[1]COMPUTER ASSISTED LEARNING IN CARTOGRAPHY AND GIS FIELDS

Constantin Nitu
Romanian Cartographic Association
University of Bucharest
nituco@pcnet.ro

Abstract

Computer assisted cartography and geographical information systems (GIS) are developed in the general frame of information society based on knowledge. The study of new mapping and GIS tools in the large field of geomatics disciplines is now a necessity. These systems use computer networks and the more complex ".net" software. More and more economic and social fields benefit of introduction of such systems. All documentation concerning these new systems is in digital form, this fact making computer assisted learning, with other words e-Learning, a necessity.

The paper describes concise the digital mapping and GIS author's achievements in the e-Learning field. The vision on the future is more and more dominated by digital realty and a special interest appears regarding geographical reality, regarding the maps and all geographical products, especially digital products. The students must learn not only to use digital maps, but the digital maps compilation using Intranet or Internet.

1. THE GEOGRAPHY AND THE WEB

The development of Internet leads to the fact that the geography becomes more and more relevant. The communication technologies using optics fiber and wireless draws nearer virtual world and real world. The geography gains new valences. Is easy to understand that Internet is a parallel digital universe or a ubiquitous "cloud", and its users live in a real world where nevertheless applicable geographical borders are. These limits are extended too in the frame of online connection. A lot of innovations were necessary in data organization and storage, making the connection of Internet sites with those of real world, practically making the connections between real world and virtual world.

Some relevant feet in this process are:

- the mapping of physical structure of Internet and particularly of nodes of the net locations to which the users are connected [11];

- the offering of geographical location services (geolocation services), which permit to web sites to determine the locations of individual users [13];

- the establishment of connections between real locations and virtual information using geoindexing (the association of geographical indices. geotags, or geocodes to web pages, to make possible geographical queries) [14];

- the examination of web documents and the searching of geographical references (for indication of location), including geographical names, postal codes, Internet addresses and the names of representative monuments (for instance the software "geo-parser", special created for this purpose by the company MetaCarta, from Vienna, Virginia, in the profit of CIA) [12];

- the creation of geographical query engines, such as Geosearch [13], which determines the geographical purpose of one page by indication of geographical locations of the pages to which there is a link, and to their content too;

- the appearance of postal geography and of the cybergeography of some revolutionary works, e.g. "Atlas of Cyberspace" (University College London) [14];

- the appearance of hierarchical query systems using the geographical coordinates (latitude and longitude) of some relevant pages, such as the GeoWeb system, the pages being then filtered using other criteria too (coordinates may be tasted in the box of one browser, as a special type of Internet address, with the extension ".geo") [14];

- the appearance of geocatching [17], central elements for the geocatching being connections between web pages and particular locations, a high-tech orientation form which implies the use of one GPS receiver find a shadowed at a specific location on a web page;

- the appearance of geoencrypting [15], which is coding a data flux in a such a way that the data are intelligible only for someone who is located in a particular place (location), for data decoding being used the data from a GPS receiver;

- the bigger potential for the relation of virtual and physical worlds is wireless connection [9], the cellular phones may access the corresponding region of cyberspace from any location of real space (here is used geolocation too);

- the appearance of the man-environment interface or even of the man-machine-environment interface, more complex than man-machine interface, especially used by designers and users of services based on location [5].

As a conclusion, the geography online is not destroyed by Internet, the two complexes - Internet and the geography, need one another and the term "geo" appears more and more in the Internet glossary (geoarching, geolocation, geochat etc.) [13].

2. GEOGRAPHICAL INFORMATION SYSTEMS

Among the information systems developed in the last decades, a special role have the spatial information systems, concise or elaborated systems [4], which capture, storage, process, disseminate and use data about characteristic objects, events, and phenomenon's of one spatial domain. The information referred to these elements has metrics and semantics attributes. Among the metric characteristics or attributes, a predominant role has location data, respectively the coordinates.

When the defined space is a small terrestrial zone, the spatial information system (SIS) becomes land information system (LIS). When the defined space of elements' locations is geographical space, LIS is transformed in geographical information system (GIS). A GIS can be created by concatenation and generalization of other LIS of adjacent areas. In the case of GIS, the location data are the geographical coordinates, defined in an accepted geodetically universal datum.

