

Slobodanka Ključanin, MSc in Technical Sciences

Slobodanka Ključanin, graduated engineer of geodesy, defended her master thesis *Interoperable Cartographic Databases* at the Faculty of Civil Engineering of the University of Sarajevo on July 9, 2006. The Committee for Grading and Defence of the Master Thesis included Prof. Dr. Zdravko Galić from the Faculty of Civil Engineering of the University of Sarajevo (co-mentor and president), Prof. Dr. Miljenko Lapaine from the Faculty of Geodesy of the University of Zagreb and from the Faculty of Civil Engineering of the University of Sarajevo (co-mentor and member) and Prof. Dr. Mirta Baranović from the Faculty of Electrical Engineering and Computing of the University of Zagreb (member).

Slobodanka Ključanin was born in Split on March 16, 1963. She finished elementary school in Solin, and the high school – Technical school – orientation surveyor in Split. In 1981 she enrolled the Faculty of Civil Engineering in Sarajevo (Department for Geodesy). She graduated in 1987. In 1999 she enrolled the postgraduate studies at the Department for Geodesy of the Faculty of Civil Engineering of the University of Sarajevo.

She worked at the Geodetic Institute in Sarajevo in the Engineering Geodesy working unit from July 1987 to September 1992. From August 1997 to April 2001, she worked at the Ministry for Environmental Construction and Protection of the Una-Sana Canton as a collaborator for geodetic works, and for cadastre at the Canton Geodetic Administration, and afterwards as Canton Geodetic Inspector. She moved to Una-Sana Forests Public Enterprise in April 2001. She worked on geodetic works related to cadastre and GIS. From April 2001 to October 2004, she participated in the production of Forest-Economy Bases for various areas on the territory of Federation Bosnia and Herzegovina. Between 2001 and 2004, she worked at the Higher Civil Engineering School at the Technical Faculty of the

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 - 1.2 Databases
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 - 2.1 Simple Features Specification for CORBA
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Interoperable Cartographic Databases

University of Bihać as an assistant for the *Geodesy*. She has lived in Sarajevo and worked as a professional collaborator at the Institute for Geodesy and Geoinformatics of the Faculty of Civil Engineering since October 2004.

Slobodanka Ključanin is a member of Association for Geospatial Information in South-East Europe (AGISEE), Association for Environmental Management of Federation Bosnia and Herzegovina and the Association of Geodesists of Herzegovina.

The master thesis *Interoperable Cartographic Databases* contains 193 pages in A4 format, 73 figures and 46 tables, a list of references with 15 titles and 74 URLs, a summary and a brief biography of the author. The master thesis has the following structure:

The introduction of the work features a brief presentation of fundamental concepts of geoinformation systems (GIS) and databases. There are basic characteristics of relational, object, object-relational and semistructured database model, and special stress is put on the definition and goals of geoinformation interoperability. Within the context of interoperability, the role of OGC (*Open Geospatial Consortium*), the role of technology required for establishing interoperability in the domain of geoinformation systems and distribution of data on the Internet using the WebGIS technology, are stressed. This is continued by a systematic and chronological overview of accomplishments in the field of geoinformation interoperability of cartographic databases, illustrated by a series of examples – interoperable WebGISes.

The chapter *Overview of OGC relevant interoperable standards* in an overview form describes the standards and concepts of geoinformation interoperability relevant for geoinformation systems, that is, for cartographic bases as a specific case of geospatial databases. Specification of Web Map Service (for raster data) was processed in detail, and also presented were fundamental characteristics of GML (Geography Markup Language) and possibilities of representing cartographic data in that language.

Slobodanka Ključanin, magistrica tehničkih znanosti

Slobodanka Ključanin, dipl. ing. geodezije obranila je 9. lipnja 2006. na Građevinskom fakultetu Univerziteta u Sarajevu magistarski rad *Interoperabilne kartografske baze podataka*. U Povjerenstvu za ocjenu i obranu magistarskog rada bili su prof. dr. Zdravko Galić s Građevinskog fakulteta Univerziteta u Sarajevu (komentor i predsjednik), prof. dr. sc. Miljenko Lapaine s Geodetskog fakulteta Sveučilišta u Zagrebu i Građevinskog fakulteta Univerziteta u Sarajevu (komentor i član) i prof. dr. sc. Mirta Baranović s Fakulteta elektrotehnike i računarstva Sveučilišta u Zagrebu (članica).



