VILNIUS UNIVERSITY

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OPTIMIZATION OF MILITARY AIRNAVIGATION CHARTS

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INTRODUCTION

Paper relevance:

The relevance of the paper derives from the evaluation of semiotic aspects, content and design of military air navigation charts. From a semiotic point of view, the conventional symbols and signs of military air navigation charts in Lithuania have not been yet investigated. The cartosemiotic analysis of signs in use will enable the optimisation of used signs systems and their perception. The results and recommendations that arise from it will enable a clear practical applicability of military aircraft and helicopter traffic to ensure reliability and safety.

Paper originality:

After Lithuania had regained its independence, the Military air force was restored also, a need of military cartography works appeared. Many cartographic maps and specifications were proposed by the NATO partners, therefore, a necessity to evaluate the foreign experience and the quality of the offered cartographic works arose, which was based on the provisions and traditions of a forming Lithuanian cartosemiotic school. Military air navigation charts, their signs, signs systems, notes have not been investigated in Lithuania until now. Therefore, it is clear that before initiating military air navigation charts of Lithuania, optimized signs specifications, databases and a corresponding air navigation chart formation procedure is necessary.

Paper scientific proposition:

The scientific proposition of this paper was formed, during the analysis and research, and it is based on the fact that after joining the NATO, new military air navigation charts which were created by the specifications and standards of the Western European countries were being used in Lithuania, this allows to suggest that the used signs, signs systems and notes in the air navigation charts contravene the Lithuanian cartosemiotic demands.

The object of investigation:

NATO military air navigation charts signs, sign systems and notes evaluation, using a complex semiotic evaluation methodology.

The aim:

To improve an understanding of cartosemiotics being presently used in military air navigation chart marking systems, separate signs of military air navigation charts and their notes, optimise the content of the charts and create a unanimous Lithuania's military air navigation database structure.

The objectives:

1. Perform an overview analysis on the purpose and applicability of military air navigation charts.
2. Perform military air navigation chart elements' analysis and summarize research data.
3. Perform a cartosemiotic analysis of military air navigation charts content, markings and notes.
4. Form formation requirements for Lithuania's military air navigation database and submit recommendations for the formation of this database.
5. Submit recommendations for operative identification, gathering and administration of information about air navigation obstacles.
6. Create methodic specification additions for the creation of Lithuania's military air navigation charts.

Defended propositions:

1. An improved thematic map and markings of cartosemiotic evaluation analysis allows to thoroughly and qualitatively perform various chart marking and note analysis, and can be applied for the evaluation of military air navigation chart markings, marking groups and notes.

2. All military air navigation chart consolidated geographic basis is strongly generalized with the aim to highlight specific content items and other relevant air navigation information.

3. Military air navigation chart markings, marking systems and notes, currently used in Lithuania, contravene the Lithuanian cartosemiotic requirements and traditions, resulting in encumbrance of map readability. Markings, marking systems and notes should be improved and standardised, depending on the established requirements of Lithuanian cartography.

4. A unified military air navigation database would allow to collect, organize, analyze and update the range of air navigation information and other flight safety critical data. One of the most important attributes in the database would be to regularly check and update vertical obstacles over 60 meters.

Practical significance:

Given the fact that the current Lithuanian cartographers use foreign military specifications for air navigation chart preparation, the dissertation offers new, cartosemiotically eligible and Lithuania approved signs, which are presented as a part of Lithuanian air navigation cartography specifications. Also, the military air navigation database structure, would systematically allow to collect various air navigation information and facilitate the air navigation cartography and its updates.

Structure of paper:

The work consists of an introduction, three main parts and conclusions. The introduction presents the problem investigation, the topicality of the study, objectives of the study, author's published dissertation topic publications of scientific journals and presentations at scientific conferences. Publications and cartographic sources for air navigation cartography analysis are given in the first part, and earlier research, connected to the dissertation topic, is reviewed, and their analysis is performed. This section also includes military air navigation charts and air navigation conventional marking classifications, standards, and requirements for air navigation marking systems. The second part analyzes the military air navigation charts' content structure, and research

methods are presented. The third section contains the results of the work related to cartosemiotic military air navigation chart analysis; the results which were gathered during the analysis are summarized, and recommendations for the optimization of military low-flight air navigation chart conventional markings, used and created by the NATO countries, are given. In this part, air navigation charts' database project and methodical provisions of the information for the gathering of vertical obstacles and their administration are given. The conclusions summarize the results. Newly recommended military air navigation chart marking specification adds and air navigation markings, used in 1937 in Poland, are given in the dissertation additions.

LITERATURE REVIEW AND PREVIOUS RESEARCH REVIEW

Documents, regulating military air navigation mapping in NATO countries, are NATO STANAG (Standartisation document) and specifications of separate maps of NATO country members. STANAG defines the general principles of air navigation mapping; it determines the map contents, marks and marking systems. STANAG defines the general principles of air navigation cartography, determines map contents, marks and mark systems. It also provides the nomenclature of various scale cartography division within pages, aspects related to countries responsibilities, their inclusions and limitations among other things. The information in STANAG documents is mostly as a recommendation in nature and does not fully describe air navigation cartography features. A wide gap is left for the interpretation and possible additions.

