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POSTER READER

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A Web-based GIS for the Monitoring of Genetically Modified Organisms ("WebGIS GMO Monitoring")

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The use of web-based geoinformation systems (WebGIS) in natural sciences and engineering is increasing rapidly. Systems designed for the efficient retrieval and the visualisation of empirical (geo-)data or for supporting land use planning and engineering are only two fields of application. Such systems are appropriate vehicles for publishing and illustrating research results and to accomplish legally obligated report duties (Pesch et al. 2007). The surveillance of GMO (Genetically modified organisms) dispersal is one new challenging task in environmental monitoring. The article at hand deals with the implementation of a geodata infrastructure (GDI) serving for GMO monitoring support.

The GDI is realised using Open Source software considering standards and specifications for interfaces and handling of geodata determined by the Open Geospatial Consortium (OGC) to ensure interoperability between Web Map and Feature services (WMS/WFS). The European directive for the establishment of a European wide spatial data infrastructure "INSPIRE" (Infrastructure for Spatial Information in Europe) or Geoportal.bund are already considering these standards, too. The developed WebGIS "GMO Monitoring" is built up by the Apache HTTP-Server and the UMN Mapserver. The mapserver allows inquiries and analyses on spatial data (raster and vector) as well as generating and visualising maps. The database management system used is PostgreSQL with the spatial extension PostGIS. The Mapbender of CCGIS is used as user interface and for administration of map services. The metadata of the geodatasets are entered by web forms considering the core metadata for geographic datasets (Kresse et. al. 2004) published by the International Standardization Organisation (ISO). The geodata can be manipulated using interactive tools like zooming, panning or centering. Data attributes can be screened by spatial as well as by logical queries. Additional GIS functions like intersection and buffering tools are implemented, too, tools for statistical analyses are in preparation.

According to the EU Directive 2001/18/EC on the deliberate release of genetically modified organisms (GMO) into the environment crops like Bt-maize or HR oilseed rape cultivated in Germany since the last few years have to be monitored by national authorities to detect possible environmental impacts. These might be changes in biodiversity

due to cross breeding and related selective effects. Released GMO are self-multiplying and heritable causing evolutionary changes in biological entities at the genotype level which then could be established in biosphere. Considering this and because of the irreversibility of the ecological effects, a systemic risk analysis is necessary (Schmidt et al. 2007). Against this background a WebGIS "GMO Monitoring" was established that offers relevant data on three different spatial levels: single federal states, the whole territory of Germany and Europe. The database includes spatial information on land use properties (CORINE, cultivation statistics), environmental monitoring networks, nature reserves and landscape characteristics as well as on current GMO crop areas as published by the Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL) (Aden et al. 2007). The WebGIS could be used for analyses of ecological, economic and legal implications of GMO cultivation at a regional scale as well as for planning GMO monitoring networks and for coexistence issues.

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Location-based Mobile Hiking Narratives

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The poster outlines the development and background for a non-intrusive light-weight location-based mobile hiking story guide. The system comprises a mobile application and a remote media server, and can be used on a large variety of mobile phones available today. Our system allows a tourism agency to put up location-based narratives for points of interest that will be "visible" to users on their current mobile phone during their hiking tour. Equipped with a GPS receiver, users can receive location-based information and listen to geo-referenced narrations about their whereabouts. Referring to our region of deployment, the Montafon region in Austria, our system is called the MontaPhone.

Today, mobile devices are a day-to-day companion for many people during their daily lives, even when they enjoy a vacation in the mountains. Most applications in the tourism domain, however, are very specialized and complex systems, featuring a wide range of information for a user who likes to be well-informed and entertained. Typically this requires special hardware and/or software - a simple cell phone is typically not enough. For the casual user, this might not always be desired. We therefore propose a lightweight tourism application that allows for a casual interaction on widely availyble devices without any need for specialized equipment. The application follows known and acquired means of interaction of users with their cell phone. To this end, we utilize the wide range of mobile phones already in user's hands today. Our system is designed to be available to a maximum of users and thus, a maximum of mobile phones.

Today, conventional tourism uses techniques such as numbers at signposts to refer to additional information. With our system, we aim to introduce a virtual sign-posting personalized to the individual user. Based on our research background in mobile applications and context-aware and multimodal interfaces, we developed a lightweight mobile phone hiking assistant application. Complementing existing approaches of accessing broadband networks, the application relies on standard GSM phone services.

The MontaPhone is a small easy-to-use application that runs on Java-enabled mobile phones. Via GNSS receiver, a user's current position is constantly matched to a list of relevant points of interest (POIs). At any time, the user can at a glance get an overview of all POIs in his or her vicinity. On approach to a POI it is signaled to the user who can then proceed to look up information about the POI in question. Narrated audio information is available on a media server and can be listened to through the application by a phone call.

The presented solution appeals to a large number of users who can use the application just on their personal mobile phone. This is expected to increase the general acceptance of mobile hiking assistants.

The availablility of a lightweight location-based application can be used to increase the awareness of their vacation area for tourists by using known and familiar devices and metaphors. Initial feedback from the evaluations is very promising and encouraging for this kind of application.

Multiple Clients in Ad-hoc Shared Ride Planning

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1 Problem and motivation

Shared ride systems aim to assign clients, e.g., pedestrians with a travel demand, to hosts such as private cars, taxis or mass transport that could potentially serve for rides. Ad-hoc shared ride services enable the assignment in an ad-hoc manner, i.e., instantly and without pre-registration [1, 2].

This work introduces multiple clients in ad-hoc shared ride planning. Multiple clients lead to competition among clients for hosts and among hosts for clients. The fundamental problem is the assignment of free capacity supply to travel demand while optimizing some objective value of the global network. The capacity assignment problem has been identified as the multi-commodity flow problem known in operations research, which is known to be NP-hard in dynamic networks [3].

2 Research questions and hypothesis

A basic research question is the definition of a global optimum for clients. In a multiple client system the total trip costs of all clients with respect to the clients' cost functions have to be considered.

The second question is to find a solution for the capacity assignment problem in this dynamic network that is computable in polynomial time. One host can receive multiple requests from clients for the same seat. If the host's seat capacity is not sufficient to serve all clients, they have to decide about the offers to make for which client. A negotiation process has to be formalized that takes this aspect into account. Therefore, the hypothesis of this work is: By solving the capacity assignment problem locally, agents are able to make effective decisions. That is, agents use local knowledge resulting in trips close to the optimal total trip costs. The communication effort is significantly less than for collecting complete transportation knowledge.

