

Coordinated Multiple Views: a Critical View

Gennady Andrienko and Natalia Andrienko

Fraunhofer Institute IAI

Schloss Birlinghoven, 53754 Sankt Augustin, Germany

<http://www.ais.fraunhofer.de/and>

{Gennady|Natalia}.andrienko@ais.fraunhofer.de

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Hundreds of papers have been presented at the five conferences on Coordinated and Multiple Views (CMV) in Exploratory Visualization and related conferences on information visualization and visual analytics [R07]. However, CMV are still rarely implemented in commercial systems and many users are even not aware that multiple views are useful and coordination can help them to solve their problems. Even toolkits especially designed for information visualization often do not offer any coordination mechanisms for multiple views. One of possible reasons for this may be that existing CMV tools and approaches are insufficiently suited to real-life problems.

Most of the CMV tools deal with single-table data sets of rather small sizes. A typical implementation allows one to create several displays (statistical graphics and/or geographical maps) representing individual entities and/or aggregates (e.g. histograms) and link them by brushing and selection. The displays are coordinated through exchanging references to selected entities. To our best knowledge, this approach works efficiently for tables with sizes up to about 10^5 records. Linking displays that reflect larger tables causes significant delays.

There are practical applications that require analysis of much larger and complex data sets. Visual analytics [VA05], a science of analytical reasoning supported by visual interfaces, deals with problems that require making grounded decisions on the basis of voluminous, heterogeneous, and dynamic data sets. In our opinion, work with such data sets is not yet properly supported by existing CMV systems, which are not scalable.

The scalability problem has four major aspects: amount of data to be analyzed, dimensionality, complexity of information, and dynamics.

1. Amount of data. When a dataset is large, visualizations that represent individual entities suffer from overplotting. Even if just one pixel of the screen is

used for representing one entity, as in pixel-oriented techniques [K00], it is impossible to present more than 10^7 records on a screen. Traditional visualizations such as scatter-plots or parallel coordinates plots have much more restricted applicability.

Visualization methods that represent aggregates [UTH07] help to avoid overplotting. Examples of such methods are histograms, binned scatter-plots, and mosaic displays. However, any aggregation involves information loss, and therefore it is necessary to provide powerful tools for checking sensitivity to aggregation parameters.

Coordination between multiple displays for very large data tables requires significant computational power. For both individual and aggregated displays, it seems appropriate to use databases for storing and processing data. An open problem is the design of coordination mechanisms that are able to work with large data sets without loading them completely into RAM. Is it possible to implement dynamic querying or brushing in such a way that only a small part of the data is loaded in the memory and all processing is done by the database? What are practical limitations of such an approach?

One of the methods for improving the computational speed is the use of pre-defined aggregates in data warehouses and OLAP systems. However, this approach does not provide sufficient flexibility needed for data exploration [AA06].

2. Dimensionality of data. In practical applications it is often necessary to deal with multi-dimensional data. One aspect of this problem is the number of data dimensions. This aspect was in focus of the information visualization community for years, and we'll not discuss it here. The second aspect is that data may have such complex dimensions as geographical space and time [AA06] that require special attention. Geographical space is not limited to just two or three coordinates but includes the geographical context, which is difficult to formalize. Time has two models, linear and cyclical, and it is often necessary to consider simultaneously several temporal cycles (monthly, weekly, daily etc.; these cycles may overlap).

A combination of several ordinary dimensions with space and time dramatically increases the complexity and

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Geographic Visualization Martin Dodge, Mary McDerby, Martin Turner, 2011-08-24 *Geographic Visualization Concepts Tools and Applications* is a state of the art review of the latest developments in the subject. It examines how new concepts, methods and tools can be creatively applied to solve problems relevant to a wide range of topics. The text covers the impact of three dimensional displays on user interaction along with the potentialities in animation and clearly explains how to create temporally sensitive visualizations. It also explores the potential for handling mobile data and representing uncertainty as well as the role of participatory visualization systems and exploratory methods. **Hallmark Features** An introduction to the diverse forms of geographic visualization which draws upon a number of theoretical perspectives and disciplines to provide an insightful commentary on new methods, techniques and tools. Richly illustrated in full colour throughout including numerous relevant case studies and accessible discussions of important visualization concepts to enable clearer understanding for non technical audiences. Chapters are written by leading scholars and researchers in a range of cognate fields including cartography, GIScience, architecture, art, urban planning and computer graphics with case studies drawn from Europe, North America and Australia. This book is an invaluable resource for all graduate students, researchers and professionals working in the geographic information sector, computer graphics and cartography. **Eye Tracking and**