While analyzing military air navigation charts and performing their assessment, the analysis was based on cartosemiotic methodologies, which are described in M. Dumbliauskiene‘s book “Cartographic Communication Basics“ (Dumbliauskiene, 2002). In this book, the author focused on the cartographic communication theory, the concept, mapping communication efficiency, marking system foundations. The dissertation was based on interaction communications, which result in an air navigation chart marking system and the analysis of the markings: object → cartographer → recipient (user).

Lithuania's military air navigation charts, their marks and systems had little researched. One of the first works in Lithuania, which was largely devoted to the marine navigational maps, but also to a large extent, affected by the air navigation charts and marks, were by Helena Vaitkevičienė's dissertation "GIS application for special purpose mapping and analysis techniques optimization (by the example of navigational maps)“. In this thesis, the author presented an overall synoptic civil air navigation chart classification and analyzed certain air navigation marking systems and their patterns. This thesis also examined air navigation cartography different note categories and their group compatibility. A very important aspect of cartosemiotics was examined: the civil air navigation chart conventional markings and symbol system correctness and evaluation. Marks and their systems were tested over a group of semantic similarity analysis: character shape, size, and color.

The research of chart marks and marking systems have been analysed in Aleksandras Berliantas‘s book “The View of Space: Map and Information” (Berliantas, 1986). Alexander Berliantas conducted a wide range of research related to cartographic image formation, understanding the principles of cartographic modeling, the ways of mark and map presentation. Author's research findings emphasize spatial map marking perception through cartographic triad: sign → image → information. Great attention was paid to exploring psychophysical cartographic image features. While drawing comparison of the marks of military air navigation profile, the work was followed by A. Berliantas’s purposive map reading scheme.

AIR NAVIGATION MILITARY CHART CLASSIFICATION

Currently worldwide set up military classification was used in analysys in order to prepare air navigation charts, while taking their level of standartisation into account. The military, as well as civil air navigation charts, ensure the safety of flight in these phases of flight:

– Control of the aircraft from the parking place to the take-off point;

– Take-off and increase in height;

– Flight, according to the route;

– Height reduction;

– Descent and, if needed, a fly over with the second landing;

– Control of the aircraft to parking space.

General-purpose small-scale air navigation charts are used for long-distance flight planning, surveying and measuring of navigational situations. Global air navigation charts of scale 1:5 000 000 are intended to plan, administer, manage, and execute long-distance flights. Charts of such scale are also used for larger scale air navigation charts. Air navigation 1:250 000 - 1:2 000 000 scale charts are designed to plan, manage and implement short- and medium-distance flights.

The military air navigation charts are divided into two main groups: operational and special air navigation charts (Figure 2).

Operational air navigation charts, in turn, are divided into:

– GNC – Global Navigation Chart;

– JNC – Jet Navigation Chart;

– ONC – Operational Navigation Chart;

– TPC – Tactical Pilotage Chart;

– JOG – Joint Operation Chart;

– Radio navigation charts.

Classification of NATO military air navigation charts

	Operational - navigation charts	Special charts	
Standardized scales, markings and other information STANAG 3677 3675 3600	JOG 1:250 000	TFC (L) 1:250 000	Standardized projections STANAG 3409
	TPC 1:500 000 ONC 1:1 000 000 JNC 1:2 000 000	LFC 1:500 000	
	GNC 1:5 000 000		
	Radionavigation charts (non-standartized)	Maneuver charts (various sclaes) Airport charts (non-standartized) Synoptic charts (non-standartized) Meteorological maps (non-standartized)	

Figure 2. Classification of NATO military air navigation charts.

Special air navigation charts are divided into:

- TPC(L) – Transit Pilotage Chart (Low);
- LFC – Low Flying Chart;
- Maneuver charts;
- Airport charts;
- Synoptic charts;
- Meteorological charts.

All these military air navigation charts are meant for a very broad scope of tasks: planning, routing, traffic management, navigation, aircraft at low altitude above ground level and traffic management at airports.

2. RESEARCH METHODOLOGY

The most important task is the cartographer’s surround sound encoded graphic communicative piece of information for the chart creation. This means that the chart maker has to take into consideration all aspects of the user's needs, while evaluating his cartographic analytical skills. It is extremely difficult to ensure proper communication quality of the maps, which is often accompanied with the usual non-generalized or minimally generalized topographical basis of the air navigation information. The latter greatly increases the load of the information in the map, burdens its readability and communication.

The military air navigation charts in the dissertation were based on the semiotic analysis of the principles of graphic symbols. This allowed to perform air navigation semiotic analysis and the use of markings to submit proposals for the following use of marks and their improvement. In view of the findings, the developed aeronautical structural classification of marking, including special low-level flight M 1:500 000 chart markings and operational air navigation chart conventional marks.