GIS includes, in a large acceptation, the phases from input data specification, to the control decisions about on natural, economic or social processes, and in a limited acceptation, only the phases from input data specification, to the result display like graphical (cartographical) or alphanumerical forms.

The outputs of the system are used in this case by other information systems (for environment protection, for business management, military etc.). The elements of such GIS are grouped in: hardware (computer networks); software (system programs, for communications, for data management and applications); the data sources and collections, and information with the products that contain this information; the technologies for data capture, processing and management; the personal for designing and using. The systems may be categorized in a lot of ways.

For instance, after the destination of the products (outputs), there are topographical, cadastral, geological, hydrological, oceanographically, glaciological, meteorological, for transportation information systems etc. One system is the cadastral system, which manages data and information about all parcels and buildings of one administrative unit.

3. GEOIMAGES AND MAPS

A geoimage (georepresentation) is any spatial-temporal generalized model of terrestrial objects and processes, which has a scale and is represented in graphical form [3]. The definition outlines all common properties – the scale, the generalization and the presence of graphical elements.

In a current mode we can distinguish three classes of plane or 2D (even 2,5D) geoimages – maps, electronic maps, remote sensing images, TV images, photos (e.g. Figure 1) etc.; 3D images – stereograms, stereo models, anaglyphs, diagrams (block diagrams), holograms etc. [4]; dynamical 3D or 4D images – animations, movies, mobile atlases [16] etc.

In each of these classes there are different products as the representation form and content, but with some common characteristics too. Some complex products result from the combination of primary products. Examples of complex products are photomaps, orthophotomaps, iconomaps etc.

All geoimages there are in graphical environment, with a meaning of any visualization and modeling system of one natural or social-economic system, suggested to be perceived by an intelligent device. The graphical environment is characterized by following properties: tetra dimensionality, which permits the reproduction of the situations in time and space; the using of geometric graphical, optical and temporal variables; the ability to reflect real and abstract objects; the interactivity or supervised work, which assures an optimal cooperation among man and visualization devices [4].

