

Resumos

3 de novembro – segunda-feira

Palestra Convidada

Toward Semantic Reference Systems for Geographic Information
Werner Kuhn (University of Münster, Germany)

Abstract: Users of geographic information should be able to refer the thematic parts to semantic reference systems, just as they refer the geometry (coordinates) to spatial reference systems. The talk will address the modeling and technology requirements resulting from this vision. In particular, the notions of semantic referencing, semantic projection, and semantic transformation (or translation) will be discussed. An example from the domain of vehicle navigation will demonstrate the ideas and their implications for semantic interoperability.

Artigos

The Web as a Data Source for Spatial Databases

Karla A.V. Borges, Alberto H.F. Laender, Claudia B. Medeiros, Altigram S. da Silva, Clodoveu Davis Jr.

Abstract: With the phenomenal growth of the WWW, rich data sources on many different subjects have become available online. Some of these sources store daily facts that often involve textual geographic descriptions. These descriptions can be perceived as indirectly georeferenced data - e.g., addresses, telephone numbers, zip codes and place names. Under this perspective, the Web becomes a large geospatial database, often providing up-to-date local or regional information. In this work we focus on using the Web as an important source of urban geographic information and propose to enhance urban Geographic Information Systems (GIS) using indirectly georeferenced data extracted from the Web. We describe an environment that allows the extraction of geospatial data from Web pages, converts them to XML format, and uploads the converted data into spatial databases for later use in urban GIS. The effectiveness of our approach is demonstrated by a real urban GIS application that uses street addresses as the basis for integrating data from different Web sources, combining these data with high-resolution imagery.

The Architecture of a Mobile Emergency Plan Deployment System

Fábio Meira de Oliveira Dias, Marcelo Tílio Monteiro de Carvalho

Abstract. This paper describes the implementation of a workflow management system to support mobile GIS workgroup applications and highlights the design of the workflow definition language the system offers. The system features a hierarchical execution model in which each instance is able to delegate the execution of sub-workflows to other active instances. It incorporates instance discovery and event handling services, that enhance the proper treatment of disconnections, and adopts an optimistic replication strategy to handle workflow context variables. The workflow definition language features special constructors that improve the legibility of large workflow definitions. The results reported here build on the experience accumulated with the implementation and deployment of an emergency management application that offers action plans, easy access to geographic data and tight control over the resources allocated to face an emergency.

Dynamic Integrated GIS Enhancement and Support Tools. First step: Analysis of Available Data

Laércio Massaru Namikawa, Chris S. Renschler

Abstract. Existing Digital Elevation Models (DEMs) contain inaccuracies that prevent them from being reliably used to support decision-making. The objective is to present the framework for the Dynamic Integrated GIS Enhancement and Support Tools (DIGEST) that aim to reduce inaccuracies of existing DEMs “on-the-fly”. DIGEST will allow a more effective use of DEMs, particularly for management during a natural disaster crisis. The DIGEST system will be integrated in an existing geographic database, with tools targeted to create quality information for the available data, and to define appropriate scale required for an event simulation based on the limitations of existing topographic data. The tools will also dynamically extract features of topographic relevance from the most recent non-photogrammetric visible, infrared and thermal imagery. The extracted features will be employed to detect changes to topographic features in the already available DEMs. Quality enhancement of the DEM based will be achieved through the integration of the extracted topographic features using data conflation algorithms. In the current paper, analysis of widely available DEMs is present to demonstrate the potential of DIGEST, with focus on the freely available data from the Shuttle Radar Topography Mission and on DEMs available from Geospatial Data Clearinghouse servers established by the Federal Geographic Data Committee (FGDC).

Planning Brazilian Urban Traffic with a Geographic Application Software

Juliano Lopes de Oliveira, Andr o Constantino da Silva, Bryon Richard Hall

Abstract. Planning and optimizing urban traffic is a difficult problem, with considerable economic and social impacts. The development of suitable software tools to aid municipal governments to control and to improve the traffic flow is urgent due to the increasing number of vehicles in urban areas. However, the development of this kind of software represents a great challenge since the problems to be dealt with in this domain are both computationally and mathematically complex. This article presents a geographic application software as a feasible solution for this problem. The solution is geared towards Brazilian medium to large cities and is based on a mathematical model of the urban traffic. This model is stored in a geographic database and allows the user of the software (typically a traffic engineer) to search for alternative solutions for traffic problems. The software can provide optimal solutions for an important family of traffic problems, namely the Traffic Equilibrium Problem (TEP). This family involves the common hashing problems (e.g. traffic bottlenecks) as well as more sophisticated problems like vehicles' pollution minimization. We have developed a prototype of the software and its solutions for the TEP were empirically validated against real traffic data from Goi nia, capital of the Brazilian state of Goi s.