Analyzing air navigation charts, 5 most used military aviation maps were selected:

– LFC, M 1:500 000; (Low Flight Chart)

– JOG, M 1:250 000; (Joint Operation Chart)

– ONC, M 1:1 000 000; (Operational Navigation Chart)

– TPC, M 1:500 000; (Tactical Pilotage Chart)

– JNC, M 1:2 000 000. (Jet Navigation Chart)

During semiotic analysis, the aim was to determine how the conventional markings, used in air navigation charts, correspond with carto-linguistic and cartosemiotic requirements by:

1. The vocabulary or semantics of the marking expressions;

2. Sign combination into groups or syntax.

While performing an entire navigational conventional marking analysis of air navigation charts, their shape, color and size were analyzed. Received results of the analysis are captured in the report form (Table 1). Operational chart marks were evaluated in individual groups, i.e. properties in certain groups were assessed (Table 2).

Table 1. Semantic evaluation of military LFC marks.

Mark description	Marks	Mark similarity				Examples of navigational mark logical structure improvements		
		By shape	By size	By color		By shape	By size	By color
				Range	Contour			

Table 2. Semantic evaluation of operational air navigation chart conventional markings.

Mark description	Marks	Mark similarity				Examples of navigational mark logical structure improvements			
		By	By	Gro	By color	By	By size	By	By

		shape	size		Range	Contour	shape		color	groups

While investigating military air navigation chart conventional marks, in a cartosyntactic aspect, to perform and summarize its analysis, a formula was created, which gives a semantic mark differentiation, hierarchic and contradictive expressions (Table 3). Sign contradiction resolution ratio is an important criterion therefore it was included in the table of analysis' syntactic marking. Contradiction resolution through the mark shape and color was rated.

Table 3. Syntactic analysis table

Mark groups	Semantic differentiation			Hierarchic resolution			Contradictions resolution		
	Correct	Incorrect	None	Correct	Incorrect	None	By shape	By color	None
Dangerous objects and obstacles									
Warning operation marks									
Navigation help marks									
Low flight information									
Coastal installation									
Night low flight routes									
Air navigation restrictions									
Aerodromes and lift off/landing trails									
Operational map marks									

Performing an air navigation chart (JOG, LFC, TPC, ONC and JNC) pragmatic evaluation was developed, which aims to determine the transmission quality and complexity, properties in certain groups, focused on a comprehensive evaluation of various air navigation charts. Such a procedure is necessary, in order to objectively determine each sufficient different map quality and value use. For this purpose we have designed a report form, which quantified pragmatic criteria: graphical load, the informative load, cartographic load, graphical originality, standardisation, readability and information value (Table 4).

Table 4. Air navigation chart pragmatic criteria

Map title	Graphical load	Informative load	Cartographical load	Graphical originality	Level of standartisation	Readability	Informative value	Overall evaluation

In order to pinpoint the use and information and graphic air navigation chart load, an evaluation method has been developed to objectively estimate the help of this chart load characteristics.

Performing the evaluation of air navigation chart readability in maps, 5 x 5 cm record plots were used, i.e. 25 square cm, which had the informative map load estimated, excluding air navigation markings, which also heavily load the maps (Table 5).

Table 5. Informative aeronautical map load

Map title	marks/1 decimeter (max.)	marks/1 decimeter (min.)	marks/1 decimeter (med.)	Comments

Determining the graphic military air navigation chart load, the same 5 x 5 cm record plots were used as for determining the informative load. In order to establish graphical chart of the load, it is necessary to calculate the area of cartography elements in each plot and to obtain the overall chart graphical load average. All cartographic chart elements are areal, linear, raster objects or inscriptions.

The graphical map load can be expressed by the formula: $A_{ž} =$

$$\frac{A_p + A_l + A_t + A_{už} \text{ x } 100}{Map\ territory}$$

where $A_{ž}$ – map graphical load percentage.

A_p – relative polygon cartography load of the elements;

$A_p = \sum p \text{ x } 0{,}0125$

where p – linear cartography elements (units).

A_l – load of linear mapping elements;

$A_l = \sum l \text{ x } 0{,}02$

where l – length of linear cartography elements (in cm).

A_t – dotted cartographic elements load;

$A_t = \sum t \text{ x } 0{,}0125$

where t – load of dot cartography elements (units).

$A_{už}$ – notes load;

$A_{už} = \sum už \text{ x } 0{,}0125$

where $už$ – individual letters or symbols (units).

Using a formula, chart or chart fragment graphical load percentage is calculated. Later, according to this indicator, and theoretically optimal load (5-12 percent) navigation graphical chart load can be optimised, generalising one or few chart layers.

All air navigation charts (JOG, LFC, TPC, ONC and JNC) notes were analysed integrally (Table 6). The contour simplicity, shape and letter clarity, contrast,

compactness and harmony are evaluated. The notes are evaluated for two criteria in accordance with (+) or without (-).

Mark note description	Font	Note example	Contour simplicity	Form and individual letter clarity	Contrast	Compactness	Harmony

In order to evaluate the efficiency of air navigation chart load, its readability, and to objectively analyze the applicability of the proposed markings, various respondents were interviewed with a questionnaire. The total number of respondents was 120. They were split up into three groups:

Pilots,

Cartographers,

other chart users.

All respondents are citizens of Lithuania and have graduated high schools in Lithuania. This suggests that a unified secondary school geography program gave equal content of cartosemiotic perception.