Visual Analytics Michael Burch, 2022-09-01 Visualization and visual analytics are powerful concepts for exploring data from various application domains. The endless number of possible parameters and the many ways to combine visual variables as well as algorithms and interaction techniques create lots of possibilities for building such techniques and tools. The major goal of those tools is to include the human users with their tasks at hand, their hypotheses and research questions to provide ways to find solutions to their problems or at least to hint them in a certain direction to come closer to a problem solution. However, due to the sheer number of design variations, it is unclear which technique is suitable for those tasks at hand, requiring some kind of user evaluation to figure out how the human users perform while solving their tasks. The technology of eye tracking has existed for a long time, however, it has only recently been applied to visualization and visual analytics as a means to provide insights to the users' visual attention behavior. This generates another kind of dataset that has a spatio-temporal nature and hence demands for advanced data science and visual analytics concepts to find insights into the recorded eye movement data, either as a post process or even in real time. This book describes aspects from the interdisciplinary field of visual analytics but also discusses more general approaches from the field of visualization as well as algorithms and data handling. A major part of the book covers research on those aspects under the light and perspective of eye tracking, building synergy effects between both fields: eye tracking and visual analytics in both directions, i.e. eye tracking applied to visual analytics and visual analytics applied to eye tracking data. Technical topics discussed in the book include Visualization, Visual Analytics, User Evaluation, Eye Tracking, Eye Tracking Data, Analytics, Eye Tracking and Visual Analytics.

includes more than 500 references from the fields of visualization visual analytics user evaluation eye tracking and data science all fields which have their roots in computer science Eye Tracking and Visual Analytics is written for researchers in both academia and industry particularly newcomers starting their PhD but also for PostDocs and professionals with a longer research history in one or more of the covered research fields Moreover it can be used to get an overview about one or more of the involved fields and to understand the interface and synergy effects between all of those fields The book might even be used for teaching lectures in the fields of information visualization visual analytics and or eye tracking

Microarray Image and Data Analysis Luis Rueda,2018-09-03 Microarray Image and Data Analysis Theory and Practice is a compilation of the latest and greatest microarray image and data analysis methods from the multidisciplinary international research community Delivering a detailed discussion of the biological aspects and applications of microarrays the book Describes the key stages of image processing gridding segmentation compression quantification and normalization Features cutting edge approaches to clustering biclustering and the reconstruction of regulatory networks Covers different types of microarrays such as DNA protein tissue and low and high density oligonucleotide arrays Examines the current state of various microarray technologies including their availability and affordability Explains how data generated by microarray experiments are analyzed to obtain meaningful biological conclusions An essential reference for academia and industry Microarray Image and Data Analysis Theory and Practice provides readers with valuable tools and techniques that extend to a wide range of biological studies and microarray platforms

Visualization and Data Analysis ,2004 **Enterprise Information Systems** Slimane Hammoudi,José Cordeiro,Leszek A. Maciaszek,Joaquim Filipe,2014-07-24 This book contains substantially extended and revised versions of the best papers from the 15th International Conference on Enterprise Information Systems ICEIS 2013 held in Angers France in July 2013 The 29 full and two invited papers included in this volume were carefully reviewed and selected from 321 submissions They reflect state of the art research focusing mainly on real world applications and highlight the benefits of information systems and technology for industry and services thus connecting academia with the world of real enterprises The topics covered are databases and information systems integration artificial intelligence and decision support systems information systems analysis and specification software agents and Internet computing human computer interaction and enterprise architecture

Healthcare of the Future Michael Lehmann,Kerstin Denecke,Murat Sariyar,Serge Bignens,Erwin Zetz,Jürgen Holm,2019-04-15 Imagining the healthcare of the future is an interesting exercise and although nobody can predict precisely what systems might operate in ten year s time the possibilities which already exist can give us a clue as to how healthcare may be managed by 2030 This book presents papers from the conference Healthcare of the Future held in Biel Bienne Switzerland on 5 April 2019 The conference reflects some of the results of a two year multi stakeholder Swiss research program in medical informatics The research program which began in 2016 saw 25 stakeholders cooperating for an integrated cross sectoral treatment pathway with the goal of avoiding communication gaps and

