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Special section on "Spatial data warehouses and SOLAP"

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1 Preface

Data Warehouses (DW) and OnLine Analytical Processing (OLAP) tools are used in Business Intelligence (BI) applications in order to support decision-making processes. DWs are a specific type of database used to integrate, accumulate and analyze data from various sources. OLAP tools provide means to query and to analyze the warehoused information and produce online statistical summaries (indicators) at different levels of details. These indicators are computed using aggregate functions (e.g. Sum, Avg, Min, Max, etc.). Users can explore DWs by performing OLAP operations (e.g., Roll-up, Drill-down, etc.). Data mining algorithms can also be used in DWs, aiming towards improving data analysis; these techniques help to discern automatically the correlations and causal links between data.

The increasing availability of geo-referenced data has made necessary the need to enrich OLAP with spatial analysis tools. OLAP systems were successfully adapted to solve problems in different areas of application and new kinds of decision support systems, named Spatial Data Warehouses (SDW) and Spatial OLAP (SOLAP) tools have been made available. SDWs are a collection of geographical information supporting spatial analysis. SOLAP tools allow users to perform spatio-temporal exploration of data: these tools combine OLAP analysis with cartographic visualization capabilities of GIS systems. The relevance of SOLAP technology

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has been widely recognized in several application domains (e.g., marketing, agriculture, environmental risk management, etc.).

There are a number of reasons to believe that the new technology of spatial DW will play a major role in the field of Geo-Business Intelligence. Today, SDW-related topics concern a large international research community that has been the source of commercial or open source software development. There are still many theoretical and practical research issues to be addressed in order to improve the technology of SDW such as query optimization, spatial data visualization, conceptual modeling, complex spatial data processing, etc., to name a few.

Quite a few of scientific laboratories and a large research community are working on SDW-related areas, but no workshop or special journal issue has focused on the topic of SDW. Thus, the large interest on the SDW-related areas and the scientific relevance of this topic has motivated us to propose a specific Geoinformatica special section dealing with these issues. Four papers have been accepted for publication in this special section. Mobility and uncertain data processing are the two main topics found in these papers.

The paper "A General Framework for Trajectory Data Warehousing and Visual OLAP" present a method for modeling a Trajectory Data Warehouse (TDW). The data warehouse model is sufficiently flexible to deal with different types of mobile objects. The authors cope with issues related to the efficient calculation of aggregate measures. The proposed TDW is provided with an interface to visualize objects inside a given area as well as the movements of objects between different areas. Measures can be aggregated at different level of granularity.

Traditional spatial data warehouses do not support spatial vagueness. In the paper 'Modeling Vague Spatial Data Warehouses using the VSCube Conceptual Model", the authors propose a conceptual model named VSCube to store and query shape vagueness in data warehouses. The VSCube conceptual model constitutes an expressive method to represent vague spatial data and spatial aggregation/predicates in SOLAP queries. An application to pest control in agriculture is presented in the paper.

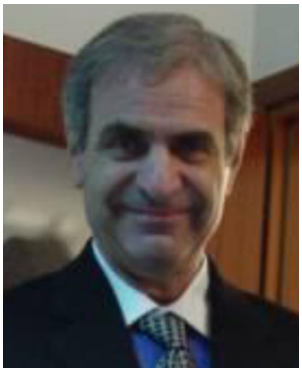
The paper "A probabilistic data model and algebra for location-based data warehouses and their implementation" introduces a probabilistic data model and algebra to represent and query uncertain data in SOLAP. The model allows for using probability distributions in facts/dimensions and an algebra defines how to aggregate uncertain data over uncertain hierarchies. These methods are applied to location-based services. Data warehouses for location-based services often combine complex spatial hierarchies with static and dynamic content, both containing uncertain data. The paper also provides a complexity analysis of the algebra, and reports on an empirical, experimental evaluation of the implementation.

