1st International Doctoral Seminar in field of Geodesy, Geoinformatics and Geospace

Book of Abstracts

22.-25. May 2017, Dubrovnik, Croatia

Organized by:

Faculty of Geodesy University of Zagreb

Technical University of Munich

Catholic University of Leuven

Published by:
University of Zagreb, Faculty of Geodesy

For the publisher:
Damir Medak

Editors:
Almin Đapo and Vesna Poslončec-Petrić

Graphical design:
Vesna Poslončec-Petrić

Printed by:
HORVAT-TISAK d.o.o, Malomlačka 37, 10020 Zagreb-Novi Zagreb

Issue: 200

ISBN: 978-953-6082-21-6

Dear reader and colleague,

internationalization of studying and excellence in science are today not any more question of prestige but the necessity for all academic institutions, professors and students. This fact is especially pronounced in running postgraduate doctoral studies, respectively in scientific and research work of doctoral candidates in the frame of those studies. We can freely say that modern, attractive and internationally recognized postgraduate doctoral study today can be envisaged without those settings. Faculty of Geodesy University of Zagreb has recognized this fact and decided to make step forward in execution of Postgraduate doctoral study Geodesy and Geoinformatics in order to raise the level of its own study excellence and international high-quality and attractive study, enabling them, when they finish it, successfully to position themselves in professional surrounding as top experts in Croatia and anywhere in the world.

One of the recognized measures as necessity and opportunity was launching of the doctoral seminar which will have an international character and highlighted interdisciplinarity, meaning that it will not be restricted on geodesy and geoinformatics studies and students. With the University of Zagreb strategic partners Technical University Munich and Catholic University Leuven support, in cooperation with the University of Zagreb rectorate and using University complementary advantages, like Centre for Advanced Academic Studies in Dubrovnik, we have launched International doctoral seminar in the field of geodesy, geoinformatics and geospace. The first seminar has been held in May 2017, and we have repeated it in May 2018, with the intention Seminar to become a permanent activity of the Postgraduate doctoral study of the Faculty of Geodesy.

Response on the International doctoral seminar, which has immediately attracted attention in broader region and results of participants satisfaction evaluation, has shown to us that organization of such seminar is an activity which is necessary and justified for raising the excellence of our study and students. Thereby, we should also not neglect the inspiring ambience of the Centre for Advanced Academic Studies and the beauty of the town Dubrovnik, which has created a unique feeling for superior scientific engagement in a relaxed atmosphere.

This Book of Abstract of 1st and 2nd International doctoral seminar, gives an overview of scientific researches of PhD students which attended the seminar, and represents next step in excellence and study internationalization fostering, promoting cooperation in research work between students and professors-mentors on the Faculty of Geodesy as well as on other academic institutions in the region and Europe. I use this introductory note also to express my gratitude to prof. Walter T. de Vries and prof. habil. Thomas Wunderlich from the Technical University in Munich and prof. Joep Crompvoets from the Catholic University in Leuven which have selflessly helped in conceiving and execution of doctoral seminars. I thank also Rectorate of University of Zagreb, dr. phil. Branka Roščić, head of the International Relations Office and Mrs. Vlasta Brunsko, head of Centre for Advanced Academic Studies in Dubrovnik for their selfless support and especially thanks have deserved members of the Seminar organization committee Assoc. prof. Almin Đapo, Assist. prof. Vesna Poslončec-Petrić and Rinaldo Paar and Dr. Bojan Vršnak.

Prof. dr. sc. Željko Bačić

Contents:

1st International Doctoral Seminar in the field of Geodesy, Geoinformatics and Geospace

Having a goal to enhance educational and research potentials at the postgraduate doctoral study of geodesy and geoinformatics through promotion of international cooperation, exchange of experiences and results of PhD students researches, networking, launching of joint scientific and research projects and building ties between students and mentors the Faculty of Geodesy, University of Zagreb is launching in cooperation with Technical University Munich from Germany and Catholic University Leuven from Belgium International Doctoral Seminar in the field of Geodesy, Geoinformatics and Geospace that will be held on May 22nd – 25th 2017 in Dubrovnik at the Centre for Advanced Academic Studies (CAAS) of University of Zagreb.

The development of IC and satellite technologies, micro- and nano-electromechanical systems and robotics has caused mayor and deep changes in geo-sciences, which is especially visible in field of Geodesy and Geoinformatics. Additionally, globalization and interdisciplinarity have fostered development of completely new concepts of data collection, analysis and usage of spatial information, where Global Navigation Satellite Systems and Unmanned Aerial Vehicles have changed paradigm of classical Geodesy, as well as Spatial Data Infrastructure is just the beginning of a process materialized today through concepts of intelligent transportation, smart cities and smart environment.

About seminar

Technological revolution and fast growth of all branches of geo-sciences puts academic society in front of great challenge, how to cope with changes and how to keep highest level of education and research, especially emphasized in the execution of postgraduate doctoral studies. At the Faculty of Geodesy, as elsewhere in the world, we see the answer in networking at all levels, enabling the PhD students, their mentors and teachers to exchange information, scientific cognition and executed projects, research results. This should enable better mobility, joint launching and participation in projects, dual mentorships and doctoral thesis.

In the above-mentioned context, PhD schools and seminars become frequent, almost regular form of activity in advanced countries worldwide. Because of lack of such content in the field of our interest in South-East Europe, we have decided to organize International Doctoral Seminar which should enable all PhD students from Faculty of Geodesy but also from other academic institutions to participate in this seminar under favourable conditions in fascinating surrounding od Dubrovnik, the pear of Croatian coast.

Organization

Seminar organizers are University of Zagreb, Technical University Munich and Catholic University Leuven. Preparation and execution of the Seminar will be done by the Faculty of Geodesy in Zagreb, Institute for Geodesy, Geomatics and Land Administration in Munich and Institute for Public Governance from Leuven with the support of the Office for International Cooperation and Centre for Advanced Academic Studies of University of Zagreb.

Seminar programme

Seminar programme will consist of sessions and workshops which will comprehend several types of activities:

- Motivation lectures given by professors and mentors,
- PhD students research presentations,
- Research projects presentations,
- Workshop on possibilities of student mobility and
- Workshop on academic cooperation possibilities between students, mentors and academic institutions.
- Depending on the number of participants, the programme will be organized in plenary or parallel session, while opening session and workshops will be plenary.
- Lecturers at the Seminar will be the Dean of the Faculty of Geodesy, Professor Damir Medak, Professor Thomas Wunderlich and Professor Walter Timo de Vries from Technical University Munich, and Professor Joep Crompvoets from Catholic University Leuven.

Technical details

The event is taking the place on May 22nd – 25th 2017. Seminar will start on Monday 22nd at 13.30 and finish on Thursday 25th at 12.30 hours.

The event location is the Centre for Advanced Academic Studies of the University of Zagreb (CAAS) located in Dubrovnik, Don Frane Bulića 4 (the building in the header of Announcement), only 200 m away from the Pile entrance to the Old town. CAAS is specialized for organization of schools, conferences, seminars and other academic events and is equipped with all necessary infrastructure for running our seminar. More info about CAAS can be found on its web page http://www.caas.unizg.hr.

Accommodation is organized in Dormitory of CAAS under very favourable price conditions. The dormitory has 70 beds in total in newly furnished single-, double-, triple- and four bed rooms or apartments.

Meals will be organized at the level of half-board accommodation (breakfast and lunch) in the nearby restaurant Mimoza.

Participants

Seminar participants are PhD students in the field of geo-sciences, their professors and mentors. Seminar participants – PhD students are expected to prepare and present their research in the length of 20 - 30 minutes (dependable on the number of participants.

We expect active participation from the teachers and mentors in the Seminar, either by holding motivation lectures, presenting research projects, presenting cooperation possibilities or new trends in organization and execution of Postgraduate doctoral studies.

Organization

For the preparation and execution of Seminar, an international Organization Committee has been established and its members are:

- Professor Željko Bačić, Faculty of Geodesy University of Zagreb (chair)
- Professor Walter Timo de Vries, Technical University Munich,
- Professor Joep Crompvoets, Catholic University Leuven,
- Assoc. Professor Almin Đapo, Faculty of Geodesy University of Zagreb,
- Bojan Vršnak, PhD, Faculty of Geodesy University of Zagreb,
- Assist. Professor Vesna Poslončec-Petrić, Faculty of Geodesy University of Zagreb and
- Assist. Professor Rinaldo Paar, Faculty of Geodesy University of Zagreb.

Detailed programme

22.05. Monday

14.00 – 14.30: Opening session

- Prof. Damir Medak, Dean, Faculty of Geodesy, University of Zagreb, welcome speech
- Mrs. Vlasta Brunsko, CAAS Dubrovnik, about CAAS and Dubrovnik
- Prof. Željko Bačić, Head of Organizing Committee, Faculty of Geodesy, University of Zagreb, about the seminar

14.30 – 16.00: Land administration

- Prof. Walter Timo de Vries, Technical University Munich: ***Constructing theory of land management and human geodesy***
- Mr. sc. Blerim Jashari, Kosovo Cadastral Agency: ***3D Objects Registration in Kosovo Cadastral System***
- Genc Salja, Faculty of Civil Engineering, Polytechnic University of Tirana: ***Study and implementation of Multipurpose Cadastral System aspects within NSDI***

16.30 – 17.30: Scientific paper writing

- Prof. Almin Đapo, Faculty of Geodesy, University of Zagreb: ***Scientific paper writing***
- Seminar-work for presenting students

23.05. Tuesday

09.00 – 10.30: Spatial Dana Infrastructure

- Prof. Joep Crompvoets, Catholic University of Leuven: ***Governance for a Smart World***
- Slaven Marasović, Faculty of Geodesy University of Zagreb: ***Local SDI evaluation and development model***
- Nikolina Mijić and Gabor Bartha, Institute of Geophysics and Geoinformatics, Department of Geodesy and Mine Surveying, University of Miskolc: ***INSPIRE Development through the Time from 2005 to 2016***

11.00 – 12.30: Geoinformatics

- Prof. Damir Medak, Faculty of Geodesy, University of Zagreb: ***Research challenges in geoinformation science 2000-2025***
- Freskida Abazaj, Faculty of Civil Engineering, Polytechnic University of Tirana: ***Defining dynamics of flooding map in Buna river areas***
- Dr. sc. Marijan Grgić, Faculty of Geodesy, University of Zagreb: ***Absolute versus Relative Sea Level Change***

11.00 – 12.30: Research and education

- Prof. Gezim Gjata, Faculty of Civil Engineering, Polytechnic University of Tirana: ***An overview on research and education in Albania and around in geodesy and geoinformation; needs for support and collaboration***
- Igor Grgac, Faculty of Geodesy University of Zagreb: ***Testing the accuracy of Locata positioning system for the purpose of determination the static and dynamic displacement measurements***
- Ivan Racetin, Faculty of Civil Engineering, Architecture and Geodesy, University of Split: ***Anomaly detection on digital images***

14.00 – 15.30: Student mobility

- Chair Bojan Vršnak, PhD, Faculty of Geodesy, University of Zagreb: ***Mobility – integral part of PhD studies***
- Dr. Marijan Grgić, Faculty of Geodesy, University of Zagreb: ***Student mobility***
- Discussion

24.05. Wednesday

09.00 – 10.30: Engineering Geodesy

- Prof. Thomas Wunderlich, Technical University Munich: ***Monitoring by TLS – Practicing Unfinished Theories***
- Ethem Bejko, Faculty of Civil Engineering, Polytechnic University of Tirana: ***Usage of advanced geodetic methods for monitoring and determining the dynamics of coastal changes Vlore-Velipje***
- Rattikarn Khambud, Technical University Munich: ***Geodetic approaches to support climate change adaptation in Thailand***

11.00 – 12.30: Geodesy

- Prof. Ivan R. Aleksić, Prof. Branislav Bajat, Prof. Branko Božić, Faculty of Civil Engineering, University of Belgrade: ***Spatial Statistics and Geocomputation***
- Margareta Premužić, State Geodetic Administration: ***Analysis of Geodynamical network computation methods***
- Genti Qirjazi, Faculty of Civil Engineering, Polytechnic University of Tirana: ***Methodologies on creation and adjustments of active GNSS network (VRS and CORS)***

13.30 – 15.00: PhD student research and cooperation opportunities

- Prof. Almin Đapo, Faculty of Geodesy, University of Zagreb: ***Institutional, project and student networking and cooperation – modern science imperative***
- Briefing on research topics of non-presenting PhD students (3' each)
    - Marko Radanović
    - Sergej Baričević
    - Ivana Čavlina Tomašević
    - Zvonimir Nevistić
    - Josip Peroš
    - Ivan Jakopec
- Discussion

25.05. Thursday

09.00 – 10.30: Cartography

- Prof. Miljenko Lapaine, Faculty of Geodesy, University of Zagreb: ***Ruđer Bošković – Geodesist and Traveller***
- Ljerka Vrdoljak, Croatian Hydrographic Institute: ***Sea bottom model as basis for security of sailing***
- Matjaž Štanfel, Faculty of Geodesy, University of Zagreb: ***Risk Assessment Support System of Outdoor Recreation in Croatia***

11.00 – 12.30: Closing session

- Students reflections and recommendations for next Seminar
- Final comments given by professors-lectures
- Prof. Željko Bačić, Faculty of Geodesy, University of Zagreb: ***Seminar closing***

1. 3D Objects Registration in Kosovo Cadastral System

Blerim Jashari
Kosovo Cadastral Agency, Pristine, Kosovo
e-mail: blerimjashari@yahoo.com

Abstract:

In recent decades Kosovo has gone through various political and administrative systems. Hence, I've tried to focus my research in the attempts from different administration systems to improve land legislation framework in order to meet citizen's needs. In addition, the study has been focused on the current administration system trying to emphasize land legislation weaknesses and suggestions for their improvements, because the challenges of the new-born country must be met.

Given that the legal framework regarding real estates in Kosovo is consolidated, its functionality is still difficult.

The subject has been studied from legal point of view and emphasizes the land legislation particularly the registration of different objects into the official state system. The expressed results explain that Kosovo, besides similar problems that other transitional countries in the region have, represents a "sui-generis" case.

In the end, compilation of most essential suggestions is spread out which ought to be applied, thus insurance, protection and guarantee of immovable real properties related rights of citizens and others to have effect.

Keywords: *Cadastre, Kosovo, legal framework*

2. Study and implementation of Multipurpose Cadastral System aspects within NSDI

Genc Salja
Faculty of Civil Engineering, Polytechnic University of Tirana, Albania
e-mail: gencsalja@outlook.com

Abstract:

This thesis is intended to analyse the historical cadastre data of Albania from the first establishment to the present day.
The projections used, variations of the principles in the cadastral system.
The quality check used for the registration of the parcels.
Analysing the accuracy of the maps, the source data used, storage methods, and updating.
Analyse IPR systems for managing information on paper and digital.
Analyse the FIRST REGISTRATION IN ALBANIA.
Distinguish the different type of errors in Rural, Urban and Suburban zones by doing test.
Review of the necessity of introducing the multipurpose cadastre 2D, 3D, 4D within the NSDI.
We intend to propose the improvement and development of the system through the handling of theoretical aspects, construction of algorithms, the manner of inclusion, quality and fulfilment of INSPIRE standards, for inclusion in the national GIS for NSDI in Albania based on appropriate examples from European Union countries.