information loss among the different participants within the treatment process The principal goals were to improve and accelerate healthcare processes and empower the patient to play an active and decisive role within their own care process The project highlighted interaction between caregivers patients and healthcare institutions based on modern information technology Topics covered are divided into 4 sections workflows in healthcare how does eHealth change the care process knowledge based IT support and eHealth and the informed patient and the book also includes the keynote conference speech on improving the hospital patient relationship with digital communication The book will be of interest to all those involved in healthcare whose aim is to improve and accelerate healthcare processes and empower patients to play a more active and decisive role in their own care *Computer Vision, Imaging and Computer Graphics Theory and Applications* Ana Paula Cláudio,Kadi Bouatouch,Manuela Chessa,Alexis Paljic,Andreas Kerren,Christophe Hurter,Alain Tremeau,Giovanni Maria Farinella,2020-02-19 This book constitutes thoroughly revised and selected papers from the 14th International Joint Conference on Computer Vision Imaging and Computer Graphics Theory and Applications VISIGRAPP 2019 held in Prague Czech Republic in February 2019 The 25 thoroughly revised and extended papers presented in this volume were carefully reviewed and selected from 395 submissions The papers contribute to the understanding of relevant trends of current research on computer graphics human computer interaction information visualization computer vision **Guide to Vulnerability Analysis for Computer Networks and Systems** Simon Parkinson,Andrew Crampton,Richard Hill,2018-09-04 This professional guide and reference examines the challenges of assessing security vulnerabilities in computing infrastructure Various aspects of vulnerability assessment are covered in detail including recent advancements in reducing the requirement for expert knowledge through novel applications of artificial intelligence The work also offers a series of case studies on how to develop and perform vulnerability assessment techniques using start of the art intelligent mechanisms Topics and features provides tutorial activities and thought provoking questions in each chapter together with numerous case studies introduces the fundamentals of vulnerability assessment and reviews the state of the art of research in this area discusses vulnerability assessment frameworks including frameworks for industrial control and cloud systems examines a range of applications that make use of artificial intelligence to enhance the vulnerability assessment processes presents visualisation techniques that can be used to assist the vulnerability assessment process In addition to serving the needs of security practitioners and researchers this accessible volume is also ideal for students and instructors seeking a primer on artificial intelligence for vulnerability assessment or a supplementary text for courses on computer security networking and artificial intelligence ACM Transactions on Computer-human Interaction ,2006 Presents original research that spans the field of human computer interaction The primary emphasis has been on results of broad application but the journal also publishes work focused on special domains on special requirements on ethical issues the full range of design development and use of interactive systems **Index of Conference Proceedings** British Library. Document Supply

Centre,2003 *International Conference on Coordinated & Multiple Views in Exploratory Visualization* Jonathan C. Roberts,2003 **Geoinformatics** ,2006 *American Book Publishing Record* ,2003 **2003 International Conference on Coordinated and Multiple Views in Exploratory Visualization (CMV 2003)** Jonathan C. Roberts,2003-01 The goal of this conference is to bring together top practitioners who are researching in the area of coordinated and multiple views in exploratory visualization CMV and to analyze and discuss state of the art concepts and future opportunities in this area The papers presented in CMV 2003 represent novel ideas and current thoughts of coordinated and multiple view exploratory visualization They demonstrate its importance diversity and breadth of application and permit the reader to study this exciting research area Supporting Early-stage Ubicomp Experimentation Scott Alan Carter,2007 **Book Review Index Cumulation** Dana Ferguson,2005-09 Book Review Index provides quick access to reviews of books periodicals books on tape and electronic media representing a wide range of popular academic and professional interests The up to date coverage wide scope and inclusion of citations for both newly published and older materials make Book Review Index an exceptionally useful reference tool More than 600 publications are indexed including journals and national general interest publications and newspapers Book Review Index is available in a three issue subscription covering the current year or as an annual cumulation covering the past year Fifth International Conference on Coordinated & Multiple Views in Exploratory Visualization Gennady Andrienko,Jonathan C. Roberts,Christopher Eric Weaver,2007 *Fifth International Conference on Coordinated & Multiple Views in Exploratory Visualization* Gennady Andrienko,Jonathan C. Roberts,Christopher Eric Weaver,2007 **Fourth International Conference on Coordinated & Multiple Views in Exploratory Visualization** Gennady Andrienko,Chris Weaver,Jonathan C. Roberts,2006-01-01 The goal of the CMV 2006 conference is to bring together top coordinated and multiple view visualization practitioners in order to share state of the art concepts and discuss future research opportunities in exploratory visualization Information visualization has produced a diverse assortment of highly interactive visual environments Coordinated and multiple view visualization tools enable users to generate hypotheses and test scenarios by exploring and analyzing multi dimensional information spaces visually Multiple views help users conceptualize information from different perspectives simultaneously Coordination allows users to investigate information through rapid tightly coupled interaction within and between multiple views Second International Conference on Coordinated & Multiple Views in Exploratory Visualization Jonathan C. Roberts,2004

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