The questionnaire presented old and new markings, the respondents were offered to select those, which they consider to visualise the represent objects more accurately and better. Also, the old and the new marks were given in various fragments of the map, where the use of a time determines which marks are found faster. In this way, marks, which have a larger logical connection with the represented object, were selected. In extreme situations, when the time to look for marking on the map is very short, these characters will significantly help for faster orientation in navigation.

PSYCHOPHYSICAL AIR NAVIGATION CHART PERCEPTION ASPECTS

New marking creation or improvement of existing cartographic marks was based on cartographic mark and form perception research, performed by cartographers. It was based on results of mental perception analysis of various forms and shapes and by elementary principles of mark analysis (Vostokova, Košel, Ušakova 2002, Bevainis 2011, Ročiūtė 2009, Dumbliauskienė, Ročiūtė 2009). Applying the analysis of military air navigation mark development, efforts have been made to create the simplest possible mark that meets the psychological perception of optimum performance. For example, new signs are offered to be sharp edged or, where possible, mark filler is proposed.

All of the above listed understanding criteria were applied to the analysis of existing air navigation marks and developing or improving the newly proposed air navigation marking specification.

AIR NAVIGATION CHART CONTENT STRUCTURE

General geographic elements

All military air navigation charts have a certain generalised topographic basics. In operative maps with a scale of 1:500 000 and finer, a generalised topographic surface image is cartographed. Objects and terrain elements' shape is indicative.

Terrain, a hydrographic network, vegetative elements, engineering objects, urban territories and the state border are cartographed in a map.

Special military air navigation charts are made on a normal topographic base, but a lighter color is used in them. This is done in order to highlight the critical air navigation information.

Special elements of content

All air navigation charts have many limiting marks. A bright (red, blue) colour, and intense tones are used to show them. Military aeronautical charts due to the ever-changing tactical situations and chart analysis, restricted by time therefore use bright colours.

In operative charts, special content elements are cartographed in blue, combined with the shadow effect. The maps display:

– airports;

– radionavigation marks;

– visual navigation marks;

– conventional restriction marks;

– obstacles;

– maximum heights;

– contour lines.

In specially designed military air navigation charts dark blue, red, purple, green and orange colors are used. These colors can have shades and shadows. With these colors the following is cartographed:

– warning signs of an air obstacle, airports, beacons, shore lines of communication wiring, power lines, control lines, landing paths are mapped in blue;

– terrestrial obstacles, various vertical obstacles, power lines (TFC (L)), paratrooper areas, flight prohibition areas, high-intensity radio frequency zones are mapped in red;

– air routes for low-altitude flights during the day are mapped in a purple color;

– air routes for low-altitude flights at night are mapped in green;

– pipeline inspecting helicopter air routes are mapped in orange.

MILITARY AIR NAVIGATION CHART CONTENT ANALYSIS

Performing the military air navigation chart analysis, 5 standard NATO air navigation charts were reserched. The study was focused on seven separate analyses of criteria that fully explore the cartosemiotic point of view. Analysis of the following criteria:

1. Semantics of military air navigation chart conventional markings.
2. Syntactics of air navigation chart markings.
3. Pragmatics of air navigation charts.
4. Optimality of the notes.

5. Readability of the air navigation chart markings.

6. Readability of the air navigation chart notes.

7. Readability of the air navigation chart overall geographic notes.

8. Graphic load of the military air navigation charts.

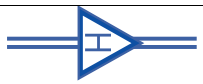
A complex questionnaire was developed to evaluate these criteria; it was sent to 120 users: military pilots, air traffic services dispatcher personnel, cartographers and respondents, who do not belong to either of the groups listed above.

Evaluation of military air navigation chart conventional markings

Performing this evaluation, 141 low flight chart (LFC), joint operation chart (JOG), tactical piloting chart (TPC), operative navigation chart (ONC) and jet aircraft navigational chart (JNC) air navigation markings were analysed. The analysis of all the markings was performed complexically, because the formed air navigation chart markings are often identical or very similar, however, often having a different meaning. This situation can be misleading for the recipients, military pilots.