Keywords: *digital map, NSDI, map standards, multipurpose cadastre, topographic map, base map, structural standard, content standard, Albania, Cadastre, GIS*

3. Local Spatial Data Infrastructure assessment and development model in the Republic of Croatia

Slaven Marasović, mag. ing. geod. et geoinf.
Vodoprivredno-projektni biro, d.d., Zagreb, Croatia
e-mail: slaven.marasovic@gmail.com

Abstract:

SDIs in EU differ between countries as the same INSPIRE implementing rules or specifics relation in countries may cause different results. National SDIs cannot be the same and differ considerably depending on political, economic and cultural national circumstances. Any framework for assessment of LSDI is likely to be adapted to particularities of cities. Also the objectives of SDI and the relevant indicators of SDI-assessment may vary.

The SDI assessment will play a crucial role in the managing SDI initiative. In this context, identifying critical factors and processes in the acquisition, implementation and utilization of an SDI assessment can make it easier to develop specific SDI model. As part of this process SDI coordinating agencies will then be able to better define and develop their strategies to achieve their objectives.

In Croatia, several assessments have been related to local SDI initiatives. Cetl (2007) "Analiza poboljšanja infrastrukture prostornih podataka, PhD" investigated sub-national SDIs on counties level in Republic of Croatia in order to analyse improvements of existing SDIs. Poslončec – Petrić (2010) "Disertacija prostornih podataka za potrebe službene kartografije, PhD" analysed distribution of spatial data for official cartography in Republic of Croatia. Blagonić (2012) "Katastar vodova u lokalnoj infrastrukturi prostornih podataka, PhD" has investigated utility registers over local geoportals in all 127 cities in Republic of Croatia. Hećimović et al. (2014) "Development of Local Spatial Data Infrastructure in Croatia" have investigated Croatian LSDI and analysed according to indicators city budget, city population and city area as well as by two EU Nomenclature of Territorial Units for Statistics regions.

Worldwide, large investments have been made to develop SDI initiatives. Given the expenditure and society's interest in the proper and effective use of these funds, it has become a necessity to have reliable methods and instruments to assess SDI initiatives. There are many assessment methods for SDI development. The task of assessing SDI is difficult due to their complex, dynamic and constantly evolving nature. As an SDI can be treated as a Complex Adaptive System, the assessment should include strategies for development those kinds of systems. One such strategy is to use multiple assessment approaches and methods. The multi-view framework contains methods that not only evaluate SDI performance but also deepen our knowledge about SDI functioning and may assist in its development. All methods, however useful and valuable, either concentrate on one aspect of SDI, or are bounded by one region, or describe SDI development in few particular countries, or are still conceptual in nature.

Croatia as member of EU is obligated to fulfil demands of INSPIRE Directive, including Annex III, as most related to local level of SDI. By 2020 whole INSPIRE should be operational. In Croatia there are 127 cities, 428 municipalities and 20 counties. Whole area of Republic of Croatia is covered with cities and municipalities. Counties are as well local level in hierarchy of SDI. The heterogeneity of SDI development on the local level in Croatia is expected also by the fact that the spatial data of some cities were destroyed during the war in 1990's.

Aim of this research is to assess local spatial data infrastructure readiness, performance and development in the Republic of Croatia.

The research will investigate: the expectations of the representatives of the cities, cities readiness to develop LSDI and the main obstacles to the development of LSDI in Croatia. Also, initiatives necessary to solve gap between current and future (INSPIRE 2020) LSDI development in Croatia will be defined.

Results of the research could be compared with previous researches of LSDI in Croatia. The comparison with previous researches is made to recognize the direction of the current development of LSDI in the Republic of Croatia.

Based on results, analysis and conclusions from this research, conceptual model of LSDI development in Croatia could be prepared.

From literature and researches: Hećimović et al. 2014. "Development of Local Spatial Data Infrastructure in Croatia", State of Play, eSDI-Net+ and SDI Readiness questions were extracted and finally selected. Also, a particularity of Croatia and state of (L)SDI in Croatia is taken into consideration. Existing literature and documentation about the previously identified problems were examined. Test specimen in this research is clearly defined with number of cities (127) in Republic of Croatia. Prior to survey, invitation was sent to city representatives. Invitation contained explanation about purpose for survey. Questionnaire was anonymous, although representative city is stated. In order of examinee protection and research ethic, city representatives want be stated in questionnaire analysis.

To assess readiness, performance and development of LSDI in Croatia, indicators should be defined. Application of performance indicators as a possible tool to assist in the measuring, monitoring, and reporting on the performance of an SDI could be found in. For defining indicators statistical analysis is one of possible ways how to try to identify indicators. At this moment, in this research chi-square test is used although, regression could give better results. Finally, indicators will be used for developing conceptual model for LSDI development in Croatia, so methodology for defining indicators is vital for quality of conceptual model.

Keywords: *LSDI, assessment, indicators, statistical analysis*

4. INSPIRE Development through the Time from 2005 to 2016

Nikolina Mijic; Gabor Bartha
Institute of Geophysics and Geoinformatics, Department of Geodesy and Mine Surveying, University of Miskolc, Hungary
e-mail: nikolinamijic7@gmail.com

Abstract:

The term of infrastructure, as a mechanism of support for spatial data, has been used for the first time in the early 1990s in Canada. Today, the concept of spatial data infrastructure (SDI) has become a worldwide new paradigm for the collection, use, exchange and distribution of spatial data and information. Spatial data infrastructure has been developed through sets of spatial data, metadata, agreements for joint spatial data use and distribution, network services and related coordination activities. SDI is always present in a certain form, but the level of implementation varies according to current demand and technological readiness. Subjects can be classified at several basic levels – from personal and corporative, through local and county, to national, regional and finally, global. Today, the most important level is the national one, i.e. the National Spatial Data Infrastructure (NSDI) project (OG 16/2007) and INSPIRE Directive (Infrastructure for Spatial Information in the European Community - 2007/2/EC). Without spatial data and related services, it would be impossible to manage space effectively, plan city development and infrastructure networks, monitor situation on the ground, or carry out many other activities.

This paper gives an overview what has been happening throughout the time with INSPIRE Directive starting from 2007. including legislative regulations, technical requirements, assumed standards, scientific methodologies, developed data specifications and, finally, resulting software tools and services. The assessment also describes overall country-wise alignment to INSPIRE standards and services implementation throughout EU member states, thus their readiness for fully standardized data acquisition, representation and exchange on national and regional levels. Hereby represented country-specific implementation assessment includes following indicators: (a) legislative conformance with imposed INSPIRE regulations, (b) technical SDI conformance with imposed standards and data specifications, and (c) implemented INSPIRE-compliant systems, services and datasets.

Keywords: *NSDI, SDI, INSPIRE, EU member states.*

5. Defining dynamics of flooding map in Buna river areas

Freskida Abazaj
Faculty of Civil Engineering, Polytechnic University of Tirana, Albania
e-mail: freskida.abazaj@gmail.com

Abstract:

Flooding events cause economic, social and environmental damage and lives loss. In Albania, the rivers constitute the highest flood risk, whose effects extended to 130 000 hectares of agricultural land. The floods are generally of pluvial origin and are occurring in the period of November – March, when is received about 80-85 % of annual precipitations. The largest floods have appeared in the low western area of the country but small rivers and the torrents cause flooding too. Basic knowledge for apprehending the flood risk concerns the frequency and intensity of floods, the exposition of humans and assets to flooding, their sensitivity to floodwater and their susceptibility to suffer damage. My study case is located in Buna River area. This is a zone with frequent flood risk. The highest damages date in January 2010 when Albania was exposed to a severe flooding event in the Shkoder region and all the area of Buna River. The overflow of water alienated the city from national road access and cut communication with the tow. The aim of this thesis is to create the floods map, to evaluate her dynamic and to determination of high-risk areas and flood damage caused by floods of different sizes. The whole methodology will be based on geographic information software due to its excellent capabilities on storing and processing spatial data.

Keywords: *flooding, spatial data, floods map, dynamic, Buna Rivers.*

6. Absolute versus Relative Sea Level Change

Marijan Grgić[1], Robert Steven Nerem[2], Tomislav Bašić[1]
[1] University of Zagreb, Faculty of Geodesy, Croatia (mgrgic@geof.hr)
[2] University of Colorado Boulder, Colorado Center for Astrodynamics Research, United States of America

Abstract: Satellite altimetry provides absolute sea level that is related to the Earth's center, whereas the tide gauges provide sea level related to the land they are adjacent to, which is often referred to as the relative sea level. The presentation at the seminar presents the differences of the measurements and the methods of combining the records.

INTRODUCTION

Earth's long-term climate changes have been dominated by the ice age cycles (Shackleton, 2000). The long cool periods (glacials) cause the ice sheet gain, mostly in high latitude areas, and the shorter, warmer periods (interglacials) cause the ice melting along with water expansion due to the water volume increase (Cazenave and Nerem, 2004). Recent studies revealed that several human-induced climate drivers contribute to the current global warming in addition to the natural climate drivers (Hughes et al., 2003). The global sea level change is one of the most certain consequences of the climate change. As the sea level significantly influences the human, animal, and plant life and habitats, especially in the coastal areas, and as it is used in wide variety of research disciplines, monitoring of the sea level change is of fundamental importance. Therefore, the sea level data are marked as the highest priority within the global scientific initiative on climate change led by The Intergovernmental Panel on Climate Change (Church et al., 2011).

METHODOLOGY, FINDIGNS, AND CONCLUSIONS

The first attempts to measure the sea level began more than 200 years ago by introducing the measuring poles along the coasts (Douglas et al., 2000). About 50 years later the first tide gauges were installed in stilling wells, and since then the network of tide gauge sites has been extended around the world. The longest reliable tide gauge records thus cover the century and a half of sea level change. Although the technology of measuring the sea level at tide gauges evolved over time, the basic principles remained the same. The main advantages of such technology (Cazenave, 1999; Mitchum, 2000) encompass (1) continuous high-frequency monitoring of sea level, (2) real-time data acquisition, (3) relatively low costs, and (4) capturing the sea level change at the coastlines directly. However, there are some significant disadvantages of tide gauge measurements (Pugh, 2004): (1) data obtained provide relative sea level, (2) lack of consistent vertical datum, (3) uneven and sparse spatial distribution, (4) data obtained must be corrected for local variability and atmospheric pressure, (5) questionable long-term stability of measurements, especially for analog instruments, and (6) installing and maintaining the instruments can be time-consuming and challenging for different sites.

A significant change in sea level monitoring happened with initiating the satellite altimeter technology in the seventies of the 21st century (Cazenave and Nerem, 2004). Over the four decades, satellite altimetry has revolutionized our understanding of the ocean topography and circulation on a global scale, having an impact on oceanography, geophysics, geodesy, and other research fields. The satellite altimetry provides (1) absolute sea level change related to the Earth's center or other geodetic reference surfaces, with the (2) global coverage, (3) high resolution, (4) uniform accuracy, and (5) from multiple sensors. However, the technology still has some drawbacks due to the (1)

relatively short observation period, and (2) a low coverage in coastal areas with (3) not (fully) available data in real time (Cazenave and Nerem, 2004).

The main difference between two measuring technologies is the geodetic reference the measurements are related to. The tide gauges obtain the sea level with respect to the land they are attached to hence capturing the influences of surrounding area such as the vertical land motion and positional changes of the sites caused by the plate tectonics, constructing works in nearby areas, mechanical forces as well as the other geophysical influences at the site. Also, the tide gauges are very often installed in harbors or in the areas of intense human activities on the sea, which cause biased, non-realistic measurements. On the contrary, the altimetry delivers sea level with respect to generally well-defined geodetic references or the Earth's center, which enables straightforward combining of those data with other spatial data and studies of the impact of sea level rise.

Several studies are investigating the possibilities of reducing the geophysical and other effects on tide gauge measurements. Many of them focus on monitoring the vertical and positional land motion at sites collocated to the tide gauges, thus delivering the corrections for tide gauge measurements. Significant efforts have been made within the SONEL project, which develops an integrated global observing system by linking both the tide gauge and the GNSS (Global Navigation Satellite System) databases in order to provide absolute sea level measurements and trends, as well as the land movement trends at tide gauge sites (Santamaría-Gómez, 2012). Some efforts were also done on estimating the geophysical influences on sea level measurements at tide gauge sites from gravity measurements, both satellite gravity through the satellite missions CHAMP, GOCE, and Grace, and continuous measurements at tide gauge sites obtained by the gravity meters.

This study reports on the different approaches to delivering the absolute sea level at tide gauges, combining the altimeter and tide gauge data, and future projects that are expected to improve the sea level measurements.

Keywords: *Absolute Sea Level, Relative Sea Level, Satellite Altimetry, Tide Gauges, Vertical Land Motion.*

REFERENCES

Cazenave, A., Dominh, K., Ponchaut, F., Soudarin, L., Cretaux, J. F., & Le Provost, C. (1999). Sea level changes from Topex-Poseidon altimetry and tide gauges, and vertical crustal motions from DORIS. Geophysical Research Letters, 26(14), 2077-2080.

Cazenave, A., & Nerem, R. S. (2004). Present-day sea level change: Observations and causes. Reviews of Geophysics, 42(3).

Church, J. A., Gregory, J. M., White, N. J., Platten, S. M., & Mitrovica, J. X. (2011). Understanding and projecting sea level change. Oceanography, 24(2), 130-143.

Douglas, B., Kearney, M. T., & Leatherman, S. P. (Eds.). (2000). Sea level rise: History and consequences (Vol. 75). Academic Press.

Hughes, T. P., Baird, A. H., Bellwood, D. R., Card, M., Connolly, S. R., Folke, C., ... & Lough, J. M. (2003). Climate change, human impacts, and the resilience of coral reefs. Science, 301(5635), 929-933.

Mitchum, G. T. (2000). An improved calibration of satellite altimetric heights using tide gauge sea levels with adjustment for land motion. Marine Geodesy, 23(3), 145-166.

Pugh, D. (2004). Changing sea levels: effects of tides, weather and climate. Cambridge University Press.

Santamaría-Gómez, A., Gravelle, M., Collilieux, X., Guichard, M., Míguez, B. M., Tiphaneau, P., & Wöppelmann, G. (2012). Mitigating the effects of vertical land motion in tide gauge records using a state-of-the-art GPS velocity field. Global and Planetary Change, 98, 6-17.

Shackleton, N. J. (2000). The 100,000-year ice-age cycle identified and found to lag temperature, carbon dioxide, and orbital eccentricity. Science, 289(5486), 1897-1902.