A Flexible Addressing System for Approximate Geocoding

Clodoveu Davis, Frederico Fonseca, Karla Borges

Abstract. One of the most important features in an urban geographic information system is the ability to locate addresses, in any form employed by the population, in a quick and efficient way. From an organized set of georeferenced address data, local governments, infrastructure companies, and the various agents that need to work in urban spaces can reliably and precisely locate points of their interest, in fields of application as diverse as public health services, crime fighting, product distribution, postal delivery and many others. This activity is known as *geocoding*, which can be defined as the process of locating points on the surface of the Earth from alphanumeric addressing data associated to events. This paper shows how geocoding can be implemented over incomplete and possibly inaccurate addressing data (which is the prevailing situation in Brazilian cities) and how users can benefit from the results of such a process. A geocoding quality indicator is proposed, with the intention of providing an indication of the degree of certainty that is associated with each individual result of the geocoding process. This indicator can then be used in spatial analysis, by giving analysts the opportunity to include the uncertainty associated with the data in their work. This project is under development, and a set of (as yet unimplemented) geocoding tools is proposed and described in the paper.

Modelling Spatial Relations by Generalized Proximity Matrices

Ana Paula Dutra de Aguiar, Gilberto Câmara, Antônio Miguel Vieira Monteiro, Ricardo Cartaxo Modesto de Souza

Abstract. One of the main challenges for the development of spatial information theory is the formalization of the concepts of space and spatial relations. Currently, most spatial data structures and spatial analytical methods used in GIS embody the notion of space as a set of absolute locations in a Cartesian coordinate system, thus failing to incorporate spatial relations which are dependent on topological connections and fluxes between physical or virtual networks. To answer this challenge, we introduce the idea of a generalized proximity matrix (GPM), an extension of the spatial weights matrix where the weights are computed taking into account both absolute space relations such as Euclidean distance or adjacency and relative space relations such as network connection. Using the GPM, two geographic objects (e.g. municipalities) can be considered "near" each other if they were connected through a transportation or telecommunication network, even if thousands of kilometers apart, or, using even more abstract concepts, if they are part of the same productive chain in a given economical activity. The generalized proximity matrix allows the extension of spatial analysis formalisms and techniques such as spatial autocorrelation indicators and spatial regression models to incorporate relations on relative space, providing a new way for exploring complex spatial patterns and non-local relationships in spatial statistics. The GPM can also be used as a support for map algebra operations and cellular automata models.

Aplicando Ontologias de Objetos Geográficos para Facilitar Navegação em GIS

Lauro Ramos Venâncio, Renato Fileto, Cláudia Bauzer Medeiros

Abstract. The Semantic Web has become an active research area with many promising applications. This paper proposes the use of an ontology to help navigation on maps, giving a concrete contribution to the adoption of Semantic Web ideas in GIS. The *OntoCarta* system, which we are developing to demonstrate our methods, relies on current standards and public domain tools to build a map navigator with: (1) a viewer for maps in different scales; (2) an ontology describing and correlating maps' objects. The combination of these components results in a knowledge directed cartographic navigation system. The system supports map zooming, while keeping contextual information for different levels of abstraction. The adoption of open formats to represent ontology enables the use of *OntoCarta* on a Web browser and fosters data reuse throughout the Internet.

Estendendo o Algoritmo PBSM com Partições Adaptáveis

Miguel Fornari, Cirano Iochpe

Abstract. The spatial join operation matches two sets of geometric descriptions by means of a geometric predicate. This work concentrates in algorithms based in space subdivision, presenting a new algorithm, based on PBSM, called PBSM-NRQB (No-Replication, Quadtree, Bucket). This algorithm uses statistical information, maintained in quadtrees, to adapt the space partitioning to object distribution and uses a file organization, based in buckets to store object descriptors in a more convenient way. The comparison with others algorithms in literature are made by performance analysis and experimental results obtained using synthetic and real data sets, showing that the algorithm is very competitive in all the situations, reducing the number of I/O operations and response time in almost every case.