The paper "Context-based mobile GeoBI: Enhancing business analysis with contextual metrics/statistics and context-based reasoning" highlights: the requirement for context-based reasoning in mobile GeoBI; the need for contextual metrics/statistics to help mobile business professionals discover their local context; the need for crossing business performance metrics with contextual metrics to help mobile business professionals in discovering the context hidden behind business performance figures, and proposes convenient solutions to tackle these needs.

Dr. Sandro Bimonte is born in 1978. He is researcher at the French Institute for Agricultural and Environmental Engineering (TSCF / Irstea—Clermont-Ferrand). He obtained his PhD at INSA Lyon, France (2004–2007). He is editorial board member of International Journal of Decision Support System Technology, International Journal of Data Mining, Modelling and Management and member of the Commission on GeoVisualization of the International Cartographic Association. His field of research is in Spatial Data Warehouses and Spatial OLAP, Visual Languages, Geographic Information Systems, Spatio-temporal Databases and GeoVisualization.

Dr. François Pinet (http://www.irstea.fr/pinet) received his M.Sc. in Computer Science in 1997 (ENS Lyon) and his PhD in Computer Science in 2002 (INSA Lyon). He is currently a research director at the French Institute for Agricultural and Environmental Engineering (Irstea—Clermont-Ferrand). His field of research is in data warehouse, environmental information systems and geomatics. He is member of several scientific committees of different international conferences and journals in the fields of geomatics. Dr. Pinet has coauthored over 90 papers (Geoinformatica, IJGIS, Sigmod Record, Environmental Modelling & Software, ER, ACM GIS, ISSDQ, etc.) and has been involved in numerous national and international IT projects. He has been a co-organizer for several conferences and workshops on information systems. In France, he also teaches graduate courses (M.Sc and PhD degrees) on computer science and GIS (Blaise Pascal University). Petraq Papajorgji and François Pinet are the editors-in-chief of the International Journal of Agricultural and Environmental Information Systems.

Dr. André Miralles received his Mechanical Engineer degree in 1976 (INSA Toulouse, France). In 1978, he was employed as researcher at the French Institute for Agricultural and Environmental Engineering where he works since. He leads during 5 years hydraulic investigations on three-dimensional stream generating into the fishway devices equipping the dams to facilitate the upstream migration of the anadromous fishes (salmon, etc.). Then, he is in charge of the laboratory doing on one hand standardized tests of the sprayers applying pesticides on the cereals or on the orchards and, on the other hand, the researches to improve the spraying techniques and the application techniques of the products. It is involved in different European projects and leads some of them. He assumes also the charge of President of the CIETAP, French committee where the manufacturers of sprayers, the industrialists of chemistry, the representatives of the government and the scientists exchange ideas and organize conferences or the exposures. In 2000, he moves to a position of computing researcher and received his PhD in Computing Science in 2006 (University of Montpellier). Currently, he works in the Joint Research Unit named Territories, Environment, Remote Sensing & Spatial Information (Montpellier, France). His main interest is focused on new methodologies for spatial data warehouse design. For that, he carries out researches on the Model Driven Architecture and on business design patterns of the agricultural and environmental domains. He applies his research in several projects on agricultural data warehouses, financed by the French Ministry of Ecology. He is associate editor of the International Journal of Agricultural and Environmental Information Systems and guest editor of the special issue on Environmental and Agricultural data Processing for Water and Territory Management.



Prof. Petraq Papajorgji is dean of engineering at the Canadian Institute of Technology Tirana, Albania. He has been a research scientist at University of Florida, Gainesvillle, Fl, USA (2001–2010). His research interests are GIS, data mining, formal modeling of information systems, UML and the Model Driven Architecture (MDA). Prof. Papajorgji has coauthored and edited a number of books on data mining techniques, software engineering techniques applied to agriculture and environment, etc. Prof. Papajorgji is member of the group of researchers honored with the highest award of Albania "The Prize of the Republic" for the study "The conditions of olive trees and measures for its further improvement". Dr. Papajorgji teaches several international courses on modeling agricultural and environmental systems using UML and MDA. He is member of several international organizations and member of organizing committees of international conferences. Petraq Papajorgji and François Pinet are the editors-in-chief of the International Journal of Agricultural and Environmental Information Systems.