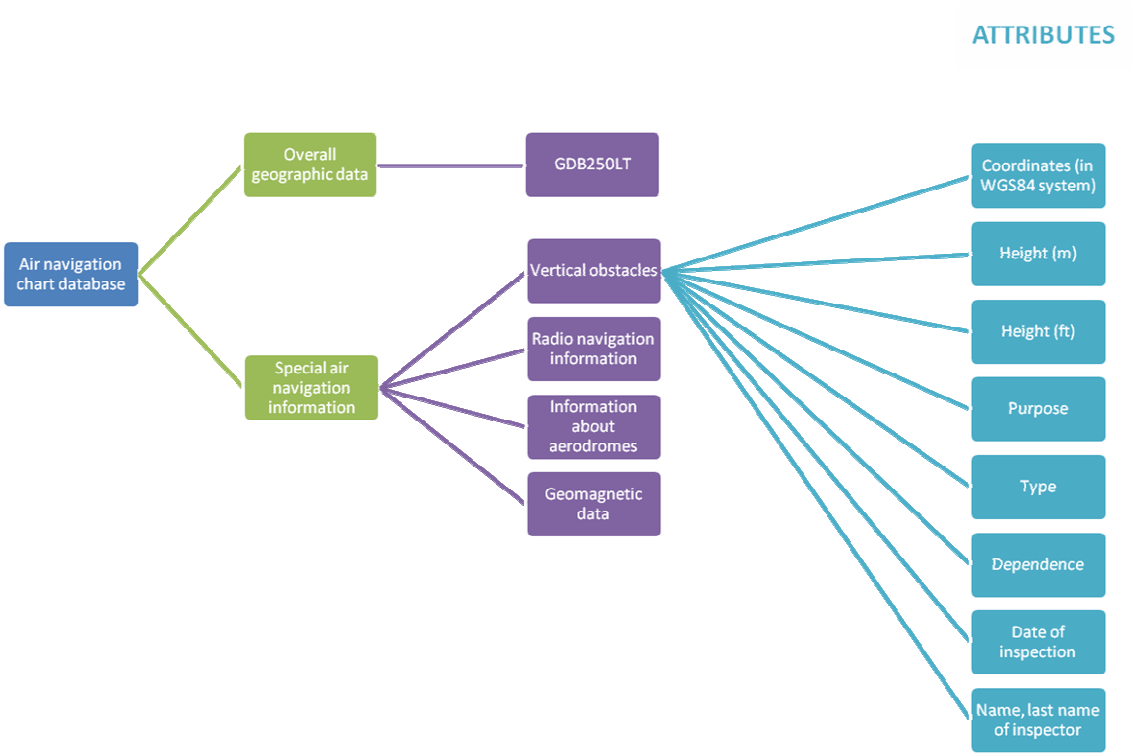
Performing the semantic marking evaluation, it is stated that air navigation markings are not completely identical they often differ, when marking the same phenomena. Some of them must be changed. The proposed new marks account for 16 percent of all marks analyzed and are presented in the table.

The newly proposed aeronautical characters

Object description	Conventional markings
Overland helicopter routes	
Helicopter route	
Helicopter corridors	
Glider protection zone	
Tow glider hang site	
Hang glider site with starting device	
Marine light	
Light vessel	
Lighthouse with a radio navigation transmitter	
Glider activity	
High intensive radio transmitter area (HIRTA)	
Suspended obstruction	
High tension power line poles on one line and the height of 80-200 feet	
High tension power line pole height of 200 feet	
Aerodrome with a hard runway over 3,000 feet	
Minor aerodrome with unknown runway (JOG)	
Civil aerodrome with an unknown runway (ONC, JNC)	
Military aerodrome with an unknown runway (ONC, JNC)	
Civil-military aerodrome with an unknown runway (ONC, JNC)	

STRUCTURE OF MILITARY AIR NAVIGATION CHART DATABASE, FIXATION OF VERTICAL OBSTACLES, INFORMATION INSPECTION AND ADJUSTMENTS

At the moment, conclusion of the military and civilian air navigation charts are compiled from a variety of cartographic, textual, statistical, cadastral sources. The required information is provided by different agencies, which gather the data by different standards. For this reason it makes sense to form a unified military air navigation database, where air navigation data would be collected, processed, analyzed, stored and updated. With the help of such database a fast and high-quality military air navigation charts update would be ensured.



One of the most important problems, while creating military air navigation charts, is the lack of systematic information about air navigation obstacles, which in height are greater than 60 meters (200 feet). A list of 100 meter high and above air navigation obstacles is administrated by the National Land Service under the Ministry of Agriculture. Data is given to them by a state-owned company "*Oro navigacija*", which is engaged in the administration of height obstacles by ICAO requirements. Still, it is necessary by NATO requirements to collect data about obstacles, whose height is over 60 meters. The gathering of such information should be entrusted to a certain branch of the Lithuanian Armed Forces. The same branch could administrate this data and update it in the Lithuanian military air navigation database. The data about air navigation obstacles would be gathered in an informative record form, which could show the most important attribute information.

Vertical obstacle verification form

Title	Vilnius television tower	Comments
Purpose of building	Television cable transmission	
Height above sea level	593,3 m / 1704,5 ft	
Height above ground level	325,5 m / 1071,2 ft	
Construction description	Ferroconcrete	
Coordinates WGS 84	6167823,2; 565723,4	
Year of build	1980	
Owner	State building	
Name, last name, signature of inspector	John Smith	
Date of inspection	2010.11.08	

CONCLUSIONS

1. Literary analysis showed that the air navigation chart markings and their system in Lithuania has not been studied. Mark systems research in Lithuania was limited to traditional natural, social and economic chart cartosemiotic analysis, resulting in some recommendations for chart of semantic, syntactic and pragmatic properties' improvement. With the help of these studies, a cartosemiotic Lithuanian school was formed.

2. Previous findings and conclusions were set and showed cartosemiotic irregularity of some of the air navigation chart military air navigation marks, which allowed to think that there are discrepancies to the traditional cartographic requirements (canons) in all military air navigation charts.

3. After examining military NATO countries' charts and according to a unified chart system, classification features and corresponding classification requirements, a summarized NATO countries' military air navigation chart classification was given, which provides a possibility to be able to integrate the emerging mapping groups.