Efficient Query Processing on the Relational Quadtree

Hans-Peter Kriegel, Peter Kunath, Martin Pfeifle, Matthias Renz

Abstract. Relational index structures, as for instance the Relational Interval Tree, the Relational R-Tree, or the Linear Quadtree, support efficient processing of queries on top of existing object-relational database systems. Furthermore, there exist effective and efficient models to estimate the selectivity and the I/O cost in order to guide the cost-based optimizer whether and how to include these index structures into the execution plan. By design, the models immediately fit to common extensible indexing/optimization frameworks, and their implementations exploit the built-in statistics facilities of the database server. In this paper, we show how these statistics can also be used for accelerating geo-spatial queries using the relational quadtree by reducing the number of generated join partners which results in less logical reads and consequently improves the overall runtime. We cut down on the number of join partners by grouping different join partners together according to a statistic driven grouping algorithm. Our experiments on an Oracle9i database yield an average speed-up between 30% and 300% for spatial selection queries on the Relational Quadtree.

4 de novembro – terça-feira

Palestra Convidada

From Objects to Events: Modeling the Dynamic World

Michael F. Worboys - National Center for Geographic Information and Analysis
University of Maine (USA)

Current temporal and spatiotemporal information system technology is based on the snapshot metaphor, where the dynamic world is imagined as a temporal sequence of snapshots. This imposes limitations on the representations and reasoning capabilities of such systems. In particular, it is not possible using temporal snapshots to explicitly model events, processes, and actions. The presentation will present an event-based ontology and show how it may be formalized to provide a framework for representing and reasoning about the dynamic world.

Artigos

Aplicação de Estruturas de Dados Eficientes na Estimação de Densidade de Eventos Espaciais

André Ávila da C. Santos, Renato M. Assunção

Resumo: Este artigo aborda o desenvolvimento de métodos computacionais para a estimação de intensidade de processos pontuais através da geração de mapas de kernel. É mostrado que o impacto dos algoritmos de busca por vizinhos mais próximos é crucial para o bom desempenho desses métodos, sendo assim necessária a escolha de um algoritmo apropriado. É proposto um novo algoritmo baseado numa estrutura de dados bastante simples para a localização desses vizinhos de forma eficiente. Em seguida, as características específicas do problema são levadas em conta, possibilitando pequenas modificações na estrutura capazes de reduzir consideravelmente o número de operações realizadas pelo algoritmo, em comparação à sua versão original. Apesar de lidarmos apenas com o caso bidimensional neste artigo, mostramos que o algoritmo é flexível o suficiente para permitir buscas em regiões multidimensionais sem grande perda de eficiência.

An Early Warning System for Space-Time Cluster Detection

Renato Assunção, Andréa Iabrudi, Martin Kulldorff

Abstract. A new topic of great relevance and concern has been the design of efficient early warning systems to detect as soon as possible the emergence of spatial clusters. In particular, many applications involving spatial events recorded as they occur sequentially in time require this kind of analysis, such as fire spots in forest areas as in the Amazon, crimes occurring in urban centers, locations of new disease cases to prevent epidemics, etc. We propose a statistical method to test for the presence of space-time clusters in point processes data, when the goal is to identify and evaluate the statistical significance of localized clusters. It is based on scanning the three-dimensional space with a score test statistic under the null hypothesis that the point process is an inhomogeneous Poisson point process with space and time separable first order intensity. We discuss an algorithm to carry out the test and we illustrate our method with space-time crime data from Belo Horizonte, a large Brazilian city. Key words: Spatial cluster detection, Knox test, Poisson process, Spatial point pattern

A Strategy for the Interpolation of Surfaces Through the Use of Basis Functions

Edson Ricardo de Andrade Silva, Creto Augusto Vidal, Joaquim B. Cavalcante Neto

Abstract. For the construction of digital terrain models based on surface interpolation, it is defined as a bivariate function $F(\mathbf{x}, \mathbf{y})$ that interpolates a finite set of N sample points, $\mathbf{P}_i = (\mathbf{x}_i, \mathbf{y}_i, z_i)$, such that, $F(\mathbf{x}_i, \mathbf{y}_i) = z_i$. In this work, it is presented a strategy for the generation of interpolation surfaces through the use of basis functions. This methodology is based on a work by Chaturvedi and Piegl [5], where improvements related to the construction of the basis functions were made. The proposed strategy allows a larger expansion of the basis function's support region, represented by the interior of a trajectory curve, composed of quadratic rational Bézier segments and reduces the approximation error between the reference surface and the interpolation surface.

GMLA: A XML Schema for Integration and Exchange of Multidimensional-Geographical Data

Robson do Nascimento Fidalgo, Joel da Silva, Valéria C. Times, Fernando da F. de Sousa, Roberto Souto M. de Barros

Abstract. This work presents a generic programming interface, or API (Application Programming Interface), for spatial operations in geographical database developed in the TerraLib environment - a base library for construction of geographical applications with integrated architecture. This API provides operations on geographical data stored in relational DBMS (RDBMS) and object-relational DBMS (ORDBMS). In the case of a new generation of ORDBMS which has a spatial extent, like Oracle Spatial, the API explores at most its resources to treat geographical data, for example, spatial indexes, operators and functions to manipulate and query these data through the query language SQL. The supplied operations of this API can be grouped as: (1) operations

over vector data, for example, topological and metrical relation query, generation of a new geometry through a distance around an specific geometry (buffer), and set operations (intersection, union and difference); and (2) operations over raster data, as zonal operation and clipping based in a mask.