7. Testing the accuracy of Locata positioning system for the purpose of determination the static and dynamic displacement measurements

Igor Grgac
Faculty of Geodesy, University of Zagreb, Croatia
e-mail: igrgac@geof.hr

Abstract:

GNSS has limitations or cannot be applied in specific environments with poor geometry like city streets, tunnels, bridges, or in indoor environment in general. To overcome these difficulties many researches have supplemented GNSS with pseudolites which also have their own limitations. Locata Corporation from Australia developed new radio-frequency based positioning system called Locata which relies on the network of ground-based, time synchronized transceivers (LocataLites) that transmit positioning signals on 2.4 GHz frequency (wavelength approximately 12 cm). Biggest achievement of Locata positioning system is new, patented, wireless technology for time synchronization between LocataLites, called TimeLoc.

Capability of Locata positioning system for displacement measurement was briefly tested on a few occasions, e.g. displacement measurements of footbridge at Parsley Bay in Sydney and slow structural deformation monitoring at Tumut Pond Dam.

Within the project "Wearable outdoor augmented reality system for enrichment of touristic content", code-named "Project Wonderland", Locata positioning system was implemented in the City of Čakovec, Croatia at Polytechnic's of Međimurje backyard. Installed Locata equipment consists of six LocataLite transceivers with 18 itelite PAT24009 antennas (three antennas for each LocataLite) and two Locata receivers with two L-Com HG2403MGU-SM antennas. Prior to establishing Locata network (LocataNet) in the field, different network configurations were simulated to achieve best possible horizontal and vertical positioning accuracy. The main task was to find optimal network configuration for getting acceptable accuracy of vertical component of positioning solution (i.e. to get the lowest possible values of vertical dilution of precision). As optimal configuration, rectangular shape of 100 meters times 50 meters was chosen and established in the field. Geodetic control network was established around Locata network by classical measurements obtained by Leica TPS1201 robotic total station. Coordinates of control network were determined with the accuracy better than 2 millimetres in horizontal and vertical direction. Control network was used as a reference for determining coordinates of LocataLite antennas.

In established LocataNet measurements were conducted and analysed to get insight into the precision and accuracy of absolute and relative positioning techniques. Analysis of obtained measurements shows precision of sub-centimetre level in horizontal direction and precision of two-centimetre level in vertical direction in terms of absolute positioning. Achieved accuracy was within 2 centimetres in horizontal direction and 3-5 centimetres in vertical direction. Using relative positioning technique significant noise reduction was accomplished, with achieved precision within few millimetres in horizontal, and up to 1 cm in vertical direction (Fig. 1).

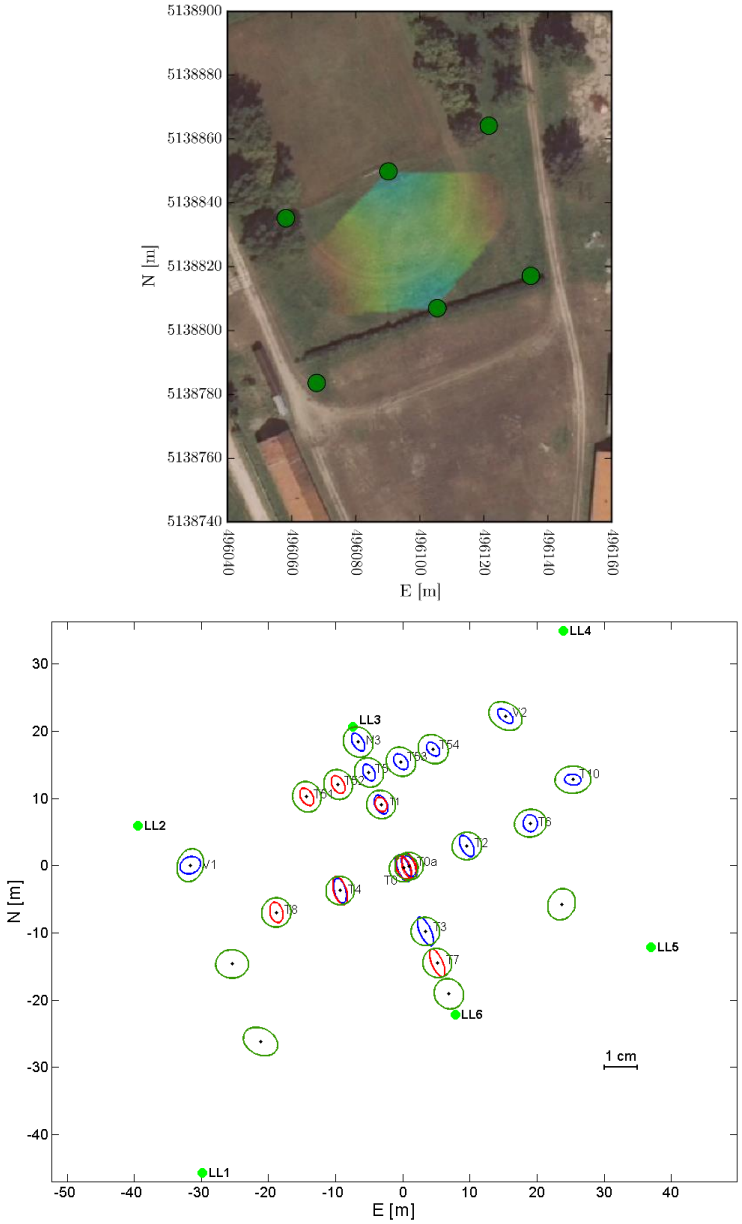


***Figure 1**: VDOP values within established LocataNet (left), theoretical (green) and empirical (red and blue) error ellipses on test points in LocataNet*

The goal of this research is to get the insight into the possibilities of the Locata positioning system to determine both long term (static) and short term (dynamic) displacements of constructions. Future research will include establishment of new Locata network in Zagreb with more extensive research on positioning using Locata, as well as research on different components that affects positioning solution (e.g. different ambiguity resolution techniques, modelling antenna phase centre offset and variations, using double differenced signals for relative positioning…). Final goal of research is to establish Locata network around railway bridge Sava in Zagreb (Fig. 2) for long and short-term displacement measurements. The behaviour of that bridge under static and dynamic load testing is known from previously accomplished measurements and conducted results (Fig. 3). Figure 3 shows determined natural frequencies by robotic total stations (RTS) and by image assisted robotic total stations (IATS).

***Figure 2**: Railway bridge Sava in Zagreb during static load testing with RTS and IATS instruments.*

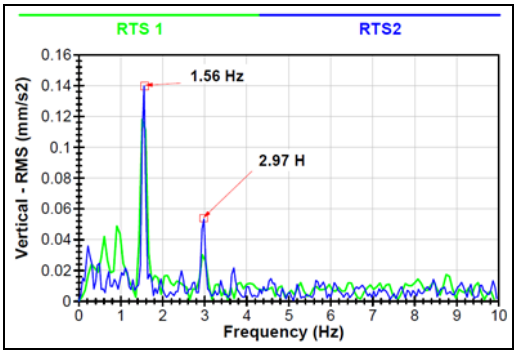


***Figure 3**: Determined natural frequencies or railway bridge Sava by RTS and IATS instruments*

***Keywords:** Locata, LocataNet, displacements, testing of precision and accuracy*

8. Anomaly detection methods for extraction of unexploded ordnances on aerial RGB images

Ivan Racetin[1], Andrija Krtalić[2]
[1] Faculty of Civil Engineering, Architecture and Geodesy, Chair of Geodesy and Geoinformatics, University of Split, Croatia, e-mail: racetin@gradst.hr
[2]Faculty of Geodesy, Chair of Photogrammetry and Remote Sensing, University of Zagreb, Croatia e-mail: kandrija@geof.hr

Abstract:

Unplanned explosion of the ammunition storage depot in Pađene, Croatia, triggered by the forest fire, happened in September 2011. Croatian research teams engaged in EU FP7 TIRAMISU project, CROMAC - CTDT (Centre for Testing, Development and Training) and Faculty of Geodesy, University of Zagreb, promptly reacted by deployment of data acquisition module of Advanced Intelligence Decision Support System for the aerial survey of impacted area. Troubling remnants of the explosion were scattered unexploded ordnances found in the various forms: undamaged, lightly or heavily deformed, burned or corroded. Remaining unexploded ordnances were not varying only in the form, they varied in the size also, ranging from rifle ammunition to cluster bombs.

Generally, for dealing with these situations ground teams of demining experts are activated for clearance and recovery tasks. Primary objective of aerial survey in visible spectrum is to provide ground teams overview of affected area which serves as input data for planning of terrain clearance actions. This paper explores the capabilities for implementation of anomaly detection methods for extraction of unexploded ordnances on aerial RGB images acquired by consumer grade digital camera.

Basically, there are two approaches in image analysis for the needs of object detection and extraction: classification and target detection. In the classification approach, the aim is to assign every pixel to the corresponding thematic class. Target detection approach, contrarily, scans the image with the aim to identify the presence of specific object or material (target). Although target detection can be regarded as binary classification with two classes: background and target, due to the difference in the essence of these approaches they are being distinguished. Number of classes is not the only difference between these approaches, term target also states that the number of the target pixels needs to be negligible compared to the number of the background class pixels. Result of this requirement is that different quality assessment methods need to be implemented depending on the approach used. Classification approach, mostly based on Bayes criterion, tends to minimize the probability of detection errors (false alarms and misses). This can easily be achieved by classifying every pixel as background, because of very sparse population of target pixels. Popular Neyman-Pearson criterion, which maximizes the probability of detection while keeping the probability of false alarm at the constant rate, is more optimal for the target detection.

Anomaly detection methods are a subset of target detection methods in which no *a-priori* information about the target spectra is available. Reed-Xiaoli (RX) algorithm is the benchmark in anomaly detector: it calculates the Mahalanobis distance between the pixel under test and the background. Mahalanobis distance uses covariance matrix and mean value which can be calculated from local background (vicinity of pixel under test) or global scene covariance matrix and mean, so we distinguish local and global RX algorithm. In this paper, local and global RX algorithms were applied to the images of exploded ammunition depot acquired by Nikon D90 camera mounted on helicopter.

As no ground truth was feasible, images were visually interpreted and manually classified. Object were vectorized using the object-based image analysis to reduce the human error in the manual vectorization.

***Keywords**: Remote sensing, Target detection, Anomaly detection, Unexploded Ordnances*

9. Opportunities of Application of Advanced Methods of Surveying in Monitoring the Dynamics of Riparian Line Velipoj-Vlore in Albania

Ethem Bejko
Faculty of Civil Engineering, Polytechnic University of Tirana, Albania
e-mail: bejko_ethem@hotmail.com

Abstract:

The purpose of this study is to analyse the current situation of Velipoj-Vlore riverside dynamics under the optics of geodetic problems.

Throughout history, the Earth has been in the process of permanent and irreversible change due to natural and human development and precisely the coastal areas have been the most frequented areas of the individual and government due to the best natural conditions they offer compared to the areas other areas.

Over the last 50 years, topographic surveys of riverbank dynamics have been conducted using methods based largely on information obtained from maps or images. It is necessary that these studies to advance more closely to the truth under the optics of implementation of advanced geodetic new methods and technologies, contributing scientifically to the discovery and explanation of the factors in this phenomenon in order to correct the orientation of development policies in these areas.

The current study of the dynamics of costal line motion can be classified in three major periods of study:

- Historical studies up to the 1870s. This study period is based on historical and archaeological materials.
- Topographic studies from 1870-1990. This study period begins in the 1870s with the publication of the first map of the region for South Albania at the scale of 1: 400,000 and ends in the 1990s with the introduction of full and accurate topographic maps.
- Satellite studies from 1990 to present day. Characteristic of this period is that the studies are based on digital graphic material taken from aerial photographs and satellite images.

From the analysis performed, it turns out that these studies show some problems as they are conducted after the occurrence of the phenomenon, based on classical or digital graphic material. Also, the reliability of these studies is not very high because the interpretation realized graphically and graph-analytically by joining the visual, logical and historical interpretation of the study period.

After evaluating these studies, we stress the conviction that they should be deepened and completed with more complex studies in relation to:

- the use of digital methods and technologies for field measurements and
- inclusion of as many areas in the study,

for obtaining results with high standard of accuracy in order to increase the accuracy of these types of studies.

Advanced methods of geodetic measurements enable capturing problematic not only in the beginnings of the phenomenon but also during its development. Coastline Dynamics is a

phenomenon of interaction between sea water and soil in its vicinity, so in this study we want to contribute to clarifying and precisely identifying each of the influential vectors in this mutual land-sea relationship.

Our analysis was based on two types of geodetic systems:

A-Analysis of data obtained from existing monitoring bases.

1. Monitoring base of the Albanian Satellite Permanent System "ALBPOS".
2. Tectonics monitoring bases in Albania.

B-Direct field measurements based on geodetic schema a geodetic ground fixed and materialized on the ground in a study area (Divjaka area) in order to determine the foreseen data and parameters to the dynamics of the phenomenon.

Establishing a proper geodetic and monitoring base creates the possibility of:

- Unification of all studies into a single reference system, meaning in a single coordinating system and
- Creating monitoring opportunities to carry out direct geodetic field measurements, where the phenomenon occurs or is expected to occur.

The geodetic network set up consists of two polygonal satellite lines with an average side of about 10km, the first in the vicinity of the costal line and the second 30-40km within the land.

The point fixing method. For this purpose, has been used mainly geodetic point of existing state geodetic network, new points located around objects with high geological stability and new fixed points on the ground in hill area.

Method of measurement. GPS System Topcon GR-3 with accuracy static positioning 3mm + 5ppm in horizontal and 5mm + 5ppm vertical, with Post Processing method. Total station Topcon IS-203 Image scanner with measuring the distance with accuracy 2mm + 2ppm and accuracy in measuring the angles 2”.

Survey Program. Measurements are designed to be implemented in time intervals every 6 months.

Data Processing and Extracting Results. Data processing will use the TopCon Tools I software specified for this type of data analysis.

We think that such applications should be extended to precise the bottom relief of the sea near the riparian line. Also, the creation of a prognostic maps, specific to the coast line, carried out every five years would help positively to increase the accuracy of the information in such studies. Application of all methods, for the fact of reliance on satellite and digital technology, requires the promotion and realization of projects started in the direction of modern national positioning systems linked to global positioning systems.

The construction of road infrastructure (Adriatic Ring), is a way to minimize the negative effects of the phenomenon in terms of land.

Keywords: *Geodetic problems, Topographic studies, Geodetic systems, Data Processing, Divjaka area, Monitoring base.*

10. Geodetic approaches to support climate change adaptation in Thailand

Rattikarn Khambud
Technical University Munich, Department of Civil, Geo and Environmental Engineering, Germany
e-mail: rattikarn.th@gmail.com

Abstract:

In the year 2011, massive flooding occurred around the Chao Phraya River, Thailand. These floods had a tremendous impact on the country's communities and economic systems which resulted in many victims and homeless as well as substantial loss of property. There are many factors that likely caused these flooding events. Two main influential issues are climate change and stimulating anthropogenic interventions.

The central region of Thailand had flooding problems previously that have been attempted to solve by using structural (hard-engineering) and non-structural methods. Nevertheless, the process of planning and implementing the action plans still have not worked out so far for long-term projects. Some of those solutions may create new risks for other factors such as public or private walls for flood protection, making concrete embankment inefficient, destroying river-landscapes or have environmental impacts.