4. A complexically prepared research method was based on the earlier established thematic chart and marking cartosemiotic Lithuanian evaluation practice. Various marking and note aspects allowed to accurately and thoroughly perform air navigation mark and note evaluation, in pursuance to reveal possible military air navigation chart cartosemiotic discrepancies and errors.

5. Psycho-physiological cartographic sight perception aspects is without a doubt the basis in the chain: detonates – cartographer – recipient. Military air navigation mark analysis and perfection was based on earlier performed psycho-physiological perception research and conclusions. New proposed air navigation chart markings completely meet the psychophysical research recommendations.

6. It was found that all military air navigation chart content structure, taking into account the scale and purpose of the chart, has a sufficiently strong basis for generalized overall geography. Meanwhile, the specific content elements are the most developed, in order to convey as much air navigation information as possible.

7. After military air navigation chart mark analysis, it was noted that not all air navigation marks meet cartosemiotic requirements and must be improved. The newly set up military air navigation chart markings are simpler, equivalent to human psychophysical perception criteria, creates faster communication and less load on the chart. The proposed marks and mark specification accessories semiotically are more accurate and are in accordance with the established tradition of Lithuanian cartography, so it can be effectively adapted to the conclusion of military air navigation charts of Lithuania.

8. Analysing the military air navigation chart notes, it was noticed that all the notes are correct and semiotically fully compliant with their tasks. According to possibility, notes minimally load the charts, giving the marks the maximum possible additional information.

9. Recommended military air navigation database could be useful for military and civilian authorities in Lithuania and other countries. Unification of database would allow quick and qualitative upgrading of military air navigation charts of the territory of Lithuania. Due to the update frequency, the reliability of data and chart cartosemiotic quality depends on the country's air navigation safety. The proposed vertical obstacle (over 60 m) scheme would ensure the collection of reliable data on obstacle collection, processing and storage in Lithuania.

Published scientific papers:

1. Donatas Ovodas, Algimantas Česnulevičius. Military air navigation database in Lithuania. *Polska kartografia w dobie przemian metodycznych i technologicznych*. Warszawa: Polskie towarzystwo geograficzne, 2010, s. 215–216. ISBN 978-83-62089-13-0.

2. Donatas Ovodas, Algimantas Česnulevičius. Karinė aeronavigacinė kliūčių duomenų bazė Baltijos šalyse. *Matavimų inžinerija ir GIS* . Kaunas: Kauno kolegija, 2010, p. 19–23. ISSN 2029-5790.

3. Donatas Ovodas, Algimantas Česnulevičius. Baza danych wojskowych map lotniczych w krajach bałtyckich. Polski Przegląd Kartograficzny • TOM 43 • 2011 • NR 4 s. 369-376. ISSN 0324-8321.

4. Donatas Ovodas, Algimantas Česnulevičius. Semantics aspects of Military aeronautical charts. 6th Vilnius seminar on Cartography and Cartosemiotics. Vilnius: ISA Commission on Theoretical Cartography, Lithuanian Cartography Society, Centre for Cartography, Vilnius University. 2011, p 40-46. ISBN 9955-9673-9-6.

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SANTRAUKA

ĮVADAS

Darbo aktualumas:

Darbo aktualumas išplaukia iš semiotinio karo aeronavigacinių žemėlapių formos, turinio bei dizaino vertinimo. Lietuvoje semiotiniu požiūriu karinių aeronavigacinių žemėlapių sutartiniai ženklai bei ženklų sistemos nėra tirtos. Kartosemitinė naudojamų ženklų analizė įgalins optimizuoti naudojamas ženklų sistemas bei jų suvokimą. Tyrimo rezultatai bei iš jo išplaukiančios rekomendacijos turės labai aiškų praktinį pritaikomumą karo lėktuvų ir sraigtasparnių skrydžių patikimumo užtikrinimui.

Darbo naujumas:

Lietuvai atkūrus nepriklausomybę atsikūrė ir Karinės oro pajėgos, atsirado karinės kartografijos kūrinių poreikis. Daug kartografinių žemėlapių ir jų specifikacijų pasiūlė NATO partneriai, todėl iškilo būtinybė įvertinti užsienio patirtį bei siūlomų kartografinių kūrinių kokybę, remiantis besiformuojančios lietuviškos kartosemiotikos mokyklos nuostatomis ir tradicijomis. Iki šiol kariniai aeronavigaciniai žemėlapiai, jų ženklai, ženklų sistemos, užrašai kompleksiškai Lietuvoje nebuvo tirti. Todėl, akivaizdu kad prieš pradedant sudarinėti karinius aeronavigacinius žemėlapius Lietuvoje, reikalingos optimizuotos ženklų specifikacijos, duomenų bazės ir atitinkama aeronavigacinių žemėlapių sudarymo tvarka.

Darbo mokslinė problema:

Analizės ir tyrimų metu suformuota darbo mokslinė problema grindžiama tuo, kad Lietuvai įstojus į NATO Lietuvoje pradėti naudoti kariniai aeronavigaciniai žemėlapiai kurie sudaromi vadovaujantis vakarų Europos šalių specifikacijomis ir standartais, tai leidžia daryti prielaidą kad naudojami karinių aeronavigacinių žemėlapių ženklai, ženklų sistemos ir užrašai neatitinka lietuviškos kartosemiotikos reikalavimų.