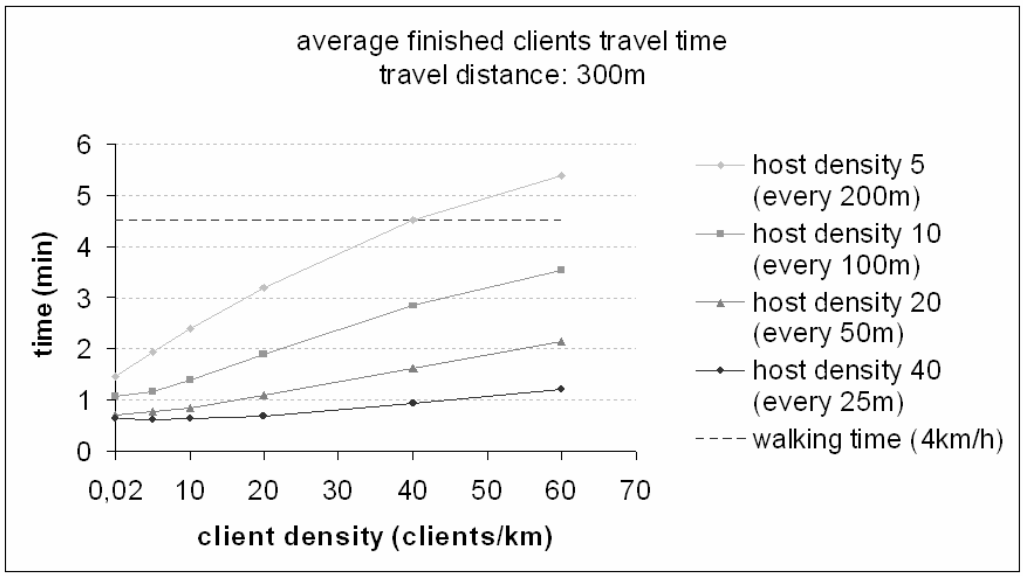
3 Approach

First, the global optimum for clients will be defined as the total clients' trip costs, which are to be minimized. Second, for solving the capacity assignment problem we develop a polynomial time approximation scheme. It spatially decomposes the complex problem into many local ones that can be solved efficiently. The heuristics has been formalized in a negotiation process between multiple hosts and clients. A simulation system for large-scale traffic simulations has been implemented that uses a real street network, realistic agent densities and physically realistic simulation parameters. With the simula-

tion system all necessary experiments have been carried out to investigate the properties of the proposed heuristics, and to test the hypothesis.

4 Results and relevance

In the simulation experiments, clients' travel costs were defined by their travel times over 300m distances. Host and client densities were varied and the host capacity was fixed to one seat per host. The client density of 0.02 represents a single client experiment.



The results show that effective capacity assignment in ad-hoc shared ride systems is possible based on local environments only. Trip quality is perceived as excellent compared to a single client system. The trip quality increases only linear with a slope below 0.1 in all experiments. Shared ride travel time is below walking time even in the worst case involving 60 clients/km and a host density above 10 hosts/km. The heuristics is simple and computationally efficient. Further, the approach is efficient with regard to communication effort. It uses only mid-range communication, i.e., less than 100m communication range. Therefore, the approach is fully scalable.

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A GIS Data Model in a Ubiquitous Computing Environment - Perspectives in Intelligent Transport Infrastructure

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Recently, there is a research paradigm to implement a ubiquitous information space for various domains. A Ubiquitous City model was proposed to provide a ubiquitous infrastructures and services in the urban areas. The Foresight project on Intelligent Infrastructure was executed by (2006) focusing on intelligent transport system. This project dealt with technologies such as Mobile Ad-hoc Networks, software agent, modeling, and simulation in order to build intelligent physical networks. There has been some GIS research in the relevance of semantic geo-information and spatiotemporal modeling to these techniques. Studies have also shown how to monitor spatial phenomena using sensors in real time.

However, these models are inclined to conceptual representation and simulation. Furthermore, in the transportation field, dynamic segmentation and link-node topology have used to manage transport infrastructures and to provide navigation functions, but on the other hand suitable model is needed to represent mobile objects. In a ubiquitous environment, these data models may be needed another extension. The purpose of this research is to explore GIS data modeling to support intelligent network nodes that interact and communicate with each other. To specify this concept, we propose a scenario within which vehicles and road facilities collaborate with each other within a ubiquitous sensor network. Consider the following scenario. ‘Sean is going to Edinburgh to attend a conference and input his destination to an intelligent vehicular system. The intelligent vehicular system will find proper route and join proper vehicle stream continuing to communicate and interact with other vehicles, traffic signal controller, and road facilities in real-time.’

To support this setting, this research performed classification of information variables, categorization for spatiotemporal representation, and grouping of interaction among categories. Firstly, variables of spatiotemporal setting were divided into 3 parts – determined variables, predictable variables, and unpredictable variables. Determined variables mean already known information before the journey such as origin, destination, pavement status, planned events and maintenances. Predictable variables describe variables which we can anticipate, but it can change like weather condition, traffic signal, etc. Unpredictable variables are unknown variables. Secondly, this setting was catego-

rized into infrastructure, traffic flow, and others. The transport infrastructure contains determined, predictable, and unpredictable variables while the traffic flow contains predictable and unpredictable variables. There are other variables such as weather condition, emergency which are unpredictable. Thirdly, we described 6 types of communication and interaction. The infrastructure and the traffic flow can affect to each other and themselves (4 types). Unpredictable variables also have an influence on the infrastructure and the traffic flow (2 types).

This research attempts to specify variables, categories, and their interaction which may support to the design of a spatiotemporal data model suitable for intelligent transport infrastructure in which every object can be either client or server as an agent and they may affect the dynamic geographic setting. Further research may be focused on the prioritisation of communication flows and data reduction for effective communication.