Understanding the performance of many European countries and realizing how efficient the national river cooperation can work hand in hand for solutions to flooding problems is one crucial means of managing flood risk. For example, the related section defines the EU policy; with a legal basis for transnational perspectives and the difference of flood protection and planning law among EU community on Elbe River, preventive flood management measures by spatial planning, the remarkable international cooperating projects on the Rhine River (room of the river concepts); the case of water retention areas nearby Cologne and the future plans of the Danube River line in the "flood protection action program 2020" of Bavarian State, Germany.

The most interesting practices are highlighted on the new Danube River and the Danube Island in Vienna, Austria, which is a quality program of flood prevention. The clever design in conjunction with other enhancements allows for the increased capacity of water flow while having a creative design that functions as a recreation area in non-flooding seasons and can render plenty of benefits for local and national communities.

This research concludes that the best benefit of geodetic approaches through water and land management in order to significantly reduce flooding in Central Thailand is a new artificial river. The new artificial Chao Phraya River would encounter challenging conditions of low-lying areas, high density population and forest area.

This solution was properly created by using new advanced satellite surveys from the German TanDEM-X and TerraSAR-X single-pass SAR interferometry of the DLR, Germany, which demonstrate results with great potential. The superior high-resolution terrain information of Hydro-DEM (12 m position and 2 m height accuracy) geo-information fed into a Geographic Information Systems (GIS) ArcGIS to find an optimum track of the relieving river. These methods, along with a more supportive system of water retention in various areas of functional land management in urban and rural areas, show encouraging results. Furthermore, a future plan of dealing with hydro-meteorological phenomena is advised to the local authority cooperation, raising awareness on establishing a community flood policy and plans for long-term optimized flood risk management.

Keywords: *Geodetic approaches, Digital Elevation Model (DEM), Land and Environment, Climate change, Flood risk management*

11. Analysis of Geodynamical network computation methods

Margareta Premužić
State Geodetic Administration, Croatia
e-mail: Margareta.Premuzic@dgu.hr

Abstract:

Paper gives description of computation methods and procedures for processing of City of Zagreb geodynamical network. Network campaigns from 1997 to 2009 are involved in data analysis. First results are performed with scientific software GAMIT/GLOBK 10.6 with Kalman filter implementation and they indicate constantly present tectonic activity of that area. In this paper all calculations are performed with another scientific software BERNESE 5.2 and comparison of GAMIT and BERNESE strategy and results are obtained. Processing strategies, models and algorithms were tested and correlation between the time series achieved are analysed to find an answer how algorithms influence the final results. This research presents to what degree the results from different software can be compared and how they complete each other. All parameters of GAMIT are configured for regional or local campaign. As the reference points of the Geodynamic network, two of the most stable points in the research area were chosen. On the other side for calculation in Bernese as reference points were chosen IGS stations GRAZ, MATE and MEDI. All three stations have continuously measurements from 1995 until today. Stations are distant from regional structures and are involved in permanent monitoring by IGS. Comparison of results obtained from periods 1997–2009 was conducted. The results of the analysis demonstrate the necessity of conducting measurements in intervals of up to one year which is essential for quality analysis and understanding of the mechanism of the structural assembly of the wider Zagreb area. Furthermore, analysis will show possibilities of using geodynamical network but also permanent network in determination of discontinuities and outliers for the purpose of monitoring of seismic and tectonic activities in specific area.

Keywords: *geodynamical network, BERNESE, computation methods*

12. Methodologies on creation and adjustments of active GNSS network (VRS and CORS)

Genti Qirjazi
Faculty of Civil Engineering, Polytechnic University of Tirana, Albania
e-mail: gentiqirjazi@gmail.com

Abstract:

Nowadays technological development in the field of Geodesy, as in any other field, has made a radical change. This has led to the facilitation and creation of new opportunities to extend the science of geodesy even further. The creation of the GNSS satellite system has brought a revolution in the methodology of determining the position of different objects in nature, since the methods used in this case are completely different from the classical methods of positioning. Even today GNSS system can be called a consolidated system since it has been used and perfected for decades. With the growth of communication technology and its integration with the GNSS system, the positioning (in cm level) is carried out in real time. In the measurement process, obtaining a good and consistent accuracy will be always a big challenge. For this reason, there is always the need to create methodologies to increase this accuracy and make it consistent in all the measurement territory.

Active GNSS Networks or so called CORS Networks consist in the creation of a set of continuous operating reference stations. CORS can take the place of a traditional base station used in differential GNSS positing. They can give an instant position to an accuracy of ± 20 mm and are used in many industries including Precision Agriculture, Construction, Mining, Surveying and in Scientific Research. A Continuously Operating Reference Station (CORS) network is a network of RTK base stations that broadcast corrections in real time, usually over an Internet connection. Accuracy is increased in a CORS network, because more than one station helps ensure correct positioning and guards against a false initialization of a single base station. CORS networks are advantageous over single baseline GPS for many reasons. Such advantages include: Elimination of base station issues (Reduced cost for hardware, security, set up time), Common co-ordinate system used by all parties, Increased working range (mobile coverage becomes the biggest limitation), Elimination of radio issues.

My thesis is oriented towards the methodologies for creation and adjustments of active GNSS Geodetic Networks (CORS Network). It will cover different theoretical concepts that that will help in understanding how these GNSS Network are created and adjusted and will show a practical approach on how the creation and adjustment of these GPS networks can be made possible. The focal points of this thesis will result in the creation of a practical manual for creating the CORS Network and a software for the network adjustment computation. I strongly believe that my thesis will be a good guideline for everyone who wants to know about the creation of Active GNSS networks.

Keywords: *GNSS, CORS, Geodetic Network, Adjustment Computation, GPS, GNSS Network.*

13. Seafloor digital model as the base for maritime safety, case study: St. Ante channel

Ljerka Vrdoljak
Croatian Hydrographic Institute, Split, Croatia
e-mail: ljerka.vrdoljak@hhi.hr

Abstract:

Sea and seafloor are origin of many natural resources, while on sea surface, vivid transport of both humans and goods that includes great part of worldwide trade is carried out. Although hydrographic activities are primarily focused on the safety of maritime transport and sea traffic, it underpins all activities that occur on sea surface, below it and underground including environmental protection and management, marine science, maritime defence, tourism, fishery, maritime boundary delimitation, etc. Studies by the International Hydrographic Organization (IHO) indicate that the cost benefit ratio when investing in national hydrographic programme is at least 1:10 for nations with significant dependence on maritime trade.

Coastal states are responsible for the maritime safety, and navigable lines and port areas are zones of special interest. Data collected during bathymetric survey is used for creation and update of navigation charts, which increases safety of the sea traffic and environment as well as it contributes to all activities related to the sea.

While purpose and content of navigation charts have not changed for a greater period of time, methods of collecting, processing and analysing of data as well as ship navigation technique have completely changed in the last fifty years. Due to the development of technology and computer systems, we have crossed from analog to digital era, and global positioning systems enable real time positioning with high accuracy. Modern technology is user friendly, widely applicable and easily accessible. Classic concept of sea navigation which includes paper charts is replaced by digital control system.

It is necessary to establish a legal framework for hydrography through laws and standards in order to achieve uniform quality of data presented on nautical charts at international level. Republic of Croatia is a member of the International Hydrographic Organization (IHO), International Maritime Organization (IMO) and has adopted the SOLAS (Safety of Life at Sea) Convention and is consequently obligated to collect, analyse and store the data necessary for production of nautical charts and to keep them up to date. Hydrographic data should be globally available and collected according to international standards.

In this paper, a review of laws and standards related to hydrography is made with emphasis on bathymetric survey and practical use.

Integration and application of modern acoustic and satellite-based methods for bathymetric survey in order to calculate 3D seafloor model is explained through case study: Bathymetric survey of St. Ante channel for production of new navigation chart. Multibeam echo sounders MBES along with LIDAR systems are modern standards for seafloor survey because they provide total sea floor coverage. MBES systems are integrated systems that consist of main Multibeam echo sounder joined with other sensor, for example satellite-based navigation system and motion reference unit. Example of Multibeam system which is described in this paper is MBES system mounted on research vessel Hidra owned by the Hydrographic Institute of Croatia.

Advanced methods and systems for bathymetric survey are acoustic systems whose method of depth calculation is based on measuring propagation time of the acoustic echo signal which travels through a liquid medium. Speed of sound in water depends on elasticity and density of the medium through which sound wave travels. Considering usual bathymetric survey in the Adriatic Sea, acoustic waves travel in the sea water in which, speed of sound depends empirically on three parameters temperature (T), pressure (p) or depth (D) and salinity (S). In shallow seas and coastal areas depth profile of sound speed is irregular and unpredictable. Sea is not a homogenous mixture of steady mass and mixing of sea layers is due to sea currents and atmospheric influence which results in different speed of sound throughout the area of interest. Consequently, uncertainty of measurements depends on precise determination of sound of speed in the water column. Correlation of physical parameters of fluid and speed of sound as well as its impact on measured depth is explained in the paper.

Considering bathymetric survey of ports and navigational routes, MBES systems are capable of complete search of the seafloor in a limited amount of time, which satisfies IHO standards as well as economic ones. Channel of St. Ante at the entrance to Šibenik port is chosen as an example of surveyed area for production of new navigation chart. It is an approach navigation route to Šibenik harbour with depths up to 44 metres. Regarding S-44 standard it is an area of special order for bathymetric survey where full seafloor search is required.

Data processing is highly automated, and it is done in the software specialized for processing of MBES data. There is a wide range of such programs on the market, but basic principle of data processing is similar. Referring to the case study of St. Ante channel, reduction of data was necessary through post processing and cells 2 m x 2 m were created. Every cell was processed with statistical filters, and median depth for each cell with its true position was calculated. For each depth value, vertical uncertainty is calculated. Absolute value of vertical uncertainty is in the range of 0.2 m to 0.4 m which is under the limit defined by S-44 standard.

Calculation of the seafloor digital terrain model is done on the basis of MBES processed data. Regardless of the interpolation method chosen, main purpose of interpolation is to calculate values for every node of regular grid based on irregularly distributed entry data.

3D digital terrain model of the sea-floor of St. Ante channel was made upon the data collected during bathymetric survey in January 2014. It is made for production of new navigation chart and lastly, it is the base for the maritime activity and sea traffic in that area.

Keywords: *hydrographic survey, multibeam system, hydrographic standards, 3D digital seafloor model*

14. Risk Assessment Support System of Outdoor Recreation in Croatia

Matjaž Štanfel
Faculty of Geodesy, University of Zagreb, Croatia
e-mail: mastanfel@geof.hr

Abstract:

The objective of this thesis is to develop and validate a risk assessment support system (RASS) for the outdoor recreation in Croatia. RASS will rely on combination of existing and newly proposed environmental, geo-physical and social data and services. Advanced computer simulation and visualization methods for generating knowledge contributing to the risk assessment and prevention of injuries or deaths in outdoor recreation in Croatia. In order to increase awareness on those risks and contribute to safety of human life, RASS results have been offered as dedicated and specially designed public service.

In order to reduce the losses (human and financial), more effort has to be invested in understanding the opportunities and the importance of using spatial analysis for risk management with a focus on the quality of input spatial data as the basis for analysis, risk apportionment, risk mapping and other significant components depending on the field of research and application. The risk management service should introduce the public to the risks and thus actively involve citizens in injury prevention, provide rescuers with an overview of the situation and support in making decisions, and give the information to injured person to know the current situation.

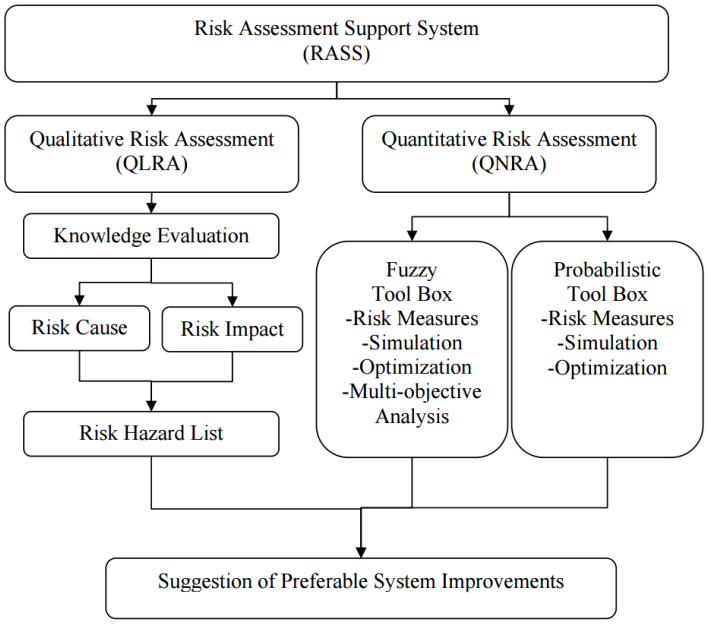


Figure 1 - Interaction between the two main components of the risk assessment (El-Baroudy et al., 2006)

Nowadays, number of participants in outdoor activities is constantly increasing due to positive health effects, especially the mental development of the child (Jones et al., 2007). Outdoor activities in Croatia, such as hiking, walking, mountain climbing, skiing, cycling, running and adventure racing are in increasing rate, and are more often reasons for interventions of Croatian

Mountain Rescue Service (HGSS) on the terrain (Šuperina et al., 2008) leading to higher costs of medical treatments, rescue expenses and posing a risk for sport-active part of society.

In the case of multi-risk situations, it is necessary to study the relationship between different risks and to determine their correlation. Risks are manifested in different scales of analysis ranging from global to local levels. Each of these levels has its goals and requirements for spatial data that serve environmental data, risk factor and risk factors.

Today, the use of geoinformation systems (GIS) is a logical choice for collecting and analysing spatial data - hence its role as a tool to assist organizations or risk management organizations to improve the quality of their decisions, increase productivity and efficiency (Mansouriana et al., 2006).

For a better understanding of the role and the need for establishment of GIS supported RASS, identification of risk has been made as well as the types of injuries and their consequences on health.

Modeling various environmental, geo-physical and social data can result with indicative risk assessment in outdoor recreation while existing data services in Croatia should be supplemented with additional ones in order to achieve usable RASS service for risk assessment in outdoor recreation. Public service providing a risk assessment of outdoor recreation in Croatia will increase safety of human life and decrease costs for response actions.

Keywords: *RASS, risk assessment, outdoor activities, GIS*

References:

El-Baroudy, I., Simonovic, S. P. (2006). A Decision Support System for Integrated Risk Management. Department of Civil and Environmental Engineering, The University of Western Ontario, 8.

Mansouriana, A., Rajabifardb, A., Valadan Zoeja, M. J., Williamsonb I. (2006): Using SDI and web-based system to facilitate disaster management, Computers & Geosciences, Vol. 32, 303–305.

Jones, L. A., Sinnott, L. T., Mutti, D. O., Mitchell G. L., Moeschberger, M. L, Zadnik, K. (2007): Parental History of Myopia, Sports and Outdoor Activities, and Future Myopia, Investigative Ophthalmology & Visual Science, vol.48, 3524–3532.