Integrating Telecom Outside Plant Systems Through the GML Standard

Gerson Mizuta Weiss

Abstract. This paper introduces the Telecommunication Outside Plant Markup Language (TOPML), an OpenGis GML (Geographic Markup Language) application schema designed to describe telecommunication outside plant data in which geographical information is an important issue. TOPML uses the standard OpenGis GML schema to include geographic properties to georeferenced telecom network elements. The use of TOPML can be a key factor for cost reduction on data gathering, conversion process of georeferenced data and system integration. By using TOPML, telecom systems can now communicate in different ways such as Web Services. The TOPML can be transformed into an SVG format, allowing geographic data visualization in the Internet. Additionally, with TOPML and the definition of services following the OpenGIS specifications, the telecom outside plant systems can move towards a standard interoperable environment. The results of this paper are being implemented in the CPqD Outside Plant System, a geographical information system that automates the telecommunications outside plant management.

Utilizando a GML na Identificação de Candidatos a Padrão de Análise para BDG

Guillermo Nudelman Hess, Cirano Lochpe

Abstract. This paper describes the development of a software architecture for the pre-processing of data in the Knowledge Discovery in Database (KDD) process, specifically for conceptual modeling of Geographic Databases. The goal is to create a mechanism to (semi)-automate the conversion of conceptual schemas based on different data models into a single canonical format, syntactically and semantically, and from that format to one accepted by the data mining softwares. Rules are presented for the syntactic conversion from UML-GeoFrame to the Geographic Markup Language (GML) and from GML to FDE.

Interface para Operações Espaciais em Banco de Dados Geográficos

Karine Reis Ferreira, João Argemiro Carvalho Paiva, Gilberto Câmara

Abstract. This work presents a generic programming interface, or API (Application Programming Interface), for spatial operations in geographical database developed in the TerraLib environment - a base library for construction of geographical applications with integrated architecture. This API provides operations on geographical data stored in relational DBMS (RDBMS) and object-relational DBMS (ORDBMS). In the case of a new generation of ORDBMS which has a spatial extent, like Oracle Spatial, the API explores at most its resources to treat geographical data, for example, spatial indexes, operators and functions to manipulate and query these data through the query language SQL. The supplied operations of this API can be grouped as: (1) operations over vector data, for example, topological and metrical relation query, generation of a new geometry through a distance around an specific geometry (buffer), and set operations (intersection, union and difference); and (2) operations over raster data, as zonal operation and clipping based in a mask.

Explorando a Multidimensionalidade da Kd-Tree para Suporte a Temporalidade em Dados Espaciais Vetoriais do Tipo Ponto

Leonardo Rodriguez Heredia, Cirano lochpe, João Comba

Abstract. The representation of time in geographic information systems (GIS) has been subject of intense investigation in late years. Actual research involves from modeling techniques for spatio-temporal representation of reality to spatio-temporal data structures and file organizations. In this paper, we propose to explore the multidimensional structure of both the *Kd-Tree* and the *Adaptive Kd-Tree* in order to keep the validation time or transaction time of the points stored in them.

Stochastic Driven Relational R-Tree

Hans-Peter Kriegel, Peter Kunath, Martin Pfeifle, Matthias Renz, Petra-Maria Strauss

Abstract. Modern spatial database applications including computer-aided design (CAD), medical imaging, molecular biology, or geographical information systems (GIS) impose new requirements on spatial query processing. Particular problems arise from the design goal to use general purpose database management systems in order to guarantee industrial-strength. Recently, there has been an increasing awareness that it is indispensable to integrate stand-alone spatial index structures, e.g. R-trees or Quadtrees, into fully-fledged database systems resulting in relational index structures, e.g. Relational R-trees or Relational Quadtrees. In this paper, we introduce stochastic heuristics for the Relational R-tree which are based on the fact that the Relational R-tree allows an individual fanout for each node. This freedom from minimal and maximal fill factors of nodes, offers a wide range of potential improvements. We develop algorithms that consider the quality of the entries of a node rather than just the quantity. Our experiments clearly demonstrate the advantages of this new stochastic driven Relational R-tree compared to the Relational R*-tree.

5 de novembro – quarta-feira

Artigos

Visual Exploration of Spatial-Temporal Database

Milton Hirokazu Shimabukuro

Abstract: Visualization research deals with the use of graphical models to represent data, coupled with suitable interaction operations that support an active user exploration of the data representations. Visualization techniques can greatly enhance knowledge discovery processes involving geo-referenced data, and the study of visual displays to assist users of geographic information, which typically includes spatial and temporal attributes, motivates developments in the new field known as Geovisualization. Users of such data are typically interested in spatial dynamics, or changes that occur over time, and the capability of simultaneously depicting the temporal component of data and the spatial information, in an integrated manner, is necessary to support real data analysis tasks. In this paper we introduce several strategies to support visual exploration of spatial-temporal databases, focusing on assisting end users on the initial stages of a knowledge discovery process. The visual approaches proposed are illustrated with an application that demands the exploration of a pluviometric database.

Image Data Handling in Spatial Databases

Lubia Vinhas, Ricardo Cartaxo Modesto de Souza, Gilberto Câmara

Abstract. The recent advances in database technology have enabled the development of a new generation of spatial databases, where the DBMS is able to manage spatial and non-spatial data types together. Most spatial databases can deal with vector geometries (e.g., polygons, lines and points), but have limited facilities for handling image data. However, the widespread availability of high-resolution remote sensing images has improved considerably the application of images to environmental monitoring and urban management. Therefore, it is increasingly important to build databases capable of dealing with images together with other spatial and non-spatial data types. With this motivation, this paper describes a solution for efficient handling of large image data sets in a standard object-relational database management system. By means of adequate indexing, compression and retrieval techniques, satisfactory performances can be achieved using a standard DBMS, even for very large satellite images. This work is part of the development of the TerraLib library, which aims to provide a comprehensive environment for the development of GIS applications.

Modelagem de Processos de Análise Geográfica Utilizando o Framework GeoFrame

Cláudio Ruschel, Cirano Lochpe, Jugurta Lisboa Filho

Abstract. O potencial de executar-se processos de análise geográfica sobre os componentes do banco de dados geográficos é, de forma geral, a maior motivação para justificar os investimentos necessários para a sua construção. A formalização desses processos em um modelo conceitual, na fase de projeto, desvincula a necessidade de uso da terminologia específica que cada *software* de SIG utiliza. Esse artigo apresenta uma solução que estende um *framework* conceitual (GeoFrame) com uma semântica que suporta a expressão de processos de análise geográfica. Os processos são identificados a partir da elaboração de diagramas de casos de uso e iniciais de atividade, incorporados no diagrama de classe e detalhados através de diagramas de atividade. Esse último diagrama especifica a execução parcial de operações de análise geográfica utilizando elementos de modelagem introduzidos na versão 2.0 da UML. Com essa extensão, e devido à compatibilidade com a UML, o GeoFrame permite a especificação de aspectos estáticos e dinâmicos de um SIG através de ferramentas CASE.

Uma Análise de Desempenho dos Métodos SCAN e BESAG&NEWELL na Detecção de Clusters Espaciais

Marcelo Azevedo Costa, Renato Martins Assunção

Abstract. Este artigo propõe uma análise comparativa dos métodos SCAN e BESAG&NEWELL definidos como testes genéricos de conglomerados espaciais. O objetivo do trabalho é explorar as peculiaridades de cada métodos avaliando o seu desempenho e o seu poder de identificação. O método BESAG&NEWELL necessita do ajuste de parâmetros por parte do usuário, sendo sensível a escolha dos mesmos. O resultado final é apresentado em um formato visual. O método SCAN incorpora os parâmetros cruciais a uma função de verossimilhança permitindo obter uma estatística para o teste bem como um nível de significância via Monte Carlo. O presente trabalho procura escrever de forma alternativa o método de BESAG&NEWELL incorporando seus parâmetros a uma função de custo que deve ser minimizada sob a região de estudo. Dessa forma, é possível avaliar o desempenho do método de BESAG&NEWELL em relação ao método SCAN.

Integration of Heterogeneous Pluviometric Data for Crop Forecasts

João Guilherme de Souza Lima, Cláudia Bauzer Medeiros, Eduardo Delgado Assad

Abstract. Crop forecast is an activity practiced by experts in agriculture, based on large data volumes. These data cover climatological information of the most diverse types, concerning a geographic region and the type of culture. Besides volume, another problem to face concerns data heterogeneity. This paper presents a project for development of a data management system for crop forecasts. The paper is centered in the management of pluviometric data, an important factor in crop management. The system is being implanted by EMBRAPA, the Brazilian Agricultural Research Corporation, and part of it is already available on the Web.