Slobodanka Ključanin rođena je u Splitu, 16. 03. 1963. godine. Osnovnu školu završila je u Solinu, a srednju Tehničku školu – usmjerenje geometar u Splitu. Godine 1981. upisala se na Građevinski fakultet u Sarajevu (Odsjek za geodeziju). Diplomirala je 1987. godine. Godine 1999. upisala se na poslijediplomski studij na Odsjeku za geodeziju Građevinskog fakulteta Univerziteta u Sarajevu.

Od srpnja 1987. do rujna 1992. radila je u Geodetskom zavodu u Sarajevu u radnoj jedinici "Inženjerska geodezija". Od kolovoza 1997. pa do travnja 2001. godine radila je u Ministarstvu za građenje i zaštitu okoline Unsko-sanskog kantona kao stručna suradnica za geodetske poslove, stručna suradnica za katastar u Kantonalnoj geodetskoj upravi, a potom kao Kantonalna geodetska inspektorica. U travnju 2001. godine prešla je u JP Unsko-sanske šume. Radila je na geodetskim poslovima vezanima za katastar i GIS. U razdoblju od travnja 2001. pa do listopada 2004. sudjelovala je u izradi Šumskogospodarskih osnova za različita područja na teritoriju Federacije BiH. U razdoblju 2000–2004. godine radila je na Višoj građevinskoj školi na Tehničkom fakultetu Univerziteta u Bihacu kao asistentica za predmet *Geodezija*. Od listopada 2004. živi u Sarajevu i radi kao stručna suradnica na Institutu za geodeziju i geoinformatiku Građevinskog fakulteta u Sarajevu.

Slobodanka Ključanin članica je: Association for Geospatial Information in South-East Europe (AGISEE), Udruženja za upravljanje okolišem Federacije Bosne i Hercegovine te Udruženja geodeta Herceg-Bosne.

Magistarski rad Slobodanke Ključanin, dipl. ing. geod. pod naslovom *Interoperabilne kartografske baze podataka* sadrži 193 stranice formata A4, 73 slika i 46 tablica, popis literature s 15 naslova i 74 URL-a, sažetak i kratak životopis autorice. Magistarski rad ima sljedeću strukturu:

1. Uvod
- 1.1 Geoinformacijski sustavi (GIS)
- 1.2 Baze podataka
- 1.3 Geoinformacijska interoperabilnost
- 1.4 Pregled dostignuća u domeni geoinformacijske interoperabilnosti kartografskih baza podataka
2. Pregled OGC relevantnih interoperabilnih standarda
- 2.1 Simple Features Specification for CORBA

- 2.2 Simple Features Specification for SQL
- 2.3 Web Feature Service (WFS)
- 2.4 Web Map Service (WMS)
- 2.5 Geography Markup Language (GML)
3. Koncept kartografske baze BiH
- 3.1 Model podataka
- 3.2 Oracle Spatial objektno-relacijski model
- 3.3 Implementacija u Oracle/MapVieweer okolišu
4. Zaključak
5. Literatura

6. Sažetak
7. Životopis
8. Prilozi

Dodatak A: Simple Feature Specification for SQL

Dodatak B: Web Feature Service (WFS)

Dodatak C: Rječnik osnovnih pojmova i skraćenica

U uvodu rada su ukratko prikazani temeljni koncepti geoinformacijskih sustava (GIS) i baza podataka. Navedene su osnovne značajke relacijskog, objektnog, objektno-relacijskog i polustrukturiranog modela baza podataka, a posebno su naglašene definicija i ciljevi geoinformacijske interoperabilnosti. U kontekstu interoperabilnosti, izdvojena je uloga OGC-a (*Open Geospatial Consortium*), tehnologija

Interoperabilne kartografske baze podataka

potrebnih za ostvarivanje interoperabilnosti u domeni geoinformacijskih sustava i distribuiranja podataka na Internetu uporabom WebGIS tehnologije. Nakon toga su sistematski i kronološki izložena dostignuća u području geoinformacijske interoperabilnosti kartografskih baza podataka, ilustrirana nizom primjera – interoperabilnih WebGIS-ova.

Poglavlje *Pregled OGC relevantnih interoperabilnih standarda* u preglednom obliku opisuje standarde i koncepte geoinformacijske interoperabilnosti relevantne za geoinformacijske sustave, odnosno za kartografske baze kao specifičan slučaj geoprostornih baza podataka. Detaljnije je obrađena specifikacija Web Map Servicea (za rasterske podatke), a prikazane su i temeljne značajke GML-a (Geography Markup Language) i mogućnosti reprezentacije kartografskih podataka u tom jeziku.

The third chapter, *Concept of cartographic database of Bosnia and Herzegovina* is of special importance, because it features the development and proposal of a cartographic database, according to all principles of the previous chapter. The main result of the research was applied and presented in an object-relational data model, using the Oracle Spatial system for managing databases. The complete procedure of producing an interoperable cartographic database was presented and proposed in great detail: from cartographic data in CAD-form, their saving in an interoperable database, to the distribution to a wide circle of users, via Internet.

The chapter *Conclusion* contains a clear summation and integration of the results of research.

Appendix A (*Simple Features Specification for SQL*) contains a detailed and precise description of component specification for SQL:1992 and SQL:1999, while Appendix B considers in detail the *Web Feature Service*, which is important for interoperability in the field of distributing vector data via Internet. Considering that the area this master thesis deals with is completely new and that most professionals are not acquainted enough with the new terminology, Appendix C is a *Dictionary of Basic Terms and Abbreviations*.

The main results of the master thesis are:

- A systematic overview of concepts and standards of geoinformation interoperability, that is interoperability of geospatial databases.
- Logical object-relational model of cartographic database.
- Proposal of concept of creating an interoperable cartographic database – from CAD-data to the distribution on the Internet.
- Concept and proposal of a prototype of interoperable object-relational cartographic database.
- Concept and proposal of distribution of cartographic data via Internet, using technologies based on OGC standards.

On the basis of review and evaluation of this master thesis, members of the Committee concluded that the candidate considered an exceptionally important, actual and interdisciplinary problem of geoinformatics and cartographic profession, studied in detail the relevant contemporary literature from the field of geoinformation interoperability within the context of databases and grasped the methodology of scientific-research work. We would like to mention the fact that this is the first research and master thesis in the field of cartographic and geoinformation interoperability produced in Bosnia and Herzegovina.

Miljenko Lapaine, Zdravko Galić

Mirko Husak, MSc in Technical Sciences

Mirko Husak finished the postgraduate scientific studies, orientation Photogrammetry and Cartography at the Faculty of Geodesy of the University of Zagreb and obtained his MSc degree on June 29, 2006. He passed all exams with excellent marks, and his thesis titled *Temporal and Historical GIS of Varaždin Old Fort*, produced as the final paper at the international postgraduate GIS studies *Comett* held in San Miniato in Italy in 1994, organised by the Department for Geoinformation of the Vienna University of Technology, and under the mentorship of Prof. Dr. Andrew U. Frank, was acknowledged as an equivalent to the master's thesis.

Mirko Husak was born in Zagreb on May 6, 1967. He has lived in Varaždin since 1970, where he finished elementary and high school. During gymnasium days he participated in competitions in mathematics, physics and informatics, and in first class he participated in the republic mathematics competition. As an excellent student, he graduated without the graduate exam and the graduate thesis. He graduated at the Gymnasium (Gabriel Santo High School Centre at the time) in Varaždin. He enrolled the Faculty of Geodesy of the University of Zagreb in 1986. During his studies, he was a student assistant for Computer Processing of Geodetic Data and Higher Geodesy. He graduated with great success in 1991, with a thesis titled *Cal-comp 9100 Digitiser Accuracy Testing*. In 1994 he applied for the International Postgraduate Course on GIS within the scope of the COMETT program of the European Union, organised by the Vienna University of Technology, held in San Miniato near Firenze, Italy. The specialisation resulted in a GIS project with a final paper titled *Temporal and Historical GIS of Varaždin Old*

Fort. In 1999 he enrolled the postgraduate scientific studies at the Faculty of Geodesy of the University of Zagreb.

He has been working at the cadastral office in Varaždin since 1992. He collaborated on professional projects Technical Cadastre of Varaždin (1994) and GIS-Supported Land Cadastre (1997). In teaching activities at the Faculty of Organisation and Informatics (FOI) in Varaždin, he has been responsible for exercises in the course Geographic Information Systems (GIS) since academic year 1994/1995. He is a GIS consultant for the development project E12584 Eurotourism Ulixes – Intelligent Tourist Agency (2002-2006) which are led by FOI Varaždin and the Town of Varaždin.

He participated at professional and scientific meetings in Croatia and abroad, and is the author of several professional papers published in proceedings and a book of abstracts and a chapter in a book. He has been a member of the Croatian Geodetic Society from 1992, the Croatian Cartographic Society from 2005, and published in journals *Geodetski list* and *Cartography and Geoinformation* periodically. He is a member of the Croatian Chamber of Architects and Engineers in Construction.

During academic year 1988/1989, he was acknowledged by the University of Zagreb as one of the best students of the University of Zagreb, in 1989/1990 he was awarded scholarship as one of the best students at the University of Zagreb, in 1991/1992 he was awarded the Rector's Award for the best student work *Centroid File of Croatian Settlements* produced at the Faculty of Geodesy of the University of Zagreb.

Treće poglavlje *Koncept kartografske baze BiH* od posebnog je značenja, jer se u njemu razvija i predlaže koncept kartografske baze podataka, sukladno svim principima izloženim u prethodnom poglavlju. Glavni rezultat istraživanja primijenjen je i prikazan u objektno-relacijskom modelu podataka, upotrebom sustava za upravljanje bazama podataka Oracle Spatial. Posebno je detaljno prikazan i predložen kompletan postupak stvaranja interoperabilne kartografske baze podataka: od kartografskih podataka u CAD-obliku, njihova spremanja u interoperabilnu bazu podataka, do distribucije širokom krugu korisnika, putem interneta.

U poglavlju *Zaključak* na jasan se način sumiraju i objedinjuju rezultati istraživanja.

Dodatak A (*Simple Features Specification for SQL*) detaljno i precizno opisuje specifikaciju komponenti za SQL:1992 i SQL:1999, dok Dodatak B detaljno razmatra *Web Feature Service*, koji je važan za interoperabilnost u području distribucije vektorskih kartografskih podataka putem interneta. S obzirom na to da je područje kojim se bavi ovaj magistarski rad sasvim novo i da većina stručnjaka ne vlada u dovoljnoj mjeri novom terminologijom, u Dodatku C priložen je *Rječnik osnovnih pojmova i kratica*.

Glavni rezultati magistarskog rada su:

- ❑ Sustavan pregled koncepata i standarda geoinformacijske interoperabilnosti, odnosno geoprostornih baza podataka.
- ❑ Logički objektno-relacijski model kartografske baze podataka.
- ❑ Prijedlog koncepta stvaranja interoperabilne kartografske baze podataka – od CAD-podataka do distribucije na internetu.
- ❑ Koncept i prijedlog prototipa interoperabilne objektno-relacijske kartografske baze podataka.
- ❑ Koncept i prijedlog distribucije kartografskih podataka putem interneta, uporabom tehnologija utemeljenih na standardima OGC-a.

Na temelju pregleda i ocjene ovoga magistarskog rada, članovi Povjerenstva su zaključili kako je kandidatkinja razmotrila jednu izrazito važnu, aktualnu i interdisciplinarnu problematiku geoinformacijske i kartografske struke, detaljno proučila relevantnu suvremenu literaturu iz područja geoinformacijske interoperabilnosti u kontekstu baza podataka i ovladala metodom znanstveno-istraživačkoga rada. Posebno izdvajamo činjenicu kako je to prvi istraživački i magistarski rad na području kartografske i geoinformacijske interoperabilnosti izrađen u Bosni i Hercegovini.

Miljenko Lapaine, Zdravko Galić

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Mirko Husak, magistar tehničkih znanosti

Mirko Husak završio je poslijediplomski znanstveni studij, smjer fotogrametrija i kartografija na Geodetskom fakultetu Sveučilišta u Zagrebu i stekao je stupanj magistra znanosti 29. lipnja 2006. On je položio sve ispite s odličnim uspjehom, a kao ekvivalent magistarskog rada priznat mu je rad *Temporal and Historical GIS of Varaždin Old Fort* (Vremenski i povijesni GIS stare varaždinske tvrđave) što ga je izradio kao završni rad na međunarodnom poslijediplomskom studiju o GIS-u *Comett* održanom 1994. u San Miniatiu u Italiji, a u organizaciji Odjela za geoinformacije Tehničkog sveučilišta u Beču i pod vodstvom prof. dr. Andrewa U. Franka.



Mirko Husak rođen je u 6. svibnja 1967. u Zagrebu, živi u Varaždinu od 1970. gdje je završio osnovnu školu. Kao gimnazijalac sudjelovao je na natjecanjima iz matematike, fizike i informatike, a u prvom razredu se plasirao i na republičko natjecanje iz matematike. Oslobođen je polaganja mature i izrade maturalnog rada kao odličan učenik. Maturirao je na Gimnaziji u Varaždinu (tadašnji Srednjoškolski centar Gabriel Santo). Geodetski fakultet Sveučilišta u Zagrebu upisao je 1986. Tijekom studija bio je demonstrator iz Kompjutorske obrade geodetskih podataka i Više geodezije. Diplomirao je s odličnim uspjehom 1991., s temom *Ispitivanje točnosti digitalizatora CalComp 9100*. God. 1994. prijavio se na International Post-Graduate Course on GIS u sklopu programa COMETT Europske zajednice, u organizaciji Tehničkog sveučilišta u Beču,

koji se održavao u gradiću San Miniato kraj Firence u Italiji. Rezultat specijalizacije bio je GIS projekt sa završnim radom *Temporal and Historical GIS of Varaždin Old Fort*. God. 1999. upisao je poslijediplomski znanstveni studij na Geodetskom fakultetu Sveučilišta u Zagrebu.

Radi u katastarskom uredu u Varaždinu od 1992. godine. Bio je suradnik na stručnim projektima Tehnički katastar Varaždina (1994) i Katastar zemljišta podržan GIS-om (1997). Na Fakultetu organizacije i informatike (FOI) u Varaždinu izvodi nastavu laboratorijskih vježbi za kolegij Zemljopisni informacijski sustavi od akad. god. 1994/95. Konzultant je za GIS razvojnog projekta E!2584 Euroturism Ulixes – Intelligent Tourist Agency (2002-2006) kojeg su nositelji FOI Varaždin i Grad Varaždin.

Sudjeluje na stručnim i znanstvenim skupovima u Hrvatskoj i inozemstvu, autor je nekoliko stručnih radova objavljenih u zbornicima radova i knjizi sažetaka i jednog poglavlja u knjizi. Član je Hrvatskoga geodetskog društva od 1992., Hrvatskoga kartografskog društva od 2005., povremeno objavljuje u časopisima *Geodetski list* i *Kartografija i geoinformacije*. Član je Hrvatske komore arhitekata i inženjera u graditeljstvu.

Akad. god. 1988/89. dobio je priznanje Sveučilišta u Zagrebu kao jedan od najboljih studenata na Sveučilištu u Zagrebu, 1989/90. dobio je stipendiju kao jedan od najboljih studenata na Sveučilištu u Zagrebu, 1991/92. dobio je Rektorovu nagradu