Šuperina, M., & Pogačić, K. (2008). Učestalost Hrvatske gorske službe spašavanja u traganju za nestalim osobama. Policija i sigurnost, 16(3-4), 235-256.

List of participants:

Ime/Name	Prezime/Surname	e-mail
Freskida	Abazaj	freskida.abazaj@gmail.com
Ivan R.	Aleksić	aleksic@grf.bg.ac.rs
Željko	Bačić	zbacic@geof.hr
Branislav	Bajat	bajat@grf.bg.ac.rs
Sergej	Baričević	sbaricevi@geof.hr
Ethem	Bejko	bejko_ethem@hotmail.com
Joep	Crompvoets	joep.crompvoets@kuleuven.be
Ivana	Čavlina-Tomašević	tomasevic@cirus.dhz.hr
Walter	de Vries	wt.de-vries@tum.de
Almin	Đapo	adapo@geof.hr
Gezim	Gjata	g.gjata2@gmail.com
Igor	Grgac	igrgac@geof.hr
Marijan	Grgić	marijan.grgic@geof.hr
Ivan	Jakopec	ijakopec@geof.hr
Blerim	Jashari	blerimjashari@yahoo.com
Rattikarn	Khambud	Rattikarn.th@gmail.com
Andrija	Krtalić	kandrija@geof.hr
Miljenko	Lapaine	mlapaine@geof.hr
Slaven	Marasović	slaven.marasovic@gmail.com
Damir	Medak	dmedak@geof.hr
Nikolina	Mijić	nikolinamijic7@gmail.com
Zvonimir	Nestić	znevistic@geof.hr
Rinaldo	Paar	rpaar@geof.hr
Josip	Peroš	josip.peros@gradst.hr
Vesna	Poslončec-Petrić	vesna.posloncec@geof.hr
Margareta	Premužić	margareta.premuzic@gmail.com
Genti	Qirjazi	gentiqirjazi@gmail.com
Ivan	Racetin	ivan.racetin@gradst.hr
Marko	Radanović	maradanovic@geof.hr
Genc	Salja	gencsalja@outlook.com
Miliam	Sylka	msylka@geoland-kosova.com
Matjaž	Štanfel	mastanfel@geof.hr

Dražen	Tutić	dtutic@geof.hr
Ljerka	Vrdoljak	ljerka.vrdoljak@hhi.hr
Bojan	Vršnak	bvrsnak@gmail.com
Thomas	Wunderlich	th.wunderlich@tum.de
Robert	Župan	rzupan@geof.hr

Notes:

2nd International Doctoral Seminar in field on Geodesy, Geoinformatics and Geospace - IDS3Geo

Book of Abstracts

08.-11. May 2018, Dubrovnik, Croatia

Detailed programme

08.05. Tuesday

14.00 – 15.30: Opening session (S1)

- Prof. Damir Medak, Dean, Faculty of Geodesy, University of Zagreb, welcome speech
- Prof. Željko Bačić, Head of Organizing Committee, Faculty of Geodesy, University of Zagreb, about the seminar

Introductory lecture:

- Prof. Arnold Hamslmeier, University of Graz: **Stellar activity and space weather on Exoplanets**, part 1

16.00 – 18.00: Astro (S2.1)

- Prof. Arnold Hanslmeier, University of Graz: **Stellar activity and space weather on Exoplanets**, part 2
- M. Dumbović, University of Graz: ***Forbush decrease model for expanding CMEs (ForbMod)***

16.00 – 18.00: Geoinformatics (S2.2)

- Prof. Joep Crompvoets, Catholic University of Leuven: ***Disruptive technologies and their impacts***
- N. Jovanović, Faculty of Civil Engineering, Architecture and Geodesy, University of Split: ***Quality analysis of OSM and STOKIS data sets***

18.30-20.00: Icebreaker party in the Dorm garden

09.05. Wednesday

09.00 – 11.00: S4.1: Engineering Geodesy & LA

- Prof. Thomas Wunderlich, Technical University Munich: ***Static and Dynamic Concepts for Setting-out Multi-storeyed Buildings***
- C. Lee, Technical University Munich: ***Land Tenure Data Gap: Combining EO data into land governance in Korean (re-) unification***
- L. Ying, Technical University Munich: ***Mapping the landscape of rural development research: A bibliometric and visual analysis***

09.00 – 11.00: (S4.2) Astronomy

- B. Heber, University of Keil: ***The role of cosmic rays for space weather***
- J. Čalogović, Faculty of Geodesy, University of Zagreb: ***Probabilistic model for heliospherc propagation of CMEs: DBEMv2 web application***

11.30 – 12.30: Workshop (S5)

- A. Đapo, Faculty of Geodesy, University of Zagreb: ***Writing scientific paper***

10.05. Thursday

09.00 – 10.30: Engineering Geodesy (S6.1)

- W. T. de Vries, Technical University Munich: ***Land division: socio-mathematical considerations***
- I. Racetin, Faculty of Civil Engineering, Architecture and Geodesy, University of Split: ***Influence of kernel size on performance of local anomaly detectors for detection of indicators of mine presence in humanitarian demining***

09.00 – 10.30: Geoinformatics (S6.2)

- J. Rada, University of Defence Brno: ***Researching quality of geographical information sources used for military terrain analyses***
- M. Husak, State Geodetic Administration: ***Contribution of Ruđer Bošković in determining Sun rotation elements and Ω using sunspot observations***

11.00 – 12.30: Workshop (S7)

- M. Dumbović, University of Graz: ***How to build a scientific career***
- M. Govorčin, Faculty of Geodesy, University of Zagreb: ***Fulbright scholarship experience***

14.00 – 15.30: Plenary - Geodesy (S8)

- Igor Grgac, University of Zagreb: ***Analysis of different LocataNet configurations on Locata positioning accuracy with emphasis on possibilities for displacements determination of constructions and implementation in construction monitoring systems***, Proposal of PhD Thesis Research Subject

16.00 Social program

20.30 Dinner together restaurant Orhan

11.05. Friday

09.00 – 10.30: Astronomy (S9.1)

- B. Vršnak, Faculty of Geodesy, University of Zagreb: ***Reflection of cosmic rays at oblique MHD shocks***
- S. Banjac, University of Kiel: ***The habitability of exoplanets orbiting M-dwarfs and K-stars***

09.00 – 10.30: Geoinformatics (S9.2)

- M. Govorčin, Faculty of Geodesy, University of Zagreb: ***Surface deformation analysis over the wider Zagreb area with MT-InSAR***
- M. Ivić, Faculty of Civil Engineering, Architecture and Geodesy, University of Split: ***Smart City, IoT and Geoinformatics***

11.00 – 12.00: Astronomy: Working meeting (S10.1)

11.00 – 12.00: Engineering Geodesy, Land Administration + Geoinformatics:
Working meeting (S10.2)

12.00 – 12.30: Closing session (S11)

- Students reflections and recommendations for next Seminar
- Final comments given by professors-lectures
- Prof. dr. Željko Bačić, Faculty of Geodesy, University of Zagreb: ***Seminar closing***

1. SMART CITY, IOT AND GEOMATICS

Majda Ivić[1]
[1]*Faculty of Civil Engineering, Architecture and Geodesy, University of Split*
e-mail: majda.ivic@gradst.hr

Introduction

The technological revolution, caused by the rapid development of Information and Communication Technology (ICT) and the emergence of new technologies, primarily today's ubiquitous digital devices with relatively low prices, changed the traditional ways of collecting and analysing data. New devices that range from purpose-built sensors to individual hand-held devices (such as smartphones), together with new platforms and new kinds of social media (e.g. Facebook) produce large amounts of data called Big data. Big data is not the only novelty brought by data revolution. There is also an Open Data initiative that was launched aiming at free data access and providing simple search tools for these data.

The idea of integrating much of this diverse data together and connecting them with traditional data as well as using them in a purpose of better functioning of cities has led to the smart cities movement (Batty 2012).

The Smart Cıty

Expansive urbanisation and population growth have been taking place over the last few decades. For the first time in history, more than half of the world's population lives in urban areas, and it is assumed that by 2050 this will increase to 70% (Gruen 2013). Today's cities bring new types of problems and challenges ranging from greater resource exploitation, energy consumption and inadequate infrastructure, but the main problem is environmental pollution and increase of the emission of harmful gases that have a negative impact on human health (Washburn et al. 2009). The answer to these problems lies in the development of smart cities based on ICT (Gruen 2013; Hancke et al. 2013; Washburn et al. 2009).

Smart city can be defined as „the safe, secure, environmental and efficient urban centre of the future with advanced infrastructures such as sensors, electronic devices and networks to stimulate sustainable economic growth and a high quality of life" (Bakici et al. 2013). The smart city concept originated from the idea of an information city by pointing out the role of ICT infrastructure and the idea of an ICT-centered city (Lee et al. 2013).

A key component of an intelligent control system such as the smart city is a sensor layer that consists of an array of sensors which are continually collecting the necessary data and thus can improve the system by making it aware of its environment (Hancke et al. 2013). In the past, infrastructure, people and goods were managed and kept in a strict, predefined way. However, smart cities are capable of adapting on the fly with the help of sensors collecting real-time data and sending them to software that has a broader picture of the situation and can potentially take a particular action (Townsend 2013). Smartness of a city is enabled technologically by the new concept called Internet of Things (IoT). IoT is a network of interconnected objects and sensing devices that harvests information, interacts with the physical world and provides services for information transmission, analytics, and applications using existing Internet standards (Association Institutes Carnot 2011).

Geodesy and geomatics play an important role in smart cities and their sensor systems. Modern geomatics tools and methods such as GIS, Global Navigation Satellite Systems (GNSS) and remote

sensing can support innovative solutions for management, governance and citizen participation practices which are brought by the idea of a smart city. Some questions usually arise in projects to make city smarter like: “Where is it?”, “What is happening where?”, “What is the best route?” (Daniel and Doran 2013). In order to provide the complete information, it is necessary to determine the spatial component in addition to quantitative and qualitative sensor measurements, for which the GNSS technology is used (Daniel and Doran 2013; Al-Hader and Rodzi 2009). Except data collecting, geomatics can also be found in data analysing. For example, GIS can be used to visualise the collected data and can be a great support tool for decision-making processes in smart cities. As a part of the digital revolution, geodesy and geomatics can be related to the concepts of IoT and smart cities, but due to the increasing interdisciplinarity, they still have to compete for their place.

Sensor layer which is a hearth of a smart city concept produces a large amount of data (Hancke et al. 2013). Although the technology is evolving rapidly, there are still some problems in implementing smart solutions regarding the Big data that haven't been resolved completely. For example where to store and how to analyse these massive data streams? Because of a large number of various sensors, there is a problem with integration of a large amount of heterogeneous information since they can have various formats and even different spatial and temporal resolutions. One of the possible approaches to these challenges could be in a Fog and Cloud Computing and applying machine learning (artificial intelligence) principles as a solution for computer-based decision making (Bačić et al. 2018; Mohammadi and Al-Fuqaha 2018). According to Kaur and Maheshwari (2016), Cloud Computing is a term for computing services that are accessible over the Internet and developed on a common pool of remotely hosted resources. On the other hand, in Fog Computing approach data can be analysed and processed by applications running in devices within the network rather than in a centralised Cloud as in Cloud Computing (Dastjerdi and Buyya 2016). Using Fog or Cloud Computing in smart cities depends on application demands. For example, if a real-time reaction is needed (e.g. smart health applications) Fog Computing should be used. Moreover, Fog Computing can be used for aggregating data and make it intelligent enough to be more easily processed in Cloud Computing.

From the perspective of geomatics, two new techniques are particularly interested and should be considered as a part of cloud computing: location cloud and remote sensing cloud. According to Li et al. (2013) the purpose of location cloud is to collect all of the information available related to some geographic location so the location-based services for a different applications can be provided, while the remote sensing cloud refers to a storage of a large volume of remote sensing data together with processing algorithms.

Among the heterogeneous information stored in clouds, there are a lot of high rate data that cannot be reviewed by humans so there is a need for a system that can learn and improve itself from previous experiences. Moreover, the operating environment of smart city applications changes over time so the system should be dynamic with the continuously learning mechanism. Because of complexity and time consumption of traditional analysing approaches, machine learning becomes inevitable for Big data and should be embedded into Fog and Cloud Computing (Mohammadi and Al-Fuqaha 2018).

Figure 1 represents a concept of a smart city system that integrates IoT, Fog and Cloud Computing. System is a closed loop which consists of collecting data (sensor layer), storing and processing data and using it for different applications.

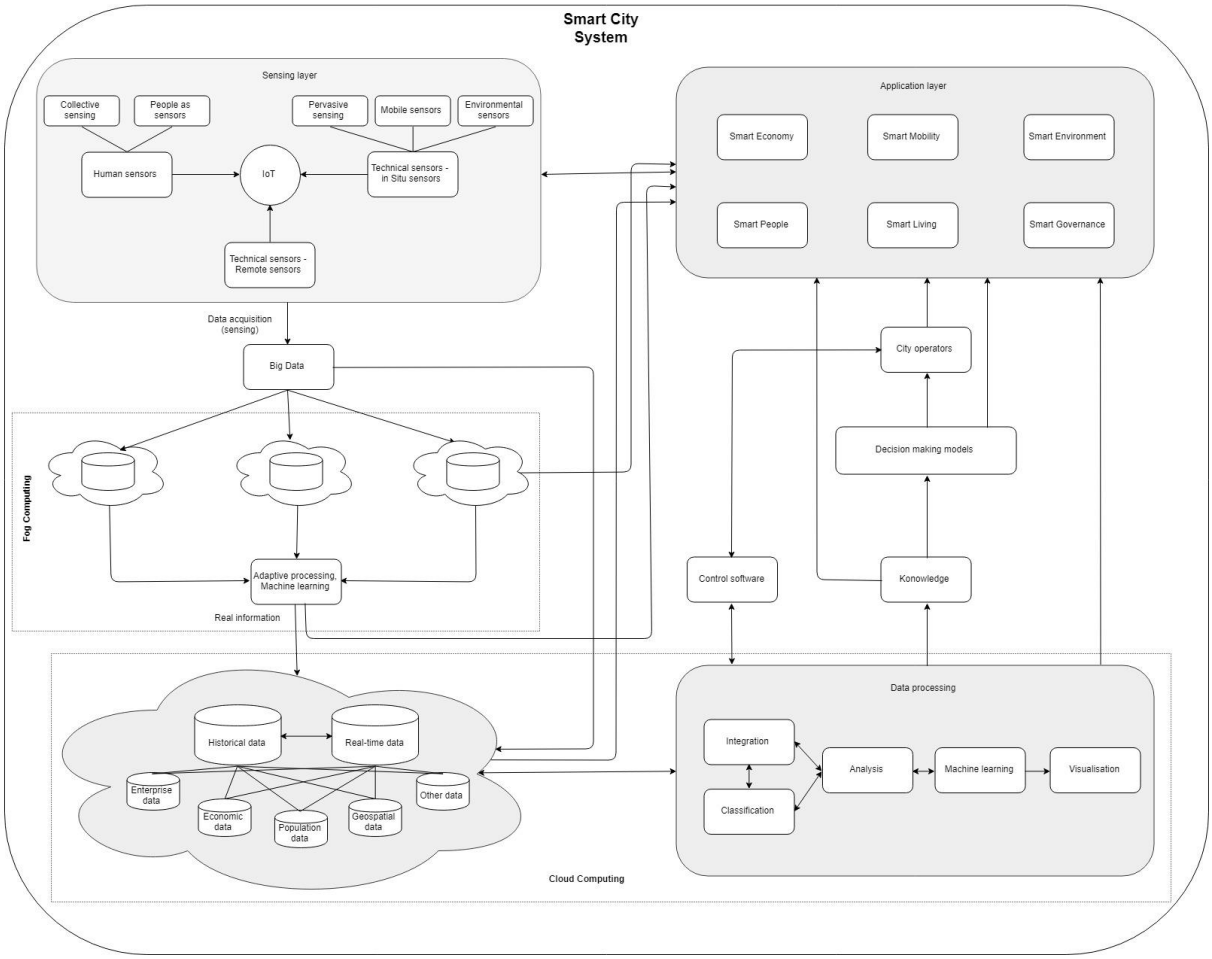


Figure 1. Smart city system

Conclusıons

There are a lot of technical issues associated with smart cities that still have to be solved, and many of them are closely related to geodesy and geomatics. Topics like 3D spatial-temporal modelling, integration of global position system (GPS), remote sensing and GIS in mobile platforms, devices and structures for ubiquitous sensing and communication, indoor and underground navigation all represent a great opportunity for further research.