Spatio-Temporal Pattern Analysis of Moving Point Objects Utilizing Eye Movement Data

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Movement pattern recognition and analysis are challenging problems in moving object databases. Moving point analysis has recently become the focus of many research projects in the area of GIScience. Many spatio-temporal data models and analytical methods have been proposed at the theoretical level, however only few of them have been implemented and applied in practice. A critical success factor for such research is the availability of relevant spatio-temporal data. The main problem is that moving point data are not easily available and accessible due to data security and privacy issues. Advances in positioning systems and tracking technologies generate a huge amount of spatio-temporal data but unfortunately they are most often not available for public use. In order to overcome this problem we utilize self-collected eye movement data from human subject experiments on graphic displays. The general goal of employing eye movement measurement and analysis is to gain insight into the viewer's attentive behavior and to characterize the eye movement signal in terms of salient eye movements, i.e., saccades and fixations (Duchowski, 2003). Fixations are a proxy of dwelling times at location (e.g., stops of a moving object in geographic space) and saccades are trajectories between dwelling locations. In this research we aim to develop visual analytics methods and data exploration tools for the effective depiction and analysis of time-referenced spatial data sets at high resolution (e.g., eye gaze data). How can we efficiently mine time dependent spatial data patterns and effectively communicate results to humans with limited spatio-temporal processing capabilities? Specifically, how can we summarize large amounts of moving point data and discover recurring or surprising patterns? At this stage of the project we have implemented an object-oriented preprocessing application in Java. Eye movement data are used as a proxy for other moving point data that are harder to obtain. We applied several filtering methods on different 2D space-time profiles created from eye movement data to detect movement patterns such as saccades and fixations. We implemented position-based fixation detection and velocity-based saccade detection methods as proposed by Anliker (1976). A systematic comparison of the two implemented approaches revealed that fixation and saccade identifications are highly dependent on two parameters: selected threshold and sampling window size. Different parameter values produce slightly different results. The parameterization of these two methods, including the selection of the optimal thresholds and window sizes remain an open question. We plan to extend the developed parameterization framework to include

different kinds of eye movement patterns such as smooth pursuits. We are also considering to add resampling and filtering functions in the time and space dimension. A third step we consider is to explore and analyze eye movement patterns in relation to their underlying spatial structure, that is, the display space that was originally used to carry out the eye movement experiments. While we are investigating moving point trajectories specifically stemming from eye movement experiments we believe that the analytical methods developed are generic enough to be useful for all types of moving entity types.

Spatial and Temporal Analyse of Land Use and Occupation of the Parana Basin III in Brazil

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This poster is part of a research financed by National Counsel of Technological and Scientific Development - CNPq (Brazil), that the authors are involved. The main subject deals with the use of geoprocessing techniques. This subject, in the last decades had great advances on the technological field, with production of tools that had extended the applicability on the mapping and monitoring natural resources. The main goal of this work was the use of temporal series to study the evolution of land use and occupation of the Parana Basin III (BPIII), located in the west of Parana State. To reach this goal, the temporal and spatial analysis was made using the following years: 1980, 1990, 2001 and 2005. The used images correspond to the products of the sensors: LANDSAT 3, LANDSAT 5 TM, LANDSAT 7 - ETM and CBERS 2. The procedures of digital images processing as pre-processing, enhancement and classification were used, through software Spring 4,2 and ENVI 4.1. Six classes had been determined: vegetation tripping, dense vegetation, water, urban area, agriculture and ploughed land. To better identify the same ones, were used digital ortophotos of the year 1996. From the analyses it could be concluded that the land use of the BPIII, in the period of 1980 the 2005, is predominantly agriculturist. The Basin is characterized of possessing a significant percentage of dense vegetation that corresponds to forest areas forests following rivers to attend the legislation and reforestation areas. Through time increased the class urban area. Concerning the class water, it was verified alteration once currently the area of the reservoir of

ITAIPU is approximately 1.313.891 Km², while that in 1980, before flooding the River Parana to build the reservoir, it had an area of 45.322 Km2. It fits to point out, that, in virtue of the used images not to have been gotten in the same period of the year, and using for the different sensors the identification of the agriculture areas and land ploughed became more difficult.

In determined periods one determined area is identified as agriculture and in the other period it can be classified as ploughed land due to seasons of cultures. Analyzing the confusion matrices resulted from the digital processing and the classification results it is concluded to be efficient this methodology concerning environmental monitoring.

Keywords: environmental monitoring, digital images processing

Hungarian Toponymic Program (MFNP)

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The poster gives a summary of the work of The Hungarian Toponymic Program (MFNP – Magyar Földrajzi Névi Program, http://geo.organic.hu). MFNP has been working as a voluntary group since 2005 as a part of the MTA-ELTE Cartographic and Geoinformatic Research Group.

Purposes of the Program:

- Research on toponymy use in Hungary (defining and solving the problems related to cartographic toponyms; examination of the development and representation of Hungarian toponyms)

- Compiling reliable and easily accessible databases, supplementing spatial data infrastructure

- Collecting and processing Hungarian geographical names in GIS environment

- Education, knowledge sharing

Projects of the MFNP:

1. Hungarian Toponymic Portal

2. Database of Hungarian Geographical Names (MFNA)

3. Interactive Tutorial of Hungarian Toponyms (IFNS)

1. Hungarian Toponymic Portal (http://geo.organic.hu)

The Website of the Program is available from 2006. The site provides publications, guidelines and tutorials related to toponymy and the cartographic representation of geographical names. Most of the materials can be read in English. Official Hungarian toponym lists, name databases can be downloaded under Creative Commons Licence.

2. Database of Hungarian Geographical Names (Magyar Földrajzi Névi Adatbázis, MFNA)

The main project of the Program is to establish the Database of Hungarian Geographical Names (MFNA), in which Hungarian toponyms of the whole Carpathian Basin are collected and analysed. MFNA takes into consideration aspects of a gazetteer for cartographical use:

- Contains geographical names with object-type and location information.

- Overview of current and past name versions

- Ethimological references

- Multilingual identification (official names for transborder Hungarian names, names in minority languages in Hungary, and recommended English terms for Hungarian features.

- In case of landscape region names the division-system and its hierarchy are represented.

- Information for cartographical representation

The framework of the MFNA is a geoinformation system, including facilities:

- different accessing levels for using, editing or supplementing the gazetteer,

- visualization of gazetteer entries by tables and maps

- name search, selecting objects by attributes, spatial query

- temporal analysis of areal references

- comparison of landscape region delineation systems

MFNA considers international standards and recommendations: ISO19112 – Geographic information – Spatial referencing by geographic identifiers Web Gazetteer Service (WGS) recommendation, which is based on OGC directives like Web Feature Service, Filter Encoding, Geographical Markup Language.

3. Interactive Tutorial of Hungarian Toponyms (Interaktív Földrajzi Névi Sillabusz, IFNS) The IFNS is an on-line tutorial of the spelling rules and correct usage of Hungarian toponyms. The Tutorial is based on the current academic source of Hungarian spelling rules. IFNS could be used also in education from elementary to higher levels. In the long run the Tutorial could be developed to work as an automatic spell-check system for Hungarian toponyms.