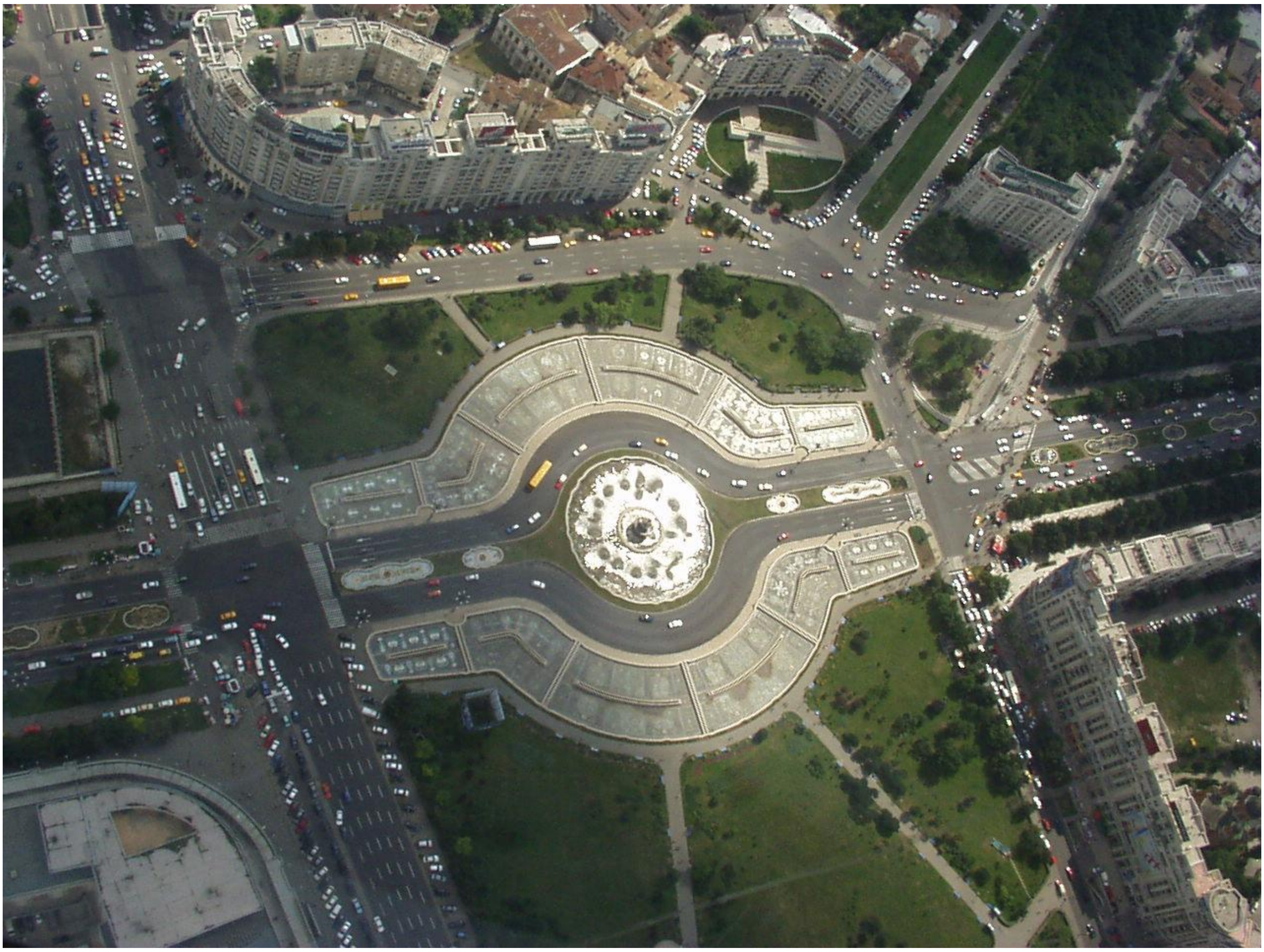

Figure 1: An aerial image from Bucharest

Were remarked the following types of graphical environments in which there are systems of geoimages: fix graphical environment (stationary), which includes traditional maps, photograms and other geoimages on hard support; controlled by program graphical environment, a visualization system based on program and technical media for computer assisted graphics (the computational graphics); mental graphical environment (virtual), in which were formulated maps and mental and cognitive forms.

Digital maps are a particular case of geoimages [4]. Digital maps must have meaning like a collection of digital cartographical data and the applications for creation, management and using of these data. The cartographic applications can contain too a database management system (DBMS). Digital cartographical data can be in raster or vector format, depending on digital map purpose. In case of raster map there are advantages for display operations, and in the case of vector data are easier the operations of location determination, length or area calculation. With this last map can be realized too the specific operations for optimal route determination [4]. A lot of complex maps can work with both data types. Data conversion from one format to another is a common problem.

3.1 Data sources for digital maps

The digital cartographic data, positional and thematic, can be captured directly in the field, using geodetically methods, by exploitation of aerial photos or remote sensing images or by import from different other data collections, in standardized formats. The data can be digitized from hardcopy maps, using vectorial digitizer or scanner [4]. The technologies for data capture are realized with complex applications.

We must remark the fact that we have to use a lot of sources for the same digital map, this fact asking for a correct choosing of coordinate system for geolocation and sources orientation, known as georeferencing or geocoding operations, and in the same time to measuring units of all thematic data.

The collected data must be organized and structured in different ways, depending on map purpose. The data can be stored in a relational database or in an object oriented database. In the case of vector data, for map visualization on the screen or by automated drawing or printing, there are programs named conventional sign and text generators. The coding of geographical entities and of all cartographic are made using concepts of "postal geography".

3.2 Digital maps as GIS outputs

Geographical information systems contain, as a rule, a complex data volume for an area, structured and divided data in layers, levels or themes [4]. From database can be extracted data corresponding to one theme, for one geographical domain, defining some borders. The output data can be transferred to one display device, using conversion formats and software (programs).

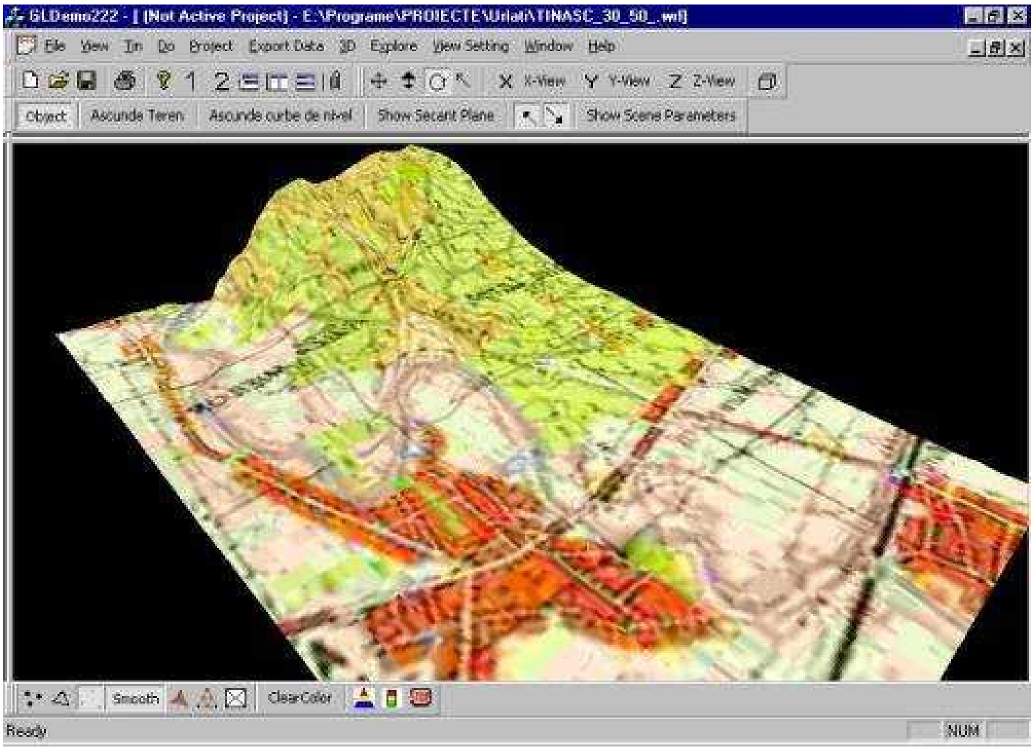

Figure 2: A complex representation using GIS

Can be realized too combinations of themes (figure 2), using logical and analytical operations with the data of two or more themes. Can be obtained not only maps, but even, other products like cart diagrams, block diagrams, photomaps (by combination of the map and of aerial photos), orthophotograms or orthophotomaps.

3.3 The advantages of digital maps

Digital maps can be encapsulated easy in other digital data collections specific to different fields of activities or to different disciplines that describe these fields. The maps can be converted easy from a form to another as format or as representation mode. The scale of automated printed map can be choused even before printing.

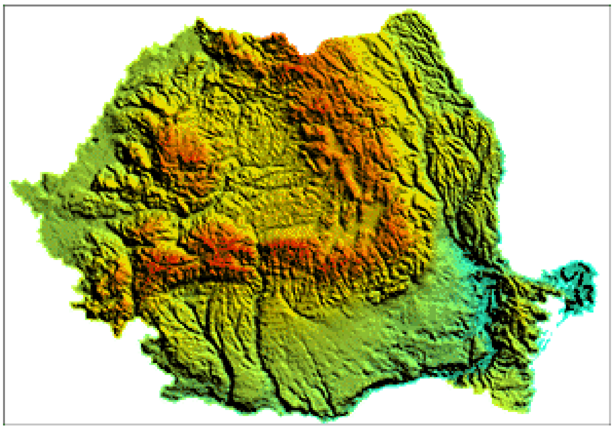

Figure 3: Map of Romania generated using DEM

The printed map can contain all the elements of one theme or can have a generalized content, retaining only desired elements, according to some well defined criteria. In few seconds can be modified some conventional signs and texts, the text fonts or the color of conventional signs and of the text. A special case is the map generated from Digital Elevation Model, e.g. Figure 3.The cartographical database can be easy updated in the case of some unpredictable events, being more rapidly emphasized real or cvasireal time mapping (after earthquakes, floods etc.).