Keywords: *smart city, geomatics, IoT, Big data*

References

Association Institutes Carnot (2011): Smart sensored objects and Internet of Things, White Paper, Greece.

Al-Hader, M., Rodzi, A. (2009): The smart city infrastructure development & monitoring. Theoretical and Empirical Researches in Urban Management, 12(2), 87-94.

Bačić, Ž., Jogun, T., Majić, I. (2018): Integrated Sensor Systems for Smart Cities. Tehnički vjesnik, 25(1), 277-284.

2. CONTRIBUTION OF RUĐER BOŠKOVIĆ IN DETERMINING SUN ROTATION ELEMENTS *i* AND Ω USING SUNSPOT OBSERVATIONS

Mirko Husak[1]
[1]*State geodetic administration*
e-mail: Mirko.Husak@dgu.hr, mhusak@geof.hr

Abstract:

Roger Joseph Boscovich, in Croatian Ruđer Josip Bošković (Dubrovnik, Croatia, May 18th, 1711 – Milan, Italy, February 13th, 1787) was Croatian Jesuit priest, astronomer, polymath, physicist, geodesist, cartographer, philosopher, poet and diplomat. He established and equipped astronomical observatory in Brera, using guidelines he sought in Greenwich astronomical observatory when he visited London 1760 and he made the program of astronomical observations activities in Brera where he planned observations of Sunspots.

His first dissertation *De maculis solaribus* (About Sunspots) 1736 describes geometric and trigonometric methods for determining period of Sun rotation and position of Sun using three positions of a Sunspot. This method is similar to his method for determine the traces of comets. In 1777 he observed for six days a regular middle-sized Sunspot traced at the Sun surface. This observations and calculations were published 1785 in the section *Sur les éléments de la rotation du soleil sur son axe déterminés par l'observation de ses taches* of the 5th book *Opera pertinentia ad opticam et astronomiam*. Using geometric method Bošković calculated value of Sun rotation sidereal period 26.77 days, since then the value was 25.5 days. Also, he calculated synodic period of the Sun 28.89 days. Today we know that the Sun plasma body with differential rotation and its rotation period lasts 25-29 days. Furthermore, Bošković created adjustment method with a condition that the sum of absolute values of deviations strives to a minimum – L_1-norm, before the method of Carl Friedrich Gauss (1777–1855) who created adjustment method with a condition that the sum of square number of deviations strives to a minimum – L_2-norm, usual today.

In 1678 Jean Dominique Cassini (Cassini IV, 1748-1825) is the first one who determined the inclination angle *i* between planes of ecliptic and equator of Sun and ecliptic longitude ascending knot of Sun equator Ω and after him many others mentioned in this research. The research should find out

1. Can we calculate sun rotation elements *i* and Ω using 1777 observations of Bošković?
2. Which method suits better for the adjustment of calculated results of Sun rotation elements: L_1–norm (Bošković method) or L_2–norm (Gauß method)?
3. Could we use the 1777 Bošković observations of three positions of one sunspot for calculating *i* and Ω values with some cotemporary method.

This research continues in the future with explanation of *De maculis solaribus* (Bošković 1736), translation of old French text *Opuscule II.* (Bošković 1785, 75-178), the explanation of the text, and recalculation of these results to find out if the published calculations of Bošković were well done.

The Bošković observations are time series data which are discussed in order to filter out outlying and noisy data. Further research could include analysis of calculations of *i* and Ω using Sunspot observations J. D. Cassini and others compared with nowadays sunspot observations and calculation with nowadays methods.

Keywords: *Ruđer Bošković, Sunspot, Sun rotatıon elements, L_1–norm, L_2–norm, time series*.

Introduction

Roger Joseph Boscovich, in Croatian Ruđer Josip Bošković (Dubrovnik, Croatia, May 18th, 1711 – Milan, Italy, February 13th, 1787) was Croatian Jesuit priest, astronomer, polymath, physicist, geodesist, cartographer, philosopher, poet and diplomat. He lived in Dubrovnik (1711-1725) and studied at *Collegium Ragusinum* and then he lived in Rome (1725-1757) where he studied (1725-1741) and toughed as professor of mathematics (1740-1757) at *Collegium Romanum*. In 1764 he was called to be chair of mathematics at University of Pavia, where he established and equipped astronomical observatory in Brera, using guidelines he sought in Greenwich astronomical observatory 1760 when he visited London and then became a member of London Royal Society in January 15th 1761. He left Pavia because he wasn't acceptable head of the Brera astronomical observatory for Austrian empire despite that he made huge impact and progress for it. In the program of astronomical observations activities in Brera (Marković 1968 and 1969, 768-770), he planned observations of Sunspots (Marković 1968 and 1969, 769). Bošković (1760) described sunspots in the poem *De Solis ac Lunae defectibus*.

Methodology

The Sun is plasma body with differential rotation (Reinsch et al 1999), faster closer to the Sun equator and slower closer to Sun poles (**Figure 1**).

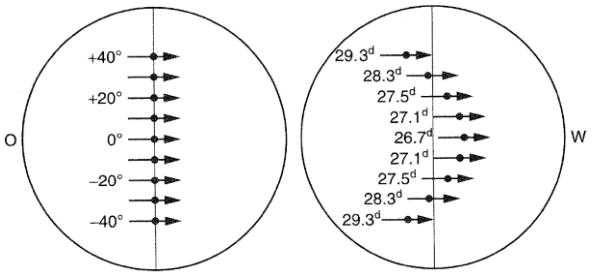


Abb. 7.4: Differentielle Sonnenrotation.

Figure 1: Differential rotation of the Sun (Reinsch et al 1999, 227).

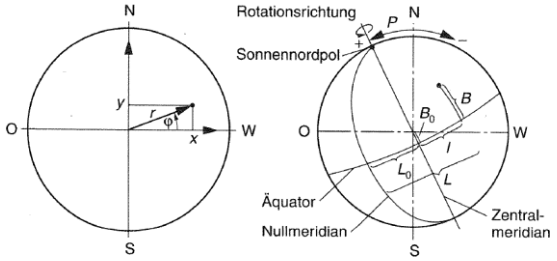


Abb. 7.1: Ebene Koordinatensysteme für Lagemessungen (links) und heliographisches Koordinatensystem (rechts).

Figure 2: Heliographic coordinates (Reinsch et al 1999, 224).

Processing of sunspot observations there is heliographic coordinates of the disk of the Sun (Figure 2). Today we know the Sun rotation period lasts 25-29 days (Bogutovac 2011). Formulas for converting coordinates (x, y) to (B, L) and vice versa are (Reinsch, K. et al 1999, 229-230):

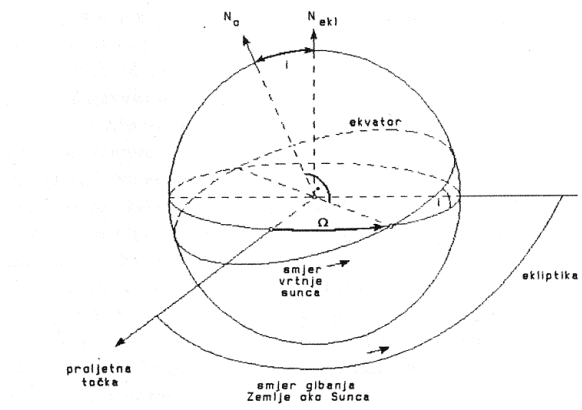
$$x = R \cos B \sin l$$
$$y = R (\sin B \cos B_0 - \cos B \sin B_0 \cos l)$$

$$\sin \vartheta = r / R$$

$$\sin B = \cos \vartheta \sin B_0 + \sin \vartheta \cos B_0 \sin \varphi$$

$$\sin l = \cos \varphi \sin \vartheta / \cos B$$

$$L = L_0 + l$$



Slika 4 - 2: Elementi rotacije Sunca.

Figure 3: Carrington's Sun rotation elements Sun rotation elements i and Ω (Brajša 1989, 23).

Brajša (1989) briefly described sun rotation elements *i* and Ω (Figure 3) called Carrington's Sun rotation elements: *i* is the inclination angle between planes of the ecliptic and the equator of Sun, and Ω is the angle measured on the ecliptic plane from the initial (Carrington) meridian through the spring point in the direction of the Sun rotation to the ascending node of the Sun equator (Figure 3). Formulas for calculating i and Ω are (Brajša 1989, 23):

$$\Omega = 74{,}40^\circ + (Y - 1850) \cdot 0{,}014^\circ$$

$$i = 7{,}25^\circ$$

where Y is the year, and 0,014° rounded value 0,01396° the annual change caused by the precession (Wöhl 1978, 165).

Carrington's meridian is initial point on the Sun surface for measuring heliographic latitude in middle world noon on January 1st, 1854 (2398220 Julian days). The angle Ω is determined by the direction of spring point on the ecliptic to the ascending node of the Sun equator on the ecliptic (Berić at al 1982, 7-11).

Findings

In 1630 Scheiner observed sunspots and found out that the sunspots closer to the Sun equator moving faster than the ones at higher latitudes, so the rotation period of the Sun depends of latitude, and at equator is the slowest, later in 1763 Carrington find out that equatorial period of the Sun is 24.96 days and at latitude 35° it is 26.38 days (Struve 1962, 250).

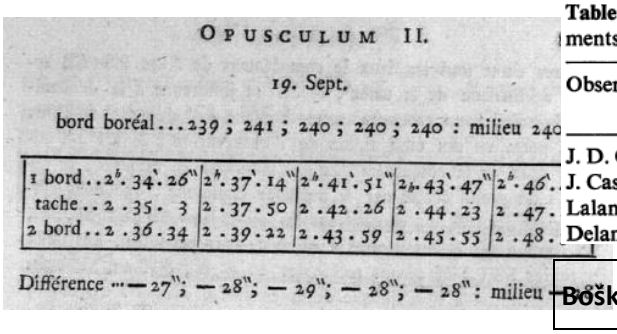
Contribution of Bošković's work on rotation elements of the Sun

The dissertation *De maculis solaribus* in Latin (Bošković 1736) described two methods, geometrical, and trigonometrical, for determination of the period of the Sun, and inclination angle *i* between plane of ecliptic, and the plane of the Sun equator using three observations of a Sunspot. In France 1777 Bošković himself observed for six days a regular middle-sized Sunspot traced at the Sun surface (Bošković, R. J. 1785, 87-89), typical set of observations for a day presents Figure 4. Using geometric method Bošković calculated value of Sun rotation sidereal period 26.77 days (*Tab. X.*), since then the value was 25.5 days. Also, he calculated synodic period of the Sun 28.89 days (*Tab. XI.*) at Figure 5 (Bošković, R. J. 1785, 145 and 168: *Tab. X.* and *Tab. XI.*).

Table 1: Table 1 (Wöhl 1978) with inserted name of Bošković.

Table 1. Solar rotation elements Ω and *i* as derived from measurements of the rotation of sunspots (all angles in degrees)

Observer	Year of observation	Ω_{obs}	Ω_{1900}	Ω_{1976}	*i*
J. D. Cassini	1678	68	71.1	72.2	7.5
J. Cassini	1740	70	72.2	73.3	—
Lalande	1775	78.07	79.81	80.87	7.33
Delambre	1775	80.12	81.86	82.92	7.32
Bošković	**1785**				



OPUSCULUM II.

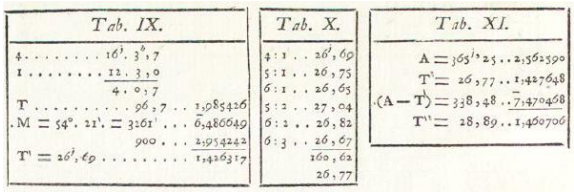
19. Sept.

bord boréal...239 ; 241 ; 240 ; 240 ; 240 : milieu 240

1 bord	2h. 34'. 26"	2h. 37'. 14"	2h. 41'. 51"	2h. 43'. 47"	2h. 46'.
tache	2 . 35 . 3	2 . 37 . 50	2 . 42 . 26	2 . 44 . 23	2 . 47 .
2 bord	2 . 36 . 34	2 . 39 . 22	2 . 43 . 59	2 . 45 . 55	2 . 48 .

Différence ... — 27"; — 28"; — 29"; — 28"; — 28" : milieu —

Pogreška! Izvor reference nije pronađen.**Figure 4: Typical set of observations for a day (Bošković, R. J. 1785, 89).**



Pogreška! Izvor reference nije pronađen.**Figure 5: Sun rotation sidereal period 26.77 days, since then the value was 25.5 days and synodic period of the rotation of the Sun 28.89 days (Bošković, R. J. 1785, 168, *Tab. IX.*, *Tab. X.* and *Tab. XI.*).**

Böhm	1833	76.78	77.72	78.78	6.95
Laugier	1840	75.13	75.97	77.03	7.15
Wichmann	1846	83.78	84.53	85.59	7.75
Carrington	1850	73.67	74.37	75.43	7.25
Spoerer	1861/66	74.52	75.07	76.13	6.97
Wilsing	1882	75.78	76.03	77.09	7.17
(data above—except column 5—as cited by Epstein, 1904)					
Dyson and Maunder (1912)	1874–1911	—	74.59	75.65	7.18
Dyson and Maunder (1913)	1874–1912	—	74.48	75.54	7.18
Epstein (1916)	1905–1910	—	76.30	77.36	7.20
Epstein (1917)	1903–1910	—	73.97	75.03	7.27
(Ω increases by about 0.01396°/year by the precession)					

Reference: Wöhl (1978).