Tyrimų objektas:

NATO karinių aeronavigacinių žemėlapių ženklų, ženklų sistemų ir užrašų vertinimas naudojant kompleksinę semiotinę vertinimo metodiką.

Darbo tikslas:

Kartosemiotinės analizės pagrindu patobulinti dabar taikomų karinių aeronavigacinių ženklų sistemas, atskirus žemėlapių ženklus bei jų užrašus, optimizuojant žemėlapių turinį ir sukuriant vieningą Lietuvos karo aeronavigacinių duomenų bazės struktūrą.

Darbo uždaviniai:

1. Atlikti karinių aeronavigacinių žemėlapių paskirties ir pritaikomumo apžvalginę analizę.
2. Atlikti karinių aeronavigacinių žemėlapių elementų analizę bei apibendrinti tyrimo duomenis.
3. Atlikti kartosemiotinę karinių aeronavigacinių žemėlapių turinio, ženklų ir užrašų analizę.
4. Suformuluoti Lietuvos karinės aeronavigacinės duomenų bazės sudarymo reikalavimus ir pateikti rekomendacijas šios duomenų bazės sudarymui.
5. Pateikti rekomendacijas informacijos apie aeronavigacines kliūtis operatyviam identifikavimui, rinkimui ir administravimui.
6. Sukurti metodinius specifikacijų priedus Lietuvos karinių aeronavigacinių žemėlapių sudarymui.

Ginami teiginiai:

1. Patobulinta teminių žemėlapių ir ženklų kartosemiotinė vertinimo metodika leidžia nuodugniai ir kokybiškai atlikti įvairių žemėlapių ženklų ir užrašų analizę ir gali būti taikytina kariniams aeronavigacinių žemėlapių ženklams, ženklų grupėms ir užrašų vertinimui.

2. Visų karinių aeronavigacinių žemėlapių bendrageografinis pagrindas yra stipriai generalizuotas su tikslu išryškinti specialiuosius turinio elementus ir kitą svarbią aeronavigacinę informaciją.

3. Šiuo metu Lietuvoje naudojamų karinių aeronavigacinių žemėlapių ženklai, ženklų sistemos ir užrašai neatitinka lietuviškos kartosemiotikos reikalavimų ir nusistovėjusių tradicijų, ko pasekoje apsunkinamas žemėlapio skaitomumas. Ženklai, ženklų sistemos ir užrašai turi būti tobulinami ir standartizuojami atsižvelgiant į Lietuvos kartografijoje nusistovėjusius reikalavimus.

4. Unifikuota karinių aeronavigacinė duomenų bazė leistų kaupti, sisteminti, analizuoti ir atnaujinti įvairią aeronavigacinę informaciją ir kitus skrydžių saugumui svarbius duomenis. Vienas iš svarbesnių bazės atributų būtų nuolat tikrinamos ir atnaujinamos vertikalios kliūtys virš 60 metrų.

Praktinė darbo reikšmė:

Atsižvelgiant į tai, kad šiuo metu Lietuvos kartografai naudoja užsienio šalių specifikacijas kariniams aeronavigaciniams žemėlapiams parengti, disertacijoje siūlomi nauji, kartosemiotikos reikalavimus atitinkantys ir Lietuvoje aprobuoti ženklai, kurie pateikiami kaip lietuviškos aeronavigacinių žemėlapių specifikacijos dalis. Taip pat pateikta karinių aeronavigacinių duomenų bazės struktūra, kuri leistų sistemiškai kaupti įvairią aeroanvigacinę informaciją ir palengvintų aeronavigacinių žemėlapių sudarymą ir atnaujinimą.

Darbo struktūra:

Darbas susideda iš įvado, trijų pagrindinių dalių ir išvadų. Įvade pristatoma tiriama problema, tyrimo aktualumas, tyrimo tikslas, tyrimo uždaviniai, disertacijos tema autoriaus paskelbtos publikacijos mokslo leidiniuose bei pristatymai mokslinėse konferencijose. Pirmoje darbo dalyje pateikta publikacijų ir kartografinių šaltinių, skirtų aeronavigaciniaims žemėlapiams analizė bei apžvelgiami ankstesni su disertacijos tema susiję tyrimai ir atlikta jų analizė. Šioje dalyje taip pat pateikiamos karinių aeronavigacinių žemėlapių ir aeronavigacinių sutartinių ženklų klasifikacijos, standartai, bei reikalavimai aeronavigacinių ženklų sistemoms. Antoje dalyje analizuojama karinių

aeronavigacinių žemėlapių turinio struktūra bei pristatoma tyrimo metodika. Trečioje dalyje pateikiami darbo rezultatai, susiję su kartosemiotine karinių aeronavigacinių žemėlapių analize, apibendrinami analizės metu gauti rezultatai ir pateiktos rekomendacijos NATO šalių naudojamų ir kuriamų karinių žemų skrydžių aeronavigacinių žemėlapių sutartinių ženklų optimizavimui. Šioje dalyje pateiktas aeronavigacinių žemėlapių duomenų bazės projektas bei informacijos apie vertikalių kliūčių rinkimą ir jų administravimą metodinės nuostatos. Išvadose apibendrinami tyrimų rezultatai. Disertacijos prieduose pateikti naujai siūlomų karinių aeronavigacinių žemėlapių ženklų specifikacijų priedai ir 1937 metais Lenkijoje naudoti aeronavigaciniai ženklai.

IŠVADOS

1. Literatūros analizė parodė, kad aeronavigacinių žemėlapių ženklai ir jų sistemos Lietuvoje nebuvo tirti. Ženklų sistemų tyrimai Lietuvoje apėmė tik tradicinių gamtinių, socialinių ir ūkinių žemėlapių kartosemiotinę analizę, ko pasėkoje buvo suformuluotos rekomendacijos žemėlapių semantinių, sintaktinių ir pragmatinių savybių gerinimui. Šių tyrimų dėka susiformavo lietuviškoji kartosemiotinė mokykla.

2. Ankstesnių tyrimų rezultatai ir apibendrinimai nustatė ir parodė kai kurių aeronavigacinių žemėlapių karinių aeronavigacinių ženklų kartosemiotinį netaisyklingumą ir leido manyti, kad visuose kariniuose aeronavigacinuose žemėlapiuose yra neatitikimų tradicinės kartografijos reikalavimams (kanonams).

3. Išnagrinėjus karinius NATO šalių aeronavigacinius žemėlapius ir atsižvelgiant į vieningą žemėlapių sistemą, klasifikacijos požymius ir atitinkamus klasifikacijų reikalavimus, pateikta apibendrinta NATO šalių karinių aeronavigacinių žemėlapių klasifikacija, kurioje yra numatyta galimybė sugebėti integruoti naujai atsirandančių žemėlapių grupes.

4. Kompleksiškai parengta tyrimo metodika rėmėsi Lietuvoje nusistovėjusia teminių žemėlapių ir ženklų kartosemiotine vertinimo praktika. Įvairūs ženklų ir užrašų vertinimo aspektai leido tiksliai ir nuodugniai atlikti aeronavigacinių ženklų ir užrašų vertinimą, siekiant atskleisti galimus karinių aeronavigacinių žemėlapių kartosemiotinius

neatitikimus bei klaidas. Ženklų palyginimo anketos pagalba sėkmingai aprobuoti naujai siūlomi ženklai.

5. Psichofiziologiniai kartografinių vaizdų suvokimo aspektai yra neabejotinas pagrindas grandyje denotatas – kartografas – recepentas. Karinių aeronavigacinių ženklų analizė ir tobulinimas rėmėsi ankščiau vykdytais psichofiziologinio suvokimo tyrimais bei išvadomis. Siūlomi nauji aeronavigacinių žemėlapių ženklai pilnai atitinka psichofiziologinių tyrimų rekomendacijas.

6. Nustatyta, kad visų karinių aeronavigacinių žemėlapių turinio struktūra, atsižvelgiant į mastelį ir žemėlapio paskirtį, turi pakankami stipriai generalizuotą bendrageografinį pagrindą. Tuo tarpu specialaus turinio elementai yra maksimaliai išryškinti, siekiant perteikti kiek galima daugiau aeronavigacinės informacijos.

7. Atlikus karinių aeronavigacinių žemėlapių ženklų analizę pastebėta, kad ne visi aeronavigaciniai ženklai atitinka kartosemiotikos reikalavimus ir turi būti tobulinami. Naujai sudaryti karinių aeronavigacinių žemėlapių ženklai yra paprastesni, atitinka žmogaus prichofizinio suvokimo kriterijus, pagreitina informacijos perdavimą ir mažiau apkrauna žemėlapį. Siūlomi ženklai ir ženklų specifikacijų priedai semiotiškai yra taisyklingesni ir atitinka nusistovėjusias lietuviškas kartografijos tradicijas, todėl gali būti efektyviai pritaikomi sudarant karinius aeronavigacinius žemėlapius Lietuvoje.

8. Analizuojant karinių aeronavigacinių žemėlapių užrašus pastebėta, kad visi užrašai yra semiotiškai korektiški ir pilnai atitinka jiems keliamas užduotis. Pagal galimybę užrašai minimaliai apkrauna žemėlapius, suteikdami ženklams maksimaliai galimą papildomą informaciją.

9. Rekomenduojama karinė aeronavigacinė duomenų bazė galėtų būti naudinga karinėms ir civilinėms tarnyboms Lietuvoje ir kitose šalyse. Vieningos duomenų bazės sukūrimas leistų greitai ir kokybiškai atnaujinti karinius aeronavigacinius Lietuvos teritorijos žemėlapius. Nuo jų atnaujinimo dažnumo, duomenų patikimumo ir žemėlapių kartosemiotinės kokybės priklauso šalies aeronavigacinis saugumas. Siūloma vertikalių kliūčių (virš 60 m) rinkimo schema užtikrintų patikimą duomenų apie kliūtis rinkimą, apdorojimą ir saugojimą Lietuvoje.

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