The digital maps or all geoimages can be transmitted easy using a network. There are even mapping servers or mapping sites, and client-server technology can be used successfully. The user may select from his own computer the existent maps in digital virtual world or he can design his own map. You can try alone up described possibilities, searching with Google engine the expressions "Terra Server" or "MapQuest" [1]. You'll have many surprises only filling the listed parameters.

4. e-LEARNING PROJECT

The project has to create a virtual campus in a large future national program to the support Information and communication technologies in the academic education. Geoinformatic (GI) and used education areas is located in Romania as well as at Universities. The mediation of knowledge in GIS-Technology is very more differently component of the area-referential study branches others GI becomes at most institutions as "support science", therefore necessarily doesn't stand in the center of the competence and teachings. We must understand the current maintenance of these GI teachings, especially since the GI education should include more than only the service of specific software. Our faculty far has itself teaching material extensive in the GI teachings about the last years accumulated.

This central idea of the GI project is the concentration and consolidation of a new stage GI learning competence. The concepts are that we must find partner institutions and more involved people, a good management is necessary, a good idea of future consortium of universities, multiplicity and heterogeneity of the involved partners from the beginning, and flexibility of the teaching materials.

For the project we think a modular design. There are different GI disciplines and goals even in the same university, but all have their importance. And in each discipline there are three stages of competence – basic, intermediate, and advanced, subdivided itself in thematically delimited modules. Each module consists in individual lessons and with its structure. Each teacher must contribute to the new support materials.

These basic ideas must be first resolved to understand first GI education, a special kind of education, that we may sometimes call it interdisciplinary field. And after these general GI education ideas, we must thinking at e-Learning using the web, with the large number of participants thinking at a common concept for the structure of these new teaching materials, as well as in pedagogic as also technical sense, e-books which had to be new learning base.

We must design the concept of e-Class, its elements, and new pedagogic key element as motivating prelude to the topic of the e-book unit, clarifying the treatment of the actual topic, looking for new examples, act – interactive part to explore the topic, a possible group work, self-assessing the test for the automatic check, and so on.

We must create a unique e-Learning platform to the administration of the students and teachers, using for miscellaneous communication media. If the classic teaching content

However remain external saved, from the e-Learning platform becomes interactive on these contents. For this reason we must understand the e-Learning platform management as an important "art" product, with a maximum at flexibility. A server of the platform must be new e-Publishing system, to generate dynamically web pages and other output formats (DOC, PDF, RTF, JPG, BMP, and PPS).

5. GEOGRAPHIC INFORMATIN SCIENCE AND e-LEARNING

Distance Learning is typically thought of as being an Internet-Based Learning (IBL) and even training program. Our educational institution, University of Bucharest, in conjunction with other educational institutions, like Military Technical Academy, partners, and clients are now offering Web-based educational courses and programs in virtually any field. The Faculty of Geography receives numerous requests from students for information about distance education programs in GIS and computer assisted cartography. We have responded to this demand by providing a comprehensive summary of two programs around for these disciplines.

University of Bucharest's Geographic Information Systems and computer assisted cartography for students Program is a credit program, offered through distance education, and focused on the inexperienced in GIS students' working. The GIS programs at the University of have a unique, general learning oriented approach. The goal of courses is to familiarize the students for using of GIS procedures in other geographic disciplines and especially for research in these disciplines. The students are trained in problem solving, in building GIS applications, or in actually developing GIS using networks.

We prepare MSc in many fields, where they are learning GIS and computer assisted cartography, but not yet in the field of GIS. Faculty of Geography of University of Bucharest has offered GIS online at the level of laboratory network, for students working with geographic data. The course is entirely delivered over the network geographic information laboratory, so that attendance is required at lab stage. The course consists of two units, geographic data capture and geographic analyze, a semester long. Some of students must complete a supervised research dissertation.

The distance learning program in geography for all the specialties provides participants with an open and flexible means of studying geographic information science, in the exciting and dynamic fields of GIS and computer assisted cartography. The distance units are not open yet to anyone within the Graduate Diploma or Graduate Certificate programs or to someone who simply wants to learn some GIS and enrolls as an extension (external) student. Unfortunately, they take part at the laboratory works, but in the future the courses will be extended from the level of laboratory network to the World Wide Web level.