Marković (1968 and 1969, 1006-1007) briefly described *De maculis solaribus*, 1777 sunspot observations of Bošković and calculation of the Sun rotation elements in *Opuscule II* (Bošković 1785, 75-178).

Nowadays researche's work about Sun rotation elements

Recently, the Sun rotation elements *i* and Ω determined: Balthasar et al (1986) derived from sunspot groups, Balthasar et al (1987) derived from recurrent single sunspot, and Wöhl (1978) determined by Doppler velocity measurements of the Solar plasma and he gave the list of researchers that determined sun rotation elements (Table 1).

Adjustment methods and time series processing

Carl Friedrich Gauß method of adjustment, the L_2-norm minimization of squared deviations is widespread. Less used is known L_1-norm minimization absolute values of deviations, but unduly not called Bošković method. Bošković method of adjustment, L_1-norm minimization absolute values of deviations clearly explains Eisenhart (1961).

Marshall and Bethel (1996) analyzed residuals from L_1-norm estimation. Bektaş and Şişman (2010) made the comparison of L_1-norm and L_2-norm minimization and they analyzed advantages and disadvantages relatively to each other with numerical application and result discussion with the conclusion that L_1-norm was affected almost none or very little from gross error, therefore the L_1-norm is used for outlier measurements detection. Marshall and Bethel (URL 1) also use L_1-norm method for detecting gross errors in photogrammetric observations.

Bošković 1777 observations of sunspots are time series data. Mathematic models for processing time series data discussed in Diebold et al (2006). Tor (2002) discuss the use of L_1-norm and L_2-norm for adjustment and for filtering out outlying data and noisy data use of Kalman filter and Box-Jenkins models for time-series analysis.

Further research steps

This research continues in the future with explanation of *De maculis solaribus* (Bošković 1736), translation of old French text *Opuscule II.* (Bošković 1785, 75-178), the explanation of the text, and recalculation of these results in order to find out if the calculations of Bošković were well done.

Conclusions

This research should give answers to the following questions:

1. Can we calculate sun rotation elements *i* and Ω using 1777 observations of Bošković? Should be Bošković in the Table 1 in Wöhl (1978)?
2. Which method suits better for the adjustment of calculated results of Sun rotation elements: L_1–norm (Bošković method) or L_2–norm (Gauß method)?
3. Could we use the 1777 Bošković observations of three positions of one sunspot for calculating *i* and Ω values with some cotemporary method.

Further research could include reliability of the results of Wöhl (1978) for each researcher's *i* and Ω values in the Table 1. Cotemporary results in Wöhl (1978), Balthasar et al (1986), and especially Balthasar et al (1987) derived from recurrent single sunspot we should compare with the results in the Table 1 taking into account the result reliability.

References

Balthasar, H., Lustig, G., Stark, D., Wöhl, H. (1986): The solar rotation elements i and Ω derived from sunspot groups. Astronomy and Astrophysics, 160, 277-279.

Balthasar, H., Stark, D., Wöhl, H. (1987): The solar rotation elements i and Ω derived from recurent single sunspots. Astronomy and Astrophysics, 174, 359-360.

Bektaş, S., Şişman, Y. (2010): The comparison of L_1 and L_2-norm minimization methods. International Journal of the Physical Sciences, Vol. 5(11), 1721-1727.

Berić, M, Frlež, E., Kovačić, S., Rabuzin, E., Tadej, I., Vršnak, B. (1982): Astronomija, metode promatranja i proučavanja Sunca, planeta, promjenjivih zvijezda i meteora. Narodna tehnika Hrvatske, Zagreb.

Bogutovac, A. ur. (2011): Leksikon Ruđera Boškovića. Leksikografski zavod Miroslav Krleža, Zagreb.

Bošković, R. J. (1736): *De maculis solaribus*. Rim. Typographia Komarek, Romae.

Bošković, R. J. (1760): *De Solis ac Lunae defectibus.* Apud Andream Millar, in the Strand, et R. Et J. Dodsleios in Pall-mall, London.

Bošković, R. J. (1785): *Sur les éléments de la rotation du soleil sur son axe déterminés par l'observation de ses taches* (75-178) in *Opera pertinentia ad opticam et astronomiam*, I-V. Venetiis apud Remondini, Bassano.

Brajša, R. (1989): Određivanje diferencijalne rotacije Sunca na visokim heliografskim širinama pomoću filamenata polarne krune. Diplomski rad, Prirodoslovno-matematički fakultet, Fizički odjel, Sveučilište u Zagrebu, Zagreb.

Diebold, F. X., Kilian, L., Nerlove, M. (2006): Time Series Anlysis. İn fortcoming Blume, L., Durlauf, S. (eds.) : The New Palgrawe Dictionary of Economics, Second Edition, MacMillan, London.

Eisenhart, C. (1961): Boscovich and the Combination of Observation. İn White, L. L: (ed): Roger Joseph Boscovich S. J., F- R. S., 1711-1787, studıes of hıs lıfe and work on the 250th annıversary of hıs bırth. 200-212.

Marković, Ž. (1968 and 1969): Ruđe Bošković. Dio prvi i dio drugi. Posebno izdanje odjela za matematičke, fizičke i tehničke nauke, Jugoslavenska akademija znanosti i umjetnosi, Zagreb.

Marshal, J., Bethel, J. (1996): Analysis of residuals from L_1-norm estimation. International Archives of Photogrammetry and Remote Sensing, Vol. XXXI, Par B5, Vienna, 38-43.

Marshal, J., Bethel, J. (URL 1): Gross error detection and convergence analysis in photogrammetric networks. Commission III, Working Group I., na URL 1: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.52.9533&rep=rep1&type=pdf, 21. 05. 2018.

Reinsch, K. et al (1999): 7. Positionsbestimmungen (224-272), in Die Sonne beobachten. Sterne und Weltraum, Heidelberg.

Struve, O. (1962): Astronomie, Einfürung in Ihre Grundlagen. Walter de Gruyer & Co., Berlin.

Tor, Y. K. (2002): L1, L2, Kalman Filter and Time Series Analysis in Deformation analysis. FIG XXI. International Congress, Washington D. C. USA, April 19/26 2002, 1-18.

Wöhl, H. (1978): Sun rotation elements i and Ω as determined by Doppler velocity measurements of the Solar plasma. Astronomy and Astrophysics, 62, 165 177.

3. Quality analysis of OSM and STOKIS data sets

Nataša Jovanović[1]
[1]Faculty of Civil Engineering, Architecture and Geodesy/University of Split,
Matice hrvatske 15, 21 000 Split, Republic of Croatia,
e-mail: njovanovic@gradst.hr

Introduction

Volunteered geographic information (VGI) can be defined as geoinformation collected by voluntary activities of individuals or groups and provided to other people to use. They present an unprecedented change in the way of creating, distributing and using geoinformation. People who collect and use them are mostly untrained and unpaid for this purpose, so the results of their work can be accurate, but also inaccurate data [Goodchild 2007]. The term of mass data collection (crowdsourcing) is closely related to VGI, but it has a greater significance [Mooney and Corcoran 2014]. The most successful examples of VGI sources is OpenStreetMap (OSM), but there are also Wikimapia, Google Map Maker, GeoNames etc. Understanding and determining quality is a very important factor, especially in the context of VGI as there are no specifications for data creation. The currently valid standard for determining quality is ISO 19157 standard which contains qualitative and quantitative elements and sub-elements. In recent years the question of quality of VGI has become the subject of numerous scientific papers. Most of them are based on comparing official products created within national mapping agency and VGI [Haklay 2010] [Forghani and Delavar 2014] [Kalantari and La 2015] [Mashhadi et al. 2015].

Methodology

The aim of this research is to determine the quality of a specific sets of VGI in the Republic of Croatia (RH), comparing the selected set of data with the official STOKIS data sets of the State Geodetic Administration (DGU). Our study area is the Split – Dalmatia County, the largest Croatian county located in the central part of the Adriatic coast. Study will address the quality of OSM land cover and road data through four quality elements: positional accuracy, thematic accuracy, completeness and fitness-for-use.

The comparison of the OSM and STOKIS datasets will be carry through preprocessing of polygons and semantic harmonization. After the preprocessing we will intersect the datasets and calculate statistical parameters relevant for data quality analysis. Figure 1 presents this procedure.

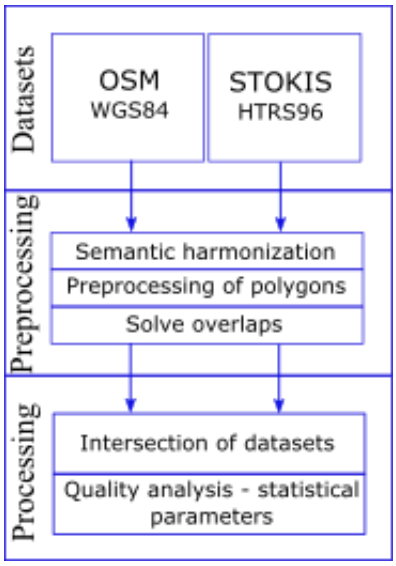


Figure 1. Methodology

Conclusion

The quality of VGI will continue to be one of the most important obstacles to the integration of VGI to official data. Official data and VGI have similarities. Both are examples of spatial data that can be assessed using the measures set out in ISO 19157. However, there are also some differences between these two data sources that present some problematic issues. These issues include spatial bias, lack of specifications, heterogeneity of the data and contributors, dynamic nature of data updating etc. [Fonte et al. 2017].

Keywords: *VGI, quality measures, ISO 19157, Republic of Croatia, OSM.*

References

Fonte, C C, Antoniou, V, Bastin, L, Estima, J, Arsanjani, J J, Bayas, J-C L, See, L and Vatseva, R. (2017): Assessing VGI Data Quality, Mapping and the Citizen Sensor, 137–163.

Forghani, M., Delavar, M.R. (2014): A Quality Study of the Open Street Map Dataset for Tehran, ISPRS International Journal of Geo-Information, 3, 750-763.

Goodchild, M. (2007): Citizens and sensors: the world of volunteered geography, GeoJournal, 69, 211-221.

Haklay, M. (2010): How good is volunteered geographical information? A comparative study of OpenStreetMap and Ordnance Survey datasets, Environment and Planning B: Planning and Design 37, 682–703.

Kalantari, M., La, V. (2015): Assessing OpenStreetMap as an Open Property Map, OpenStreetMap in GIScience: experiences, research, and applications, Springer International Publishing, Switzerland, 255-272.

Mashhadi, A., Quattrone, G., Capra, L. (2015): Impact of Society on Volunteered Geographical Information: the case of OpenStreetMap, OpenStreetMap in GIScience: experiences, research, and applications, Springer International Publishing, Switzerland, 125-141.

Mooney, P., Corcoran, P. (2014): Has OpenStreetMap a role in Digital Earth applications? International Journal of Digital Earth, 7, 534-553.

4. Land tenure data gap: combining EO data into peace and conflict research

Cheonjae Lee
Chair of Land Management, Technical University of Munich, Germany
e-mail: Cheonjae.lee@tum.de

Abstract

In recent changes in relations between South and North Korea, gathering and establishing reliable information for policy-making and economic cooperation for peace and stability on the Korean peninsula has been recognized as one of the most important agenda. Within these (re-)unification contexts, land tenure has a pivotal role in transforming institutions and facilitating peacebuilding and integration process as well as governing territorial development. However, North Korea rarely disclose and distribute land-related information how they manage and use state-owned land or administratively allocate land to communities or cooperatives etc. Due to this peculiarity, the scope of relevant researches has been very limited, and most studies have been dependant on the secondary data.

The availability of earth observation (EO) data, that has sparked growing interest in measuring the context of social phenomena and making multi-level analysis at both spatial and temporal scales possible, has been increased significantly in many disciplines. In recent years, many studies using EO data for North Korea as inaccessible terrain also have been proposed, but this is manly based upon the tracking land use and land cover (LULC) changes to classify and monitor the levels of urbanization, deforestation and agricultural situations. The researchers and policy-makers still have faced with difficulties in incorporating and synthesizing land tenure information with EO data due to the limited access to North Korean data (levels of accessibility), complexity of integrating land tenure and EO data (methodological levels) and its lower reliability and validity of acquired information (analytical levels).

This paper reviews the potential availability of EO data and techniques with high-resolution imagery in Korean (re-)unification settings in particular and examines how existing and more traditional land tenure data can be synthesized and visualized in conjunction with EO data into land management practices as well as peace and conflict research. The first part gives comprehensive overviews the types of EO techniques and data collections in Korean (re-)unification settings. The second part consists of what socioeconomic, administrative and regulatory data with regard to land tenure are exist. Next section discusses not only methodologies in gathering and integrating EO and existing land tenure (LT)-related data but also how to reinterpret information. In the conclusion, it is argued that new and innovative approaches in merging EO data and LT-related data have significant potential when it comes to peace and conflict research especially coping with an inaccessible terrain.

***Keywords**: earth observation (EO) data, land use and land cover (LULC), land tenure (LT), inaccessible terrain, Korean (re-)unification*

5. Mapping the landscape of rural development research: A bibliometric and visual analysis

Ying Lu
Chair of Land Management, Technical University of Munich,
e-mail: ying.lu@tum.de

Abstract

Over the last decades, the concept of "rural development" has been widely discussed in academic literature. However, there is a growing realization that it would not be possible to generate a universal accepted definition of it, while the concept has evolved, reflecting both the dramatic transformation occurring in the rural economics, environment and societies and the shifting goals of groups of actors. So far, little attention has been given to the quantitative analysis of the evolution of this research field. This study aims to demonstrate the changing landscape and current status of rural development research. We analyze a total of 5645 articles downloaded from the database Web of Science and the time span is from 1965 to 2017 through bibliometric and science mapping methods and supported by four software tools: HistCite, CiteSpace, VOSviewer and Map and Alluvial Generator. In this study, we detect the trends and patterns of publications and visualize the disciplinary distribution, journal co-citation network, author co-citation network, keywords co-word network and document co-citation network. The evolution of rural development research is presented through analysis of the trends of changes in subject categories, keywords, and most active topics. The bibliometric analysis and visualization also allow us to identify the discursive shifts and current narratives and reveal the changes of interests, power, and ideology of actors in the rural contexts.