Design of a Clearinghouse arrangement to support framework data sets in a NSDI (National Spatial Data Infrastructure) Case study: Rwanda and Msunduzi Municipality (South Africa)

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This study discusses the design of a Clearinghouse for Rwanda. In this research, a preliminary diagnosis of the current situation in Rwanda in terms of SDI activities is presented. This analysis is made on the basis of a survey using a questionnaire and measurement instruments such as fieldwork, desk studies, literature review and observation carried out in different institutions public and private during fieldwork in Rwanda and Msunduzi Municipality in South Africa. Msunduzi Municipality was chosen as area of study because of the availability of expertise in SDI and openness of the societies towards foreigners.

In this study different clearinghouse system architectures have been analyzed and an appropriate architecture for the Rwandan Clearinghouse is proposed. The clearinghouse architecture is based on the World Wide Web and consists of three main components:

 Web Client (client tier),  clearinghouse gateway (middleware tier) and  Clearinghouse nodes (server tier).

This work provides also possibilities to monitor all the datasets within the whole clearinghouse system. An approach for the implementation of the National Clearinghouse is presented as a prototype.

A Combined Public-Private Display Navigation Service

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1 Introduction and motivation

Nowadays, mobile private devices with displays are commonly used for different applications. According to (IfD, 2006), a mobile phone is available to 87% of the Germans. In spite of growing display sizes, there is often the problem that the display size of the private device is too small for various applications. There have been several approaches which try to solve this problem by interacting with the environment. (Schöning et al., 2006) propose using paper based public maps for an overview. They use a camera-enhanced mobile device as a magic lens that provides a dynamic overlay with additional information on it. We now present a navigation service which combines the use of public displays and private displays of mobile phones.

1.1 Scenario

T-Com currently equips telephone booths with digital screens. We started a project using these TeleStations (T-Com, 2007) for displaying advertising spots for local shops. This system is extended by providing a shop-finder navigation service that can be downloaded from the TeleStation onto the private mobile phone via Bluetooth. The service guides the user from the TeleStation to the shop whose advertisement is currently shown at the time of downloading.

2 Navigation Service

We performed a survey in the city of Münster where we asked 22 different passers-by which form of navigation service they would prefer when being guided via mobile phone. It turned out that landmarks as well as survey maps are the favorites.

Therefore, the navigation is done via landmark pictures. For that, the display of common mobile phones suffices. But in case the user likes to switch to a survey map of the route, the display is too small to identify details. We will explain how the TeleStations can be used to get rid of this problem.

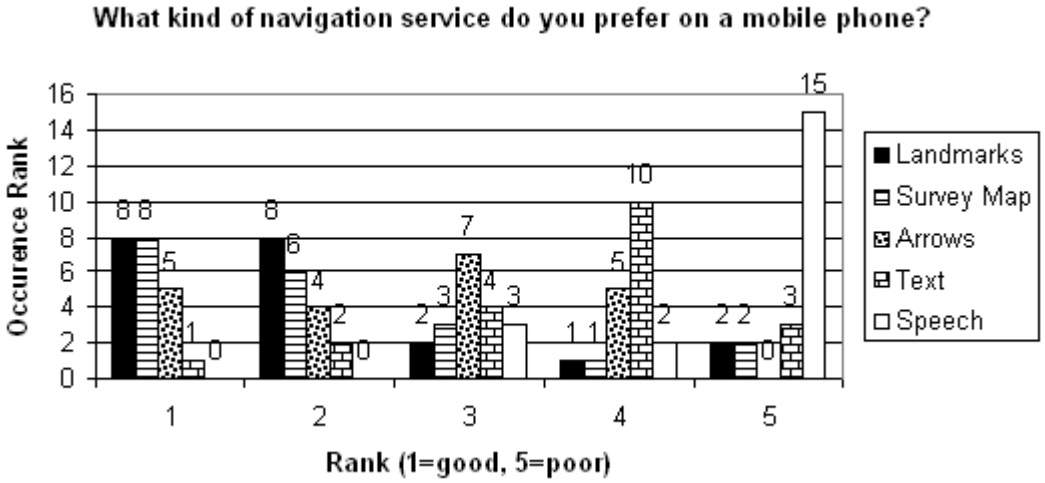

Figure 1: Results of the survey in the city of Muenster

3 Interaction of mobile phones with TeleStations

While the user downloads the navigation service, the TeleStation can access the unique Bluetooth MAC Address of his mobile phone and stores it in an online database. Additionally a download timestamp and the destination of navigation are stored. The entry is deleted after a defined period of time, assuming that the user has reached his destination or canceled the navigation process.

There is an application running on the TeleStation that continuously scans the nearer environment for Bluetooth devices. For every detected device it checks the online database for a MAC-Address entry indicating that the device is currently being guided. Knowing its own position and getting the destination of the device from the database, the route is generated and painted on a picture of a map. The currently running advertisement is interrupted as long as the device is in range of the TeleStation and the map is shown instead.

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The Framework of GeoSemantic Web Service

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Advanced geographic technology has triggered many geospatial data, software, hardware, and services. However, two impediments for GIS interoperability have been produced: syntax and semantic problems. In this research, we (1) focused on the semantic impediment in GIS, which is considered as a high-prioritized research area by NCGIA and UCGIS, and (2) presented an architecture for the geosemantic web services, including four components: an users' portal, spatial and domain ontologies, searching in SDI (spatial data infrastructure), and service chain. Users can log in the portal and discover suitable GIServices, GIS data and GIS function services, with more accuracy and results with discovered GISerivces can be generated (semi) automatically for users' evaluation. This study has also (3) integrated spatial and domain ontologies in Taipei city, Taiwan, to fulfill the need of the geosemantic web services. The framework not only provided a suitable and flexible architecture in SDI to solve the geo-semantic problem but also presented a knowledge-based and web GIS services-based spatial decision support system.

Keywords: semantic web, ontology, GIS services, spatial data infrastructure

Enhancements to Expectation-Maximization Method for Unsupervised Image Classification

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This work presents a modification of the Expectation-Maximization (EM) Clustering Method. On the EM approach, the aim is to approximate observed distributions of values (image pixels, in our case) based on mixtures of different distributions, to different clusters. The results of EM clustering are probabilities, so each observation (pixel) belongs to a cluster with a certain value in the interval [0, 1]. The highest probability will indicate the pixel class.

Such method is applied to Mixture models, which are density models that comprise several component functions, such as Gaussian. These component functions are combined to provide a multimodal density. Mixture models work as the independent variables were measured as fractions of a total. In an image, sometimes the clusters appear overlapped. This is reason why we are using the EM approach to classify them.

