

1. Raziskovalna organizacija (*Research organisation*):

Univerza v Ljubljani, *Fakulteta za gradbeništvo in geodezijo*

2. Ime in priimek mentorja (*Name and surname of a mentor*):

Anka LISEC

3. Področje znanosti iz šifranta ARRS (*Primary research field*):

2.17 Geodezija

4. Kontaktni e-naslov mentorja (*Contact of a mentor*):

anka.lisec@fgg.uni-lj.si

5. Kratek opis programa usposabljanja (*Short description of the program*):

Usposabljanje mladega raziskovalca bo potekalo v okviru doktorskega študija Grajeno okolje, znanstveno področje *geodezija in geoinformatika* na Univerzi v Ljubljani, Fakulteti za gradbeništvo in geodezijo. Raziskovalno delo bo usmerjeno v razvoj *sistema za vrednotenje in zagotavljanje kakovosti prostorskih podatkov*, kjer se bomo osredotočali na *kakovost 3D-prostorskih modelov realnega sveta v okoljih geografskih informacijskih sistemov (GIS)*.

Področje modeliranja prostora v obliki grafičnega prikaza v informacijskih okoljih se je znanstveno-raziskovalno začelo razvijati s pojavom informacijske tehnologije že pred desetletji, vzporedno s tem pa se je začelo pojavljati pomembno raziskovalno vprašanje o zagotavljanju kakovosti teh podatkov. V začetnih obdobjih so se modeli prostora v okoljih GIS pojavljali praviloma v dveh razsežnostih, 2D-modeli prostora so še danes praviloma del uradne prostorske podatkovne infrastrukture mnogih držav, tudi Slovenije.

Razvoj tehnologij, ki omogočajo množični zajem podatkov na eni strani, ter informacijske tehnologije, ki omogoča obdelavo množice prostorskih podatkov in grafični prikaz prostorskih modelov stvarnega sveta v 3D-okoljih (tudi 4D-okoljih), so na področju zagotavljanja kakovosti prostorskih podatkov prinesli nove izzive. Pri tem je treba izpostaviti, da 2D-modeli prostora pogosto več ne zadoščajo ustrezno podporo odločitvam v prostoru (navigacija, prostorsko planiranje in prostorski razvoj, umeščanje objektov v prostor, upravljanje s tveganji in ukrepanje ob naravnih in drugih nesrečah, spremljanje pojavov v prostoru ipd.). Posledično se številne države tudi v okviru temeljne uradne prostorske podatkovne infrastrukture nagibajo k uvedbi 3D-prostorskih podatkovnih modelov tako na področju topografskih kot na področju nepremičninskih in drugih prostorskih podatkovnih zbirk.

Danes so na voljo različne napredne tehnologije za množičen zajem prostorskih podatkov, kot so letalski fotogrametrični zajem, zračno in terestrično lasersko skeniranje, satelitsko daljinsko zaznavanje ipd. – vse ob nujni podpori tehnologij za določanje položaja in zasukov senzorjev v referenčnem koordinatnem sistemu, kar je pomemben pogoj za večkratno uporabo teh podatkov v okoljih GIS. Tako pridobljene prostorske podatke je treba ustrezno

obdelati s ciljem oblikovati posplošen prikaz prostorskih entitet – to je grafični model pojavov v prostoru, ki je lahko v vektorski (točke, linije, poligoni, prostori) ali rastrski obliki. Nujen pogoj, da lahko take prostorske podatke združeno uporabljamo v okoljih GIS, je poleg zagotavljanja enotne koordinatne osnove ustrezen opis kakovosti izdelkov.

Čeprav so posamezni segmenti zajema in obdelave množice prostorskih podatkov že zelo razviti, pa danes manjka celovit vpogled in razumevanje postopkov v vseh njegovih fazah, vpliv dejavnikov znotraj posameznih faz na končno kakovost izdelka, kot tudi ustrezen in razumljiv opis kakovosti prostorskih podatkov oz. modelov.

Cilj raziskave je opredeliti model za vrednotenje in opis kakovosti prostorskih podatkov, kjer se bomo osredotočili na podatke, ki jih pridobivamo s sistemi za množični zajem in jih predstavljamo s 3D-grafičnimi modeli v referenčnem koordinatnem sistemu. Model za vrednotenje in opis kakovosti prostorskih podatkov bo zasnovan na način, da bo omogočal nadzor in spremljanje kakovosti prostorskih podatkov v več fazah razvoja 3D-modela prostorskega pojava. Tak model za vrednotenje kakovosti prostorskih podatkov bo na drugi strani omogočil zagotavljanje ciljne kakovosti modela prostorske entitete.

Poseben pomen sistema za vrednotenje in opis 3D-prostorskih podatkov, ki jih pridobimo z uporabo sodobnih tehnologij za množičnim zajem podatkov ter z obdelavo teh podatkov in grafično predstavitev v okoljih GIS, je med drugim mogoče prepoznati na področju uradne prostorske podatkovne infrastrukture, ki je temelj številnim odločitvam in ukrepanju v prostoru. Ti podatki pogosto predstavljajo nadalje referenčno osnovo za posredovanje raznolikih prostorsko umeščenih informacij, zato so tudi prepoznani kot ena pomembnejša infrastruktura sodobne družbe.

Training and research activities of the young researcher will take place in the framework of the doctoral study programme *Built Environment*, scientific field *geodesy and geoinformation* at the *University of Ljubljana, Faculty of Civil and Geodetic Engineering*. The research will be focused on developing a system for evaluation and assuring the quality of spatial data, where we will centre on the quality of 3D-spatial models of the real world in the GIS (geographical information systems) environment.

The research field of the real world modelling in the form of graphical representation in an IT environment began to develop with the development of information technology decades ago; in parallel, an important research question emerged regarding assurance of data quality. In the first period of spatial modelling and GIS representations, spatial models were basically in two dimensions. Such 2D-models are as a rule even today a part of the official spatial data infrastructure (SDI) in several countries, including in Slovenia.

Technological development in the fields of mass acquisition of spatial data, and development of IT-solutions, capable of processing of crowds of spatial data as well as of graphical presentations of real world spatial models in 3D-environment (4D-environment), have brought new challenges in the field of assuring quality of spatial data. Here, it has to be emphasized, that 2D-spatial models are often no longer sufficient for using them as support for different spatial decisions (navigation, spatial planning and spatial development, allocation of objects in the space, risk and disaster management, Earth observation etc.). As the consequence, many countries tend to introduce 3D-spatial data models within their basic spatial data infrastructure – in the field of topography as well as for the purpose of real property and other official spatial data sets.

Nowadays, there is a variety of advanced technologies for mass acquisition of spatial data,

such as aero-photogrammetric solutions, aerial and terrestrial laser scanning, satellite remote sensing etc. – together with the necessary technological support for determination of positions and rotations of those sensors in the reference coordinate system, which is an important prerequisite for multipurpose databases and data re-use in GIS environment. The acquired data has to be process in a proper way in order to create the generalize representation of spatial entities – this is a graphical model of spatial phenomena, which might be in a vector (points, lines, polygons, volumes) or raster form. A necessary prerequisite for usage of the data in the GIS environments is in addition to the common reference coordinate system, the appropriate description of data quality.

Although the individual segments of gathering and processing of crowds of spatial data are already highly developed, the comprehensive insight into the phases of spatial data gathering and processing is missing in order to understand and evaluate the impact of different factors within individual phases on data quality. Additionally, the methodology for data quality evaluation and for quality description of a final product are missing.

The main aim of the research is to define a model for evaluation and description of spatial data quality; here, we will focus on data, which are provided by different technological solutions for mass acquisition of spatial data and represented as 3D-graphical models in a reference coordinate system. Model for evaluation and description of the quality of spatial data will be designed in a way that will allow control and monitoring of spatial data quality in different phases of a 3D model development for a selected spatial phenomenon. Such a model will enable the delivery of the planned quality of spatial models.

The contribution of the proposed model for evaluation and description of the quality of 3D spatial data, which are provided using technologies for mass acquisition of spatial data and which are processed and graphically represented as spatial models in the GIS environments, is to be recognized, inter alia, in the field of official spatial data infrastructure that is a foundation of many spatial decisions. The data of the official SDI often represents the reference for transmission of differentiated spatial information, this is why the official SDI is recognized as one of the most important infrastructures of modern society.