Keywords**: *

6. Influence of kernel size on performance of local anomaly detectors for detection of indicators of mine presence in humanitarian demining

Ivan Racetin[1], *Andrija Krtalic*[2]
[1] *Faculty of Civil Engineering, Architecture and Geodesy, Chair of Geodesy and Geoinformatics, University of Split, Croatia*
e-mail: ivan.racetin@gradst.hr
[2] *Faculty of Geodesy, Chair of Photogrammetry and Remote Sensing, University of Zagreb, Croatia*
e-mail: kandrija@geof.hr

Abstract

In humanitarian demining, land release is the term which comprises all exertions to identify, define and remove all presence and suspicion of mines and explosive remnants of war (ERW) by non-technical survey, technical survey and/or clearance (IMAS 08.10, 2013). Non-technical survey is used to collect data and provide evidences about presence, type, distribution and surrounding environment of mine/ERW contamination, without the use of technical interventions (IMAS 08.10, 2013). Airborne and spaceborne surveys of Suspected Hazardous Area (SHA), as the integral part of non-technical survey, are often executed to collect information about indicators of mine presence and indicators of mine absence. In the National Mine Action Authorities, acquired remote sensing data usually goes through process of photo interpretation and image processing. In this process, regarding the image processing, only rudimentary tools are implemented. Aerial or spaceborne georeferenced images are visually inspected by professional human photo interpreters, which is labour-intensive and time-consuming task. Photo interpreters rely on their knowledge of military doctrine, contextual information and rich experience to successfully detect and identify indicators of mine presence and absence. The idea of this research is to provide assistance to the interpreter in the interpretation of digital images rather than to replace him.

Explosion of ammunition storage depot, caused by the forest fire, happened in the Padjene, Croatia on September 13, 2011. Data acquisition module of Advanced Intelligence Decision Support System (Bajic, 2010) was engaged for the aerial survey of the contaminated area. Color aerial RGB images acquired by Nikon D90 digital camera with 50 mm lens are selected as the test data.

In this paper, the Reed-Xiaoli (RX) (Reed and Yu, 1990) local anomaly detection technique is evaluated as the tool which would improve current practices of photo interpretation applied in the non-technical survey. Local anomaly detectors compare the values of central pixel in particular kernel with the values of local background to determine is the central pixel indicates anomaly or not. The most important parameter influencing the performance of local anomaly detectors is the kernel size. It is the value which defines the size of local background. Relationship between the indicator of mine presence size and form, pixel ground sample distance and spectral difference between the central pixel and local background need to be taken into the account when determining the kernel size. RX anomaly detector calculates the Mahalanobis distance between the pixel under test and the background. Mahalanobis distance uses covariance matrix and mean value calculated from the local background.

Performance of RX anomaly detector was evaluated using the receiver operating characteristic (ROC) curves and area under curve (AUC) measures (Manolakis et al., 2003, Matteoli et al., 2010). AUC scores decreased with the increase in the kernel size of the RX anomaly detector. ROC curve and AUC are generated on the pixel basis, but the one targets do not necessary occupy single pixel.

Practically, it is enough to alarm only one pixel per target. Acquired RX detector results were then further analyzed to define appropriate thresholds for delineation of target and background classes. It was shown that the smallest number of false positives (0.87 % of the input data) occurred for the kernel size which is around 55 times larger than the average target area, while at least one pixel per target was alarmed. Although higher AUC scores where achieved for smaller kernel sizes. To tackle this problem, an object-based performance measures should be applied when assessing the quality of anomaly detectors. For the data used in this research, generally poor results were achieved, maximum AUC score achieved was 0.27 for the kernel size which was 5 times larger than the average target area.

To improve the detection performance multispectral and hyperspectral data will be implemented in the further research. As the spectral dimensions will increase with this kind of data, there will be need for methodological improvements by introduction of preprocessing steps to reduce the data load.

Keywords: *humanitarian demining, indicators of mine presence, anomaly detection, kernel size*

References

Bajic, M. (2010): The advanced intelligence decision support system for the assessment of mine suspected areas***,*** Journal of ERW and Mine Action, 14.3, 69-75

IMAS 08.10 (2013): Non-technical survey. First Edition, 10 June 2009, Amendment 2, March 2013, https://www.mineactionstandards.org/fileadmin/MAS/documents/imas-international-standards/english/ (March 1, 2018)

Manolakis, D., Marden, D., Shaw, G. (2003): Hyperspectral Image Processing for Automatic Target Detection Applications, Lincoln Laboratory Journal, 14.1, 79–116

Matteoli, S., Diani, M., Corsini, G. (2010): A tutorial overview of anomaly detection in hyperspectral images, IEEE Aerospace and Electronic Systems Magazine, 25.7, 5–27

Reed, I. S., Yu, X. (1990): Adaptive multiple-band CFAR detection of an optical pattern with unknown spectral distribution, IEEE Transactions on Acoustics, Speech, and Signal Processing, 38.10, 1760–1770

7. Researching quality of geographical information sources used for military terrain analyses

major Ing. Josef Rada,
University of Defence Brno, Czech Republic
e-mail: josef.rada@unob.cz

Abstract

Many studies and doctoral works about military geographical analyses of terrain have been created at the department of geography in University of Defence over a period of last ten years. These papers have studied methods and approaches within the framework of various military terrain analyses in depth. The analyses of data sources themselves were produced just as side results of original researches. Current author´s doctoral work is focused particularly on geographical data sources, solves their availability and accuracy, both military and civilian data. It compares data originated in the Czech Republic and data from abroad with the orientation to designated data in NATO.

The goal of this work is to analyse wide variety of terrain data sources, especially elevation models and road vector datasets and determine the most suitable type of these data for respective terrain analyses. The second goal is to define the degree of influence of the data quality for different types of military geographical terrain analyses and their quality. This means to determine the correlation between data quality and military analysis type. Selected analyses to scrutinize are cross-country movement, observation, cover and concealment and gun firing. The initial task of this study is a determination of data owners or their producers. Many of these sources are being produced in VGHMÚř (office of military geography and hydrometeorology. Guidance for the doctoral work is the cross-country movement study, a long-term research programme of the department of geography and meteorology in University of Defence in Brno.

The approach to address the above research question is analysing at first geometric comparison of gathered data, their attributes, accuracy and up to date status by using various methods. More comprehensive tools of ArcMap will also be utilised, for the most part in mutual comparison of individual databases. Methods of mathematical statistics will be used for evaluation of data, e.g. computation of variance of discrete random value or determination of intervals of reliability for Normal distribution $N(\mu,\sigma^2)$. To enlarge data sample results of measuring in terrain will be also used for statistical evaluation, e.g. measuring of slopes inclination, visibility, height of vegetation, especially forests, character of soils etc. Three different areas are selected, one in military training area, one in near-urban area and last in border highlands region. With all obtained and processed datasets, statistical data for evaluation will be created by comparing real values measured in the landscape and those theoretical values extrapolated on a computer. Main area of interest resides in observing slopes inclination and digital terrain models, e.g. DMR 5G (digital terrain model), DMP (digital model of surface), SRTM etc.

Statistics and diagrams are expected as results, e.g. statistical deviations of data, and level of impact of these errors to terrain analyses as conclusions. For instance, evaluation of positive and negative properties of data, such as accuracy, complexity or up-to-dateness, their usability in practise and defining of the most suitable information sources for military geographical terrain analyses. Output figures of this research might have a significant influence on efficiency of analyses processing in practise at direct geographical support of the Army. A successful result would also enable more straightforward utilisation of data in a production sector of Geographical service of the Armed

forces of the Czech Republic, primarily in the field of vector databases update, creation of topographic maps and web geographical services provision.

Keywords**:** *military, geospatial, data, collection, terrain, analyses*

8. Forbush decrease model for expanding CMEs (ForbMod)

Dumbovic, M.[1]; Heber, B.[2]; Vrsnak, B.[3]; Temmer, M.[1]; Guo, J.[2]; Möstl, C.[4]; Kirin, A.[5]
[1]Institute of Physics, University of Graz
[2]Institute of Experimental and Applied Physics, University of Kiel
[3]Hvar Observatory, Faculty of Geodesy, University of Zagreb
[4]Space Research Institute, Graz
[5]Karlovac University of Applied Sciences, Karlovac, Croatia
e-mail: mateja.dumbovic@uni-graz.at

Abstract

The Project ForbMod aims to unravel how galactic cosmic rays are influenced by solar storms in the inner solar system (Sun to Mars) by developing a new model and utilizing a number of spacecraft and planetary observation, including those by the Radiation Assessment Detector aboard the Mars Rover Curiosity. The project focuses on Forbush decreases (FDs) in the galactic cosmic ray flux, which can be used as one of the ”signatures” of an ICME passage. An analytical diffusion-expansion FD model was developed that is based on the widely used approach of an initially empty, closed magnetic structure (i.e. flux rope) that fills up slowly with particles by perpendicular diffusion. Remote CME observations and 3D reconstruction is used to constrain initial and boundary conditions. CME evolutionary properties are taken into account by incorporating the flux rope expansion. Several options of flux rope expansion are regarded as competing mechanism to diffusion, which can lead to different FD characteristics. This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 745782.

Keywords: *coronal mass ejections, flux ropes, galactic cosmic rays, forbush decreases*

9. Reflection of cosmic rays at oblique MHD shocks

Bojan Vršnak[1], Anamarija Kirin[2], Mateja Dumbović[3], Bernd Heber[4]

[1]Hvar Observatory, Faculty of Geodesy, University of Zagreb
[2]Karlovac University of Applied Sciences, Karlovac, Croatia
[3]Institute of Physics, University of Graz
[4]Institute of Experimental and Applied Physics, University of Kiel
e-mail: bvrsnak@geof.hr

Abstract

Decreases of the cosmic-ray (CR) count rate (Forbush decreases; FDs), caused by fast coronal mass ejections (CMEs), often show two stages – the first one is caused by the CME-driven shock and the second one by the magnetic structure of the ejection itself. We study the role of the magnetic mirror effect at the shock front in the situation where the shock thickness is much smaller than the proton gyroradius, i.e., when the guiding-centre approximation and the magnetic-moment conservation are not applicable. The problem is solved analytically, providing calculation of the shock-related FD amplitude, A, in the CME-sheath region as a function of particle energy, in different shock geometries. Typical amplitudes are several percentiles of the upstream CR count rate, decreasing with the particle energy (A~-lnE). FD amplitudes are larger for stronger shocks and larger shock thicknesses. Maximum amplitude for 1 GeV protons is about 7-8%.

Keywords: *keywords: coronal mass ejections, shocks, galactic cosmic rays, forbush decreases*

10. The habitability of exoplanets orbiting M-dwarfs and K-stars

Sasha Banjac
University of Kiel
e-mail: banjac@physik.uni-kiel.de

Abstract

During the next five years, considerable advancements in observational capabilities within the field of exoplanetary science are expected. In particular, upcoming missions, like the JWST and the E-ELT, will make it possible to further characterize the habitability of exoplanets orbiting M-dwarfs and K-stars, by determining the atmospheric composition using the transit spectroscopy method. In such systems, the expected resolution could be enough to detect substances produced by biological processes (biosignatures). Still, careful interdisciplinary analysis is necessary (physics, chemistry and climate), in order to account for possible false-positives and false-negatives. Furthermore, the high cost and limited life time of such missions make it obligatory to perform parametric studies to better understand the expected range of spectral signatures and thus enable a more efficient use.

Here we present the Atmospheric Radiation Interaction Simulator (AtRIS), a new Geant4- based code tailored specifically to enable parametric studies of radiation propagation through exoplanetary atmospheres. The main purpose of AtRIS is to calculate the electron-ion pair production rates, which are necessary as input for atmospheric chemistry models. However, AtRIS can also provide detailed information about the secondary particles that can be used to, for example, investigate the radiation environment at surface and thus directly characterize the habitability. We present validation studies against Earth measurements and first results.

Keywords: *cosmic rays, exoplanets, atmospheric model*

11. Probabilistic model for heliospheric propagation of CMEs: DBEMv2 web application

Čalogović, J.[1], Dumbović, M.[1], Vršnak, B.[1]Temmer, M.[2], Mays, L. M.[3], Veronig, A.[4] Piantschitsch, I.[4]

[1]Hvar Observatory, Faculty of Geodesy, Zagreb, Croatia
e-mail: jcalogovic@geof.hr, mdumbovic@geof.hr, bvrsnak@geof.hr
[2]Institute of Physics, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria
e-mail: manuela.temmer@uni-graz.at
[3] Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA
[4] Institute of Physics, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria,
e-mail: astrid.veronig@uni-graz.at; isabell.piantschitsch@uni-graz.at

Abstract:

Forecasting of coronal mass ejections (CMEs) arrival is one of the major tasks for operational space weather services, as CMEs are the major cause of intense geomagnetic storms and can have potentially harmful impacts. The Drag-based Model (DBM) with CME cone geometry is an analytical model that predicts the CME arrival time and speed at Earth or any other target in the solar system (Vršnak et al., 2013). It is based on the equation of motion that depends on the CME launch speed, background solar wind speed and drag parameter gamma which is derived empirically. Compared to the numerical models (e.g. ENLIL) the main advantage of DBM is very short computational time (<<1s). We recently developed the Drag-Based Ensemble Model (DBEM) that takes into account the variability of model input parameters by making an ensemble of n different input parameters to calculate a distribution and significance of DBM results (Dumbović et al., 2018). Using such approach, DBEM can determine the most likely CME arrival times and speeds, quantify the prediction uncertainties and calculate the forecast confidence intervals. Since the improved DBM code can make thousand or more DBM calculations in one second, the DBEMv2 web on-line application was developed with aim to provide a real-time CME forecast. It allows the user to enter all input parameters and uncertainties and to get CME arrival time and speed distributions performing up to 100 000 DBM runs in less than one minute. To validate DBEMv2 model results we compare the DBEMv2 output to observed ICME arrival times at Earth as well as to the results of the numerical ENLIL-WSA+Cone model.

Keywords: *Sun, solar-terrestrial relations, coronal mass ejections (CMEs), solar wind, magnetohydrodynamics (MHD), CME propagation model, space weather*

List of participants:

Ime/Name	Prezime/Surname	e-mail
Željko	Bačić	zbacic@geof.hr
Saša	Banjac	banjac@physik.uni-kiel.de
Joep	Crompvoets	joep.crompvoets@kuleuven.be
Jaša	Čalogović	jcalogovic@geof.hr
Walter	de Vries	wt.de-vries@tum.de
Mateja	Dumbović	mateja.dumbovic@uni-graz.at
Almin	Đapo	adapo@geof.hr
Igor	Grgac	igrgac@geof.hr
Marin	Govorčin	mgovorcin@geof.hr
Arnold	Hanslmeier	arnold.hanslmeier@uni-graz.at
Bernd	Heber	heber@physik.uni-kiel.de
Mirko	Husak	mhusak@geof.hr
Majda	Ivić	mivic@gradst.hr
Nataša	Jovanović	natasa.jovanovic1909@gmail.com
Andrija	Krtalić	kandrija@geof.hr
Cheonjae	Lee	cheonjae.lee@tum.de
Ante	Marendić	amarendic@geof.hr
Damir	Medak	dmedak@geof.hr
Zvonimir	Nevistić	znevistic@geof.hr
Rinaldo	Paar	rpaar@geof.hr
Josip	Peroš	josip.peros@gradst.hr
Vesna	Poslončec-Petrić	vesna.posloncec@geof.hr
Ivan	Racetin	ivan.racetin@gradst.hr
Josef	Rada	josef.rada@unob.cz
Filip	Sterc	fsterc@gmail.com
Bojan	Vršnak	bvrsnak@gmail.com
Thomas	Wunderlich	th.wunderlich@tum.de
Lu	Ying	ying.lu@tum.de
Robert	Župan	rzupan@geof.hr

Notes: