \in E(e_j' = e) \text{ is true then}$$

this led to $s_i \rightarrow e_j'$

where $i \in \mathbb{N} = \{1,2,..n\}$ and $j \in \mathbb{N} = \{1,2,\ldots n\}$.

The proposition above is main characteristic of the presented here model because builds "virtual educational" connection between every virtual student and his personal virtual educator.

Since here is considered organizational approach the identification roles and relationships among them are considered as presented in table 1.

Table 1. Roles of the agents in AES group

Agent	Interactions	Roles
„Identification subsystem“	Assigns to all subjects and objects an unique ID. Collaborates with other agents.	Offeror
„Prime Educators “	Sets primal Educator class for Educator instances	Master
„Educator instance“	Commitment on behalf of Prime Educator in virtual learning process.	Assistant
„Student instance“	Commitment in virtual learning process.	Assistant
„Virtual Supervisor“	Supervises (makes decisions based on instance states) interactions in virtual learning process. Manages resource access. Records instances activity	Supervisor

„IES configurator“	Configures and initiates all agents. Records its own activity.	Initiator
„Security subsystem“	Manages resource and data access. Manages entrance permissions. Manages life support.	Security Manager
„Transport subsystem“	Tracks ground and air vehicles with ID in the area. Records tracked data.	Dispatcher
„Storages operator subsystem“	Controls all input/output traffic and data flow conditions.	Operator
„Guests“	Acts on behalf of temporarily granted external user access	Guest
„Hardware subsystem“	Monitors all devices activity, devices status, life conditions indicators. Issues alerts in life threatened cases. Executes common and critical tasks.	Worker

Having abstract level of the presented system there should in consideration the possibility of association of the various types of roles and that this association is not necessarily static, throughout the whole life of the system, agents may alter their role or get more than one role.

4. Conclusion and future work

The proposed conceptualization of model of intelligent educational structures gives a solution (or partial way) in certain cases of transition of classic educational structure to its digital agent based implementation. With a digital learning process implemented in the agent based system a new virtual didactic approach is proposed where every student could have opportunity to be in tight connection with a separate virtual educator, and vice versa – a single real educator is equipped with digitally enhanced abilities for multiply communications at the same time during the learning process. In the future periods a detailed work is considered for functional modeling of interactions between agents of the instances of educator and student.

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Author's name and academic degrees and titles: chief assist. Eng. Valentin Tonev Atanasov, PhD
Workplace: Faculty of Technical Sciences, Department „Communication and Computer Technologies", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria
E-mail: valopaint@yahoo.com, v.atanasov@shu.bg

ENHANCEMENT OF THE EFFICIENCY OF IIND/IIIRD DEGREE REGIONAL DEPARTMENT OF DISTRICT DIRECTORATE OF MINISTRY OF INTERNALS

Veselin Kr. Raynov

ABSTRACT: *In this paper an enhancement of the efficiency of IInd/IIIrd degree Regional Department of District Directorate of Ministry of Internals is made.*

KEYWORDS*: Efficiency, Ministry of Internals, Regional Department.*

1. Introduction

A regional department is the main structure unit in a District Directorate of the Ministry of Internals. Different names have been used through the years – directorate of the surroundings, Municipal department. Up to 2014 "Transport police" regional department was part of the structure of the Ministry of Internal Affairs and it was part of Transport Police Department of the National Police General Directorate. What was specific for those units was that they were implementing counteraction to crime and protection of the public order in the railway transport and infrastructure on the territory of a few districts.

2. Main text

A Regional Department (IInd / IIIrd degree) of a District Directorate of the Ministry of Internals (herein referred as the Department) serve the territory of two or more Municipal centers with the adherent settlements (towns and villages) and their lands.

The following units are part of it, as they are managed by direct head of groups:

- "**Criminal Police" Group**, consisting of investigators and junior investigators in the following scope of activities:
- -"Criminality counteraction"
- -"Counteraction to Economy crimes", as well as
- -"expert – criminal specialists", res. Junior experts in Science Technical Laboratory / expert criminal activity;

- "**Security Police" Group**, which include police (junior police) inspectors and commanders of departments, as follows:
- - "territorial police"
- - "traffic control"

- - “public order security”
- - “junior auto controllers”
- - “policemen”

directly engaged with the road traffic control (for the department commander and the junior auto controllers) and the implementation of patrol-post duties (commanders and policemen),

- **Police station** (region of activity – particular municipal center and the settlements in the Municipality, including all adherent lands). In some cases one police station in a regional department in the District Directorate may serve more than one Municipal centers.

There are investigators and junior investigators in the following scope of activities in the stations:

- - “counteraction of criminal activity”,

as well as police (junior police) inspectors in the following scope of activity:

- - “territory police”.

In some stations in the country there are positions for “policeman” job, directly engaged with the fulfillment of the patrol – post activity.

In order to achieve better efficiency of the activity of the police workers of the above described self-contained units of a regional department, they may be distributed to work on both territorial (for the operative and uniformed personnel) and linear principle (for the operative personnel),

(*Linear principle here means – working in certain areas of activity – crimes against personality, against ownership, such related to vehicles, drugs, search of people, etc.*).

What is more, some auxiliary units function as a part of the regional departments in order to facilitate the main activities of the independent units, and namely:

- “**Operative duty part**” **unit**
- **Regional department administration**

Some employees of particular units and sectors of District Directorates fulfil their work duties in the Regional Departments, and namely:

- junior / senior investigating policemen in “Investigation” departments with place of implementation of their work duties in a given regional department, managed by the heads of the “Investigation” departments and directly subjected to the Head of “Investigation” Department in the respective District Directorate of the Ministry of Internals.

- Employees with no police authority, working in the Bulgarian Identity Documents Sectors with place of work in a given regional department, providing administrative services to the publicity with permanent

residence on the territory of the same regional department as per their Bulgarian Identity Documents (including Driver License).

Analyzing the main indicators of the regional department, its Management face planning tasks and conduction of a complex of organizational-management events in order to fulfill the objectives of the Ministry of Internal Affairs, related to crimes against personality, ownership of citizens, dangers to publicity, with accent on small and adjacent settlements.

Main highlight in the police work is also the work in counteraction of the organized crime, "human trafficking", production and distribution of drugs, corruption, counteraction to economic crimes, incl. in crimes, related to the distribution of excise goods with no banderole, when such required by law. Another important moment in the work of the police bodies shall be the prevention of fires, accidental situations, resulting from human intervention and / or negligence. The Management of a regional department shall focus special attention also on monitoring and control (through a complex of prevention measures) over risk groups, formed on age, ethnical, economical etc. signs.

Serious attention shall be given to the activity of the police bodies in relation of the road-transport traumatism and for the purposes of promotion of the drivers' culture. Last but not least, the enhancement of the efficiency in the investigation activity of the police bodies in the system of the Ministry of Internals should take place (having in mind the fact that not a few procedural-investigation actions may be assigned to police units, working in regional departments).

Each head of a regional department is facing the justified necessity of actual application of reasoned management decisions, targeting achievement of the needed management efficiency, overcoming interpersonal differences in order to improve the working environment. The result sought by the head of the department should be promotion of the public trust both in the Ministry of Internals and the regional department in question, and not the last, the trust to each employee in the department. The decisions planned shall be focused to each activity, fulfilled by the department. They should be directed towards enhancement of the structure results and getting a positive public valuation.

I – "Operational – search activity"

In accordance with Art. 8, Para 1 of the Law on the Ministry of Internal Affairs the operational-search activity is a complex of overt and covert actions of the operative-search bodies of the Ministry of Internal Affairs in counteraction of crime and the threats on the national security and the public order protection.

This activity is done by Employees, working in scope of activity "Criminality Counteraction" and "Counteraction to Economy crime" in the respective Regional Department of the District Directorate of the Ministry of Internal Affairs.

The Regional department personnel shall put efforts, as follows, for the implementation of the operative-search activity:

- Timely checks of received operative signals for particular crimes. The whole "arsenal" of operational-search methods should be applied in order to prevent untrusted information to be provided to the police bodies (incl. such, aiming to deviate the attention of the police from the significance of the particular crime). The time limits should be set in line with the specifics of each particular case and shall be monitored by the direct heads of the Police units, to which they are assigned. The time limits should be not too long (because of the possibility of evidence or /and facts concealment or destruction) and also to restrict the sense of impunity in the guilty people and in order to accuse them for criminal responsibility in order to fulfill an effective criminal repression against them.
- holding regular meetings with the people, representing the police units, their acquaintances etc.
- Effective usage of the Ministry of Internal Affairs available information funds.

The Management of each Regional Department shall precise the organization and tasks distribution in their department, for example the head may organize the work not only by the so called "territorial principle", but also by "linear principle", only by giving an internal order for that. This could bring to bigger personal participation of each investigator (junior investigator) and also to result in better and more efficient analysis, on the ground of which, particular measures against crimes to be scheduled and applied.

If operative information of significant importance is obtained that would help combating crimes, related to distribution of drugs and excise goods with no banderole, when required by Law, the Head of the Regional Department shall engage all the available police personnel, notwithstanding of the position taken, having in mind the fact that the Employees, fulfilling territorial servicing of the population, the Employees, implementing patrol-post activity and the Employees, fulfilling road control would enter in different situations with different participants and on different places (including such faraway).

II – „Security activity"

In accordance with Art. 14, Para 1 of the Law on Ministry of Internal Affairs the security activity is focused on public order protection and securing the safety of the road traffic in Republic of Bulgaria.

This activity (on level IInd/IIIrd degree Regional Department of Ministry of Internal Affairs) is fulfilled by police bodies, working in "territorial servicing of the population", "patrol – post activity" and "road control".

In order to achieve better efficiency when implementing security activity the Head of the regional departments may:

- Initiate changes in the legal framework concerning the requirements for occupation of the position of "junior police inspector" (due to the fact that in a small part of the regional departments in the country the number of working is incomplete), namely the elimination of the requirement for occupation of the post of minimum professional experience of 2 years. Initiation of changes in the regulations, concerning the appointment of officials from the Ministry of the Interior to issue slip for fines, to draw up acts for establishing administrative violations under the Road Traffic Act (RTA) and the Insurance Code (IC), proposedly that such powers should also be conferred on patrol officers. This would lead to a greater saturation of the territory served by the regional department with police forces with powers under the RTA and the Criminal Code, which in turn would lead to efficiency in carrying out administrative - criminal repression against the violators of the RTA and the Criminal Code.
- Performing "rotations" of the "territorial police" Employees in carrying out their assigned tasks in control activity in compliance with the Law on Public Administration and the Criminal Code, as the Employees are directed to work in this direction beyond their designated ones (according to the instructions for organization of activities in the Ministry of Interior territorial services to the population) regions.
- Participation of the "uniform personnel" in different events, targeting to introduce the publicity both to the specifics of the police work and the applied positive practices.

3. Conclusion and future work

In conclusion, beside the vision presented above for some of the methods for promotion of the efficiency of the IInd / IIrd degree regional directorate of District Directorate of the Ministry of Internal Affairs the heads of the regional departments shall fully apply the instruments under the Law on Ministry of Internal Affairs in order to promote manifestation of professional attitude, high results achieved, particular significant impact, but

also to seek disciplinary responsibility for significant omissions of the personnel.

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Author's name and academic degrees and titles: Veselin Kr. Raynov, PhD student

Workplace: Faculty of Technical Sciences, Department „Management of security systems", Konstantin Preslavsky University of Shumen, Shumen, Bulgaria

E-mail: vesselin.raynov@gmail.com

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