Our method aims at improving stability and capability for finding EM "intrinsic" structure. The stability has been improved by supplying the results of the standard K-Means algorithm as seed points and the best data structure description searched by applying cluster validity measures to each configuration, varying the initial number of clusters. A high-resolution urban scene has been tested and the best clustering partition compared to a supervised classification result, used here as a way to map the "actual" data structure.

We show how to implement the EM algorithm and how to apply it to unsupervised image classification. Besides, some classification results obtained with the proposed method and other three ones are shown to compare their accuracy. The implementation of the algorithm used TerraLib library, which is available for free download at `http://www.terralib.org/`. Also a system for image classification was developed and it is available at `http://www.dpi.inpe.br/~tkorting/index_en.html?sel=projects`. Future works include optimizing the whole algorithm to reduce computational cost.

One advantage of the EM algorithm is that its convergence is smooth and is not vulnerable to instabilities. However, wrong initial parameters might result in meaningless classification. Therefore, we have proposed approaches that estimate the first parameters using other clustering methods, such as K-Means.

WebDMA – Data Mining Analyst Web Service

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This work aims to present to the GISc (Geographical Information Science) community a system implementation that is able to extract shape attributes through a Web Service. Particularly, this system is a Web Processing Service, because it deals with user data and results in some data processing. And more than this, the same system can be used for data mining with the C4.5 decision tree classifier.

Using TerraLib Library, an open source C++ library available at http://www.terralib.org/, WebDMA can be downloaded for free and modified according to the user needs. This system has already been used with success for deforestation analysis at Amazonia region, in Brazil. But also, the architecture of WebDMA allows the user to perform any kind of shape analysis, using ordinary shape files.

Then, WebDMA has three main modules, namely Extraction, Mining and Classification. The Extraction module receives as input a shape file and returns a set of shape attributes, such as area, perimeter, fractal dimension, etc. The Mining module is used to generate a decision tree, according to a training phase that is performed by the user, through XML files. And last, but not least, the Classification module receives a new shape file and a decision tree (generated by the previous module) to classify a new data set, according the training phase.

The system's architecture allows it to be "plugged" into any system that needs this kind of operation. The basic operations, concerning OGC (GetCapabilities and DescribeProcess) are implemented, so it becomes easy to use. The particular operations of WebDMA are GetDecisionTree, GetClassification and GetAttributes. With these operations the system can extract attributes from a shape file, can also train a decision tree with any number of patterns, and finally classify a new shape file according previous training.

Evaluating Eye Movement Data as a Proxy for Moving Point Data

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Large amounts of movement data at high spatio-temporal resolution are generated daily through technological devices, such as mobile phones, navigation aids or GPS tracking devices. The exploration of moving point datasets to identify movement patterns has recently become a research focus in GIScience (Dykes &Mountain 2003). Several visual analytics tools have been developed, such as CommonGIS (Andrienko 1999) or GeoVista Studio (Gahegan 2002) to visually explore large moving point datasets. Visual analytics tools combine computational methods with the outstanding human capabilities for pattern recognition, imagination, association and analytical reasoning (Andrienko et al. 2004).

Unfortunately, privacy issues often make it difficult to access high-resolution geographic movement datasets. Eye-movement studies typically generate rapidly and fairly inexpensively large amounts of fine-grained moving point datasets. These data consist of an entity (i.e., a gazepoint) that moves through time over a visuo-spatial display. Eye movement data are characterized by fixations (i.e., gaze dwell times at locations) and saccades (gaze trajectories between dwell locations). Standard data analysis software provided by eye trackers (e.g., Tobii Studio) typically provide limited tools to depict and analyze recorded eye movements, for example with so-called gaze plots, including fixation points connected through scan paths.

How similar eye movement data are compared to moving points in geographic space is an open research question. In other words, can one utilize eye movement data as a proxy for moving point data in geographic space? We are tackling this question by developing an experiment aimed at evaluating humans' responses to the visualization of eye movement data (gaze plots) compared to other moving point data, such as animal tracks and public transportation networks. An online study has been developed including visual search tasks to assess distances, travel times and amount of change between locations on a display. One of the independent variables is context, that is, participants are told the displays are either a public transportation network, animals in an unconstrained space, or eye-movement data while looking at the same displays. Participants are given a brief introduction to the context before being shown identical visual stimuli (between-subject

design). Additionally, a subset of the participants is being eye-tracked during the experiment.

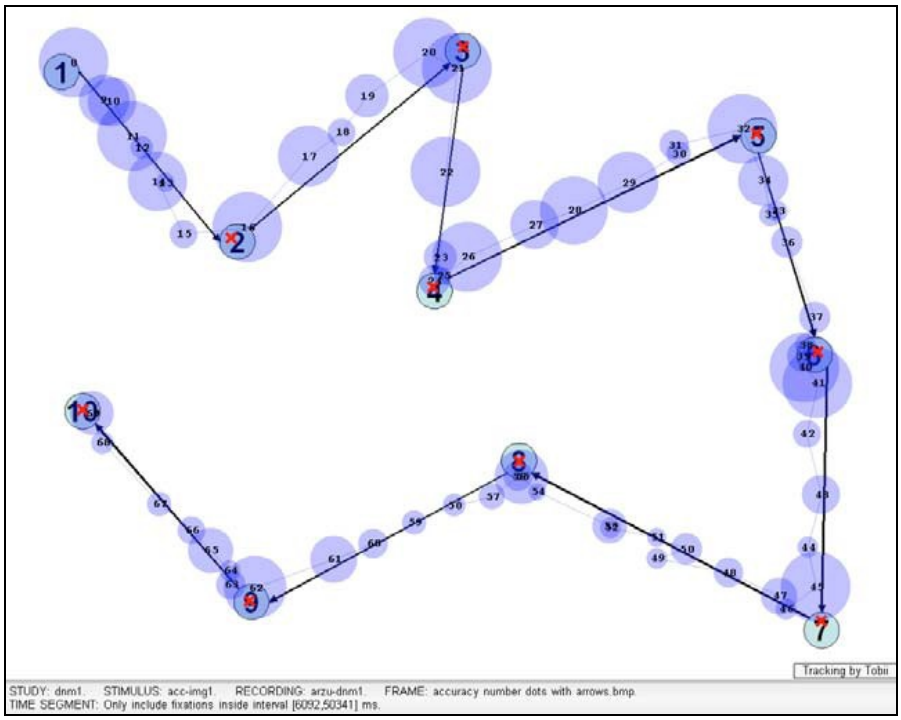

Figure 1: Gaze Plot - a visual output of eye movement data (Source: own output from calibration procedure)

The outcome of this study should provide insights whether and how eye movement data can be used as proxy for moving point data in geographic space. Moreover, with the results from the eye-movement analyses we hope to gain additional insights in how humans assess distance, time and change in visual displays. This work is part of a larger PhD project aimed at identifying and evaluating the usefulness and usability of existing visual analytics interfaces to avoid cognitive overload.