Courses currently offered are Geographic Information (GI), Geographic Information Systems (GIS), computer assisted cartography and geographic databases. Geographic Information defines geographic data, the metrics of data, positional data and geographic attributes. A big attention is assigned to coordinate systems, registration and georeferencing. For GIS, a principal attention is given to the modules GIS Introduction, GIS functionality, geographic analysis (Spatial Analysis in GIS), GIS practical procedures, GIS examples in different fields and GIS management. Geographic databases studies general DBMS, special cases of GIS databases and special procedures used in Geographic Information Science.

Computer assisted cartography is a stand-alone course for some specialties (cartography, territorial planning and GIS) or part of a general course of cartography for all others specialties. On study here digital map, electronic map or chart, display view properties, map media, DEMs, cartographic symbols, digital map lettering, type of colors in digital map, digital map generalization and so on.

For all these disciplines there are e-books which can be consulted in the lab network. E-books are electronic pages of normal books. The idea is that in the future each normal edited book must have its electronic variant. There are under development e-books for laboratory works for some software programs used by majority of students. They take with them these short web pages on a CD when they are going for practical exercises in the field with laptops or in the labs of organization in practice the time at the end of each year.

5. AKNOLEDGEMENTS

The use of computer and computer network assisted learning involves keeping the relation professor-student. This classical relation has this role. The face to face meetings in the class and in the lab have a strong role in learning. The importance of lab works guide became important too.

The labs must be opened all the day, the students having their personalized time. At the GIS and computer assisted cartography objects we are putting a big accent on the product making, respectively on digital maps or other geoimages. On the future portal of our faculty, we must put some mapping applications to be used from a distance, the technology client-server doing it very easy.

In this case, the students from our distance centers (Turnu Severin, Macin or Calimanesti, where are the sections of our faculty) or a student from other town de can not only read the lessons, but even use the applications stored on the portal.

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Biography

Born in 1941, in Stâlpeni, Arges County, Romania (45°00’00’’ latitude and 25°00’00’’ longitude). **Graduate Degree**: BA in military sciences – Higher Military School for Officers Sibiu (Artillery and Rockets, 1962). Engineer in geodesy – Military Technical Academy, Bucharest (1973). **Post-graduate Degree**: Ph. D. in geodesy, photogrammetry and remote sensing, Military Technical Academy (1992), paper-work “Contributions to a programme package achievement for computer assisted mapping” (published). . Ph.D. conductor in geodesy, cartography, photogrammetry and remote sensing in Military Technical Academy (from 1997). **Career Degree**: researcher, senior researcher III, II, and I degrees, in Military Institute for Research in Geodesy and Topography (Ministry of National Defense, 1973-1991); Professor – Military Technical Academy (1991-1997); consultant professor (1997-2002), professor (from 2002) – University of Bucharest (Faculty of Geography), for Geographic Information Systems, computer-assisted cartography and geomatics. **Administrative Functions**: active officer in Ministry of National Defense (1962-1997, until the rank of Brigade General); head of Research Laboratory for Photogrammetry, Computer-assisted cartography and Remote Sensing, Ministry of National Defense (1989-1992); head of Dept. of Geodesy, Military Technical Academy (1992-1994); dean of Faculty of Engineering, Geodesy and Civil Engineering, Military Technical Academy (1994-1997), member of academic board, Military Technical Academy (1992-1997). Membership in National and International Organizations: member of Romanian cartographic Association (actual president) and of Romanian Society of Photogrammetry and Remote Sensing (former president of Commission I, 1992-1996, and of Commission IV, 1996-2004); expert of National Council for Scientific Research of Ministry of Education and Scientific Research; member of scientific board of National Office for Cadastre, Geodesy, Cartography (NOCGC, 1997-2000); member of the board of examiners (NOCGC, 2000-2004); member of international organization AFCEA (2001). **Publishing activity**: member of editorial boards of scientific journals Review of Geodesy, Cadastre and Cartography (1992-2000), Review of MTA (1990-1997), and of Bulletin of Photogrammetry and Remote Sensing (1992-2004); 11 published books, more then 80 published scientific papers in national and international reviews.