Acknowledgments

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A Bridge over Troubled Definitions: is it a River or a Lake?

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Geographic Information Systems (GIS) have grown in popularity and usage in a variety of areas, from simple searching on google maps to navigating your car to the airport without arguments. However, present GIS relies heavily upon predefined and precise information, such that a road is always a road and is always the same road. But many of the geographical features around us do not have precise definitions. A river is defined simply as "a large permanent flowing stretch of water", but what exactly is the point something becomes large? And what about in Australia where rivers don't have water in all year round? Such features are resistant to precise definitions, so we instead want a way of reasoning which takes into account the vagueness. Ontologies have been proposed as a method of describing information in the geographical domain, as this would allow logical representation of the features as well as allow reasoning to take place. However, at present vagueness is handled inadequately, with most systems choosing to either ignore or remove the vagueness as it is were a defect of the language. This is not the case; vagueness is an integral and useful part of our language, allowing us to describe the world around us in a simple manner. A more suitable approach to the problem therefore, is to find a way to incorporate vagueness into our definitions and reasoning process. Computers think in binary; humans do not. If we can bridge this gap, we can work together. My research looks at how vagueness in geographical features can be handled by grounding logical definitions upon the data, thus making such definitions context based. Usually the ontology and data levels are seen as separate; we have an ontology which when applied to some data returns features. However, as previously discussed, geographical definitions are context based, and so applying a British based ontology to Australian based data (or vice versa) may not produce the desired results. By grounding the ontology upon the data we make an explicit link between the data and the ontology, thus allowing context based definitions to be used. To achieve this, work is required at both the data and ontology levels. At the ontology level we need to determine what form of vague reasoning we intend to use and what variables we need to be able to extract from the data to achieve this. At the data level, we need to determine how to represent the data effectively and how we may obtain the required variables. For my system, I have looked at inland water networks. Using supervaluation theory to handle the vagueness, variables within the data can be treated as 'precisifications', thus definitions are representative of a particular context or instance. Using only a few basic features such as

linearity and closeness, I have had success in segmenting the data into features that would have otherwise needed to be classified in advance.

Usability of geo-information within an academic context of use: a practical approach

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According to ISO 9241, usability is ‘‘the extent to which intended users of a product achieve specified goals in an effective, efficient and satisfactory manner within a specified context of use.’’ In the area of Geographic Information Systems, much of the usability literature today focuses on evaluating hardware and software, user interfaces and Internet websites. Very little attention has been given to geo-information itself which supports users in the performance of their tasks, and their spatial reasoning undertaken for problem solving activities. Considering usability tests, fewer methods have been developed for determining the potential use of geo-information.

It is our contention that fundamental advances in determining the usability of geo-information will depend as much on establishing a solid theoretical basis for a usability framework as it does on the application of usability tests. Therefore, this poster presentation describes our efforts to develop a usability framework to determine the usability issues of geo-information in academia, both in research and teaching activities. Towards this end, a web questionnaire was designed to uncover three usability elements: accessibility, purpose of use, and user satisfaction. Accessibility referred to the possibility for users, regardless of GI technology, to access and use geo-information products, such as maps, plans, satellite images, and aero photos. The questions were developed to gather information about the relative ease or difficulty in accessing these products due to costs, quality, and lack of knowledge about existing data sources.

Purpose of use is a usability element that was defined as the use of geo-information under two main academic activities (i.e. research and teaching). The web questionnaire was distributed by e-mail to over 300 academics coming from several disciplines; for example, geology, ecology, archaeology, marketing, mining and transport. In the web questionnaire, the question order, wording, and responses were critically important. Many questionnaires fail to achieve their aims mainly because they have too many questions and responses, making them confusing to the users. Therefore, our aim was to design a short and well structured questionnaire. Twelve closed questions were designed to analyse responses from multiple users who could state if they agree (yes) or disagree (no), the degree of agreement or preference, as well as choose one or more items from a list and give commentaries and explanations.

The received questionnaires went successfully, and there were valuable findings. Users strongly welcomed the potential of the questionnaire. We collected numerous user comments, and aspects of use, including ideas that could help us to enhance the use of geo-

information in an academic context. For example, most of academics use geo-information for research purposes (60%) rather than lecturing. The accessibility issues are more related to the use of different data formats and specifications. Users also encounter problems in finding the data sources. In most of the cases, they use the Internet to access the required geo-information, being Google the most used source by them. Finally, it was also interesting to witness that only 12% of the users were familiar with the existence of Spatial Data Infrastructures.

Vario-Scale Geo-information

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Today, current practice is to store digital geographic data sets at multiple scales with multiple resolutions, i.e. data is stored multiple times at a fixed number of resolution (or scale) intervals in so-called Multiple Resolution Databases (MRDB's). In these data structures links between corresponding objects of the different resolution levels are stored, to offer consistency during the use of the data. Drawbacks of those structures are that redundant data is stored and that these structures are not suitable for progressive data transfer, because each resolution level requires its own graphic representation to be transferred.

Raster images can accomodate progressive transfer nicely with techniques like wavelet compression and data pyramids. Using the data structures, first a coarse representation can be sent and later on refined ones with more details. It is more diffcult to obtain those effects with vector data, as these require more advanced data structures.

In earlier research both the theoretical and practical (implementation) aspects of an example of such a more advanced data structure, the tGAP structure (topological Generalized Area Partitioning) have been described [Van Oosterom, 2005], [Van Oosterom et al., 2006]. The purpose of this tGAP structure is to store the data only once, with no redundancy of the geometry and refence to composing elements of highest level of detail (LoD) for any other element of lower LoD. Di_erent representations can be derived on the y from this structure according to the LoD needed.

In this research extensions to the original tGAP vario-scale data structures are to be developed, to get to a continuous representation of the real world with respect to resolution, instead of a discretised representation in multiple layers, each only representing one resolution level. This includes storage methods, semantics, progressive transfer of data over networks and smooth zoom and pan (e.g. geo-morphing) at the client side.

Benefits of such an approach, but not limited to those mentioned here, are:

- data consistency between different resolutions
- possibility of progressive transfer
- smooth zooming / panning
- variable scale in one map (fish eye effect)

Methods that will be adopted to reach this objective will be (amongst others):

- Literature review on generalizsation issues

- Development of data structures in geo-DBMSes, network interfaces, interactive clients
- Generalization experiments with real world data at di_erent scales, for example:
  - Topographic data
  - Height data
  - Soil data

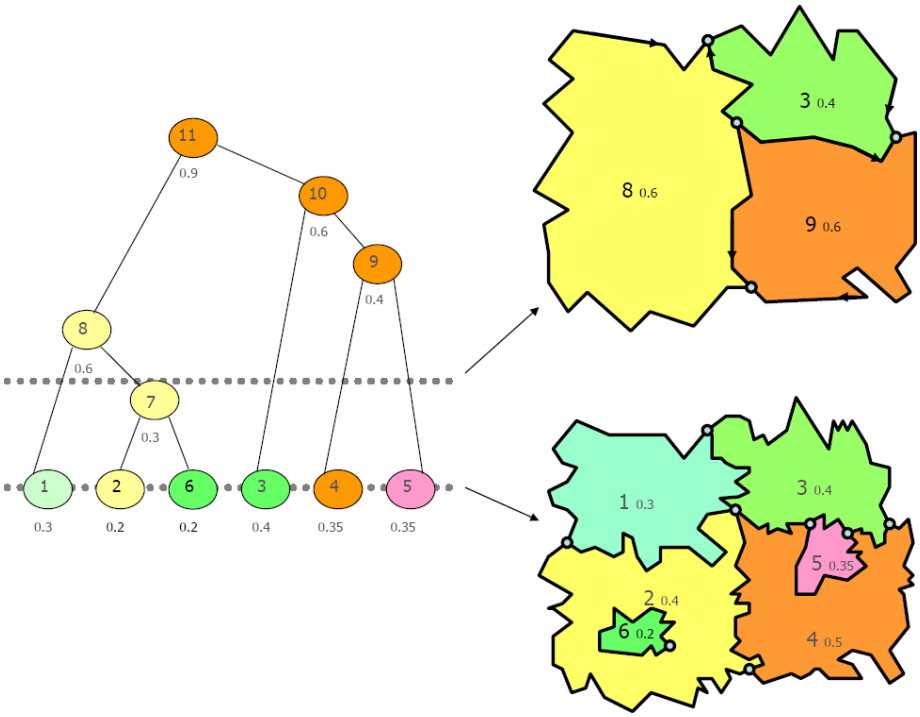

Figure 1: tGAP structure in action

This research may contribute to long standing issues in generalization research: it tries to find one integrated model of the world, suitable for visualization and querying, in which non-predefined resolutions can be accommodated and from which multiple representations can be derived.

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Information Sharing and Communication Within Coastal Zone Management System and The Use of Participatory Geographic Information System Technique in Vietnam

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Information is one of the central criteria of an integrated, adaptive coastal management. Coastal managers attempt to make their decisions based on an analysis of the best available sources of information, including the opinions and perceptions of stakeholders. However, for coastal zone planning and management (CZM), insufficient and inaccessible information are among main obstacles (Bodungen & Turner, 2001). The shortage and inaccessibility of information and knowledge for decision making in coastal management which are results of the improper understanding of the management issues, the absent of information sharing mechanisms, and lack of the integration of local and traditional knowledge (Uluocha, 2003) leads to many uninformed, partial decisions. At the local level of CM, information sharing mechanisms can facilitate meaningful participation and promote decision-making (Mabudafhasi R., 2002).

The GIS tool has been used widely by coastal managers mostly to support decision making. Spatial information plays an important role in CZM especially with local coastal communities who are more likely to be familiar with visualized information than other forms of information. At this level of application, GIS should be used in a participatory way which helps improving information sharing and communication among stakeholders in CZM, and supports the making of more informed decisions for coastal problems and conflicts. Participatory GIS is an attempt to utilise GIS technology in the context of the needs and capabilities of communities that will be involved in and affected by development projects and programmes". The focal objective of PGIS is capturing local knowledge and combining it with more formal spatial information sources.

The poster focuses on: (1) Investigate the information needs of coastal users and managers and the flow of information within the hierarchical management system in Viet-

nam; (2) the use of participatory GIS in coastal decision making toward the goal of sustainable development and poverty alleviation of the coast, especially at local scales of management.

Methodology employed is survey with semi-ended questionnaires and participatory geographic information system technique. The PGIS technique with photomaps is used to collect indigenous information about the state of coastal resources management. Photomaps are printouts of geometrically corrected aerial photographs (ortho-photographs) placed in map coordinate systems. Participants are invited to delineate land use and other significant features on transparencies laid-out over the photo. Information on the transparencies is later scanned or digitized and geo-referenced and contributes to decision making system under scheme of multi-criteria decision analysis (MCDA) of ESRI ArcGIS package in which local knowledge is displayed in form of a separated layer. The use GIS-based multi-criteria analysis in this research is to integrate and analyse data from various sources and formats on natural and socio-economic aspects of the human and natural processes in the coastal zone basing on GIS environment.

Outcomes from the research show that information flows passively within the hierarchy system of coastal management. Local people and other coastal users are experiencing top-down flow of information and their information/voice is mostly not heard by coastal authorities. Participatory GIS might be of suitable solution which is able to both (1) overcome the technology limitation and technology knowledge shortage of local community and (2) overcome the above mentioned problem of information sharing and communication.

Route Aware Maps

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Maps are an important visualization tool for assisting people during wayfinding tasks.

Basically, there are two kinds of maps for representing routes pictorially: strip maps and global survey maps. Strip maps only depict the actual route and offer on-route orientation. They may be considered as a visualization of verbal route directions. Survey maps are the more "traditional" maps and offer a global view embedding the specific route.

Both representations have advantages as well as disadvantages: strip maps are effective when one follows the route, as the offered information is concise and there is no further distractive information depicted. They can be easily transformed (reflecting cognitive or geometric considerations), since no additional environmental data and street-networks have to be considered. But due to lacking overview information they fail to support a traveler to reorient and to reconfigure in case of disorientation. In contrast to that, survey maps offer this overview. They usually depict the surrounding environment in respective detail. This rich representation has its price as well: where strip maps have not enough information, are survey maps cluttered with additional information and increase the cognitive load of the user. This makes it difficult to extract the information necessary for route following, relocation and reconfiguration.

In our poster we will present work on a new type of map, the Route Aware Maps (RAM) which is a hybrid of strip and survey maps. With the development of RAMs we try to eliminate the disadvantages of the both basic approaches and at the same time combine the positive aspects. Inspired from the strip map we offer a route-focused and skeleton-like view of the actual route. No unnecessary information is included in the map. But we will interpret necessary and unnecessary from a new point of view. We analyze the actual environment and the street network according to possible interpretation errors. Possible sources for wrong decisions during wayfinding are for example complicated or redundant configurations of streets and environmental features, blocked ways or inattention of wayfinder. We try to identify plausible sources for navigation errors and include alternative routing or re-routing to the original route depending on the mutual effectiveness. These alternative routes will include unique reorientation points to indi-

cate navigation errors. Additionally we will include region based information such as districts and prominent landmarks to include survey-like information.

The aim of our RAM is to design a map which is optimized towards the wayfinding task, which is resistant to possible navigation errors of the wayfinder.

Standardized Web Coordinate Transformation Service

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The purpose of the poster is to present the work on the implementation of the web coordinate transformation service, which is based on OGC implementation specification WCTS (Web Coordinate Transformation Service) and is developed within the dissertation project. This standardized web service is designed to be a suitable component for geospatial data coordinate transformations within the distributed GIS, that has closely mirrored the development of Web Services technology.

The aim of the project is to create standardized web service for transformations of coordinates between various reference systems, also with the extension of WCTS functionality, with the facility of transforming or converting and storing the informations about spatial data accuracy.

The implementation software is called pyWCST, and is developed in Python programming language, some extensions are written in C++ language in order to support better performance of mathematical transformation operations. PyWCTS is highly extensible and supports various transformation methods. In addition to the web service implementation, PyWCTS can be used as a stand alone transformation utility, and also as a transformation software library. It is designed to exploit the capabilities of OGR/OSR modules, parts of well known Open Source GDAL library, however it is not depended on these modules, it extends their transformation capabilities and offers more transformation methods. Within the pyWCTS, we are also testing the support for WSDL/SOAP interface. This web service implementation is supposed to be used as the national authorised transformation web service in Czech Republic, for a high accuracy transformation between European reference system ETRS 89 and national reference system. The global high accuracy transformation method is based on a two main steps process, the 3D seven parameters transformation and the grid interpolation of the positional differences (similar process applied for example in Dutch RDNAPTRANS).

It is increasingly important for users to not only know the coordinate values, but also the accuracy of those coordinate values, so users can decide which coordinate values represent the best estimate of the true value for their applications. To support the data positional quality information preservation, our coordinate transformation service pyWCTS will also provide mechanisms for computing, converting and storing informations about data accuracy and operation accuracy and thus will allow the support for the analysis of the propagation of errors in results of GIS analysis. Thus the WCTS can be extended and can provide functionality as a positional accuracy transformation service. The posi-

tion accuracy can be expressed in a covariance matrix. The covariance matrix defined in GML dataQuality schema is designed for this purpose, and we use it for storing position accuracy estimation of the horizontal, vertical, or 3D spatial data. Covariance matrices can be transformed and converted into another forms of position quality metadata, e.g. error ellipses, circular and vertical errors.

Within the project, we have started to implement this functionality, that is not supported in present-day transformation softwares, and we would like to present our particular results of the solution for the position accuracy estimation support in WCTS.

Modeling Fire Spread: Dynamic Spatio-Temporal Modeling on Different Levels of Abstraction

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In disaster management, dynamic spatio-temporal models can provide useful information to minimize the harm and losses caused by disasters. The implementation of those models requires the choice of an implementation technology (i.e. framework). Models become multi-disciplinary and complex and the complexity of adequate implementation technologies rises. As new modeling and simulation (M&S) functionality is being developed, the number of different M&S frameworks grows. Implemented models are framework specific, which is an obstacle for model re-use and model integration.

In our work, we seize the suggestion of Evert et al. (2005) to develop a M&S framework based on a software architecture in which models are *explicitly* represented on different levels of abstraction. This facilitates the separation of model and implementation. To demonstrate our concept, we develop a modeling framework, that enables the construction of models of wildland fire spread. In the following, we provide a brief sketch of the concept and the framework.

On the highest level of our architecture, a model is described in terms and concepts of the modeled domain. A domain specific modeling language (DSL) is provided for modeling. A fire spread model is described using concepts derived from Rothermel's mathematical model for wildland fire spread (Rothermel (1972)).

On the second level, a DSL-model is represented in the concepts of the Cellular Automaton (CA) formalism. In CA-models space is divided into a grid of cells. The algebraic DSL-model is automatically transformed into a CA-model via model-to-model transformation.

At the heart of the automatic model transformation is a mapping from the DSL-model's algebraic expressions to CA-transition functions, which describe the behavior of cells. Furthermore, state variables and parameters are transformed to CA-states and some auxiliary states and transition functions are added to the CA-model by the automated transformation. Since the DSL-model only specifies the position of the fire front in one dimension, the description of the two-dimensional behavior is provided by automatically adding a propagation algorithm.

On the lowest level, the CA-model is represented using the concepts of the framework that is executing the model. In our prototypical implementation we use SELES (

http://www.seles.info) for model execution. The CA-transition functions are automatically transformed into expressions, that can be solved by SELES.

In the next version of our system, we will allow the specification of differential and difference equations, which have to be treated using sophisticated numerical techniques. This is an issue, because the development of frameworks allowing the combination of CA and such continuous systems is an ongoing task.

We plan to overcome this issue by using an execution framework that provides continuous system simulation functionality and the possibility to compose models of sub-models. Each cell constitutes a sub-model and the CA is the composition of those sub-models. The simple structure of CA-cells allows the automatic generation of such composed CA.

With this approach, we want to provide a modeling architecture that is an alternative to "traditional" M&S frameworks. The three-level-architecture facilitates a high degree of independence from particular implementation technologies, easier modeling, and model and M&S-functionality re-use[1].

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Ontologies for Disaster Management Response

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Increasing numbers of natural disasters and man-made disasters, such as earthquakes, tsunamis, floods, air crashes, etc., have posed a challenge to the public and demonstrated the importance of disaster management. The success of disaster management, amongst all, largely depends on finding and successfully integrating related in-formation to make decisions during the response phase. This infor-mation ranges from existing data to operational data. Most of this in-formation is geographically related and therefore when discussing integration of information for disaster management response, we of-ten refer to the integration of geo-information. Current efforts to in-tegrate geo-information have been restricted to keyword-based-matching Spatial Information Infrastructure (SII, may also known as Spatial Data Infrastructure). However, the semantic interoperability challenge is still underestimated. One possible way to deal with the problem is the use of ontology to reveal the implicit and hidden knowledge. This paper presents an approach for ontology develop-ment and ontology architecture, which can be used for emergency response.