Activity Report 2013

Project-Team AVIZ

Analysis and Visualization

RESEARCH CENTER
Saclay - Île-de-France

THEME
Interaction and visualization

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Project-Team AVIZ

Keywords: Visualization, Data Analysis, Interaction, Collaborative Work, Perception, Evolutionary Algorithms

Creation of the Team: 2007 February 08*, updated into Project-Team:* 2008 January 01.

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2. Overall Objectives

2.1. Objectives

All human activities are being transformed by our rapidly increasing abilities to collect, manage and understand vast amounts of data. A 2003 study estimated that the amount of data produced in the world was increasing by 50% each year [1]. According to SearchEngineWatch [2], the amount of information made available through Internet search engines has grown exponentially for the last decade, and major Web search engines currently index more than 2 billion documents. However, since our brains and sensory capacities have not evolved in the meantime, gaining competitive advantage from all this data depends increasingly on the effectiveness with which we support human abilities to perceive, understand, and act on the data.

With this increase of data, the traditional scientific method of applying model-based analysis to understand the data is no longer sufficient. We have access to data that we have never encountered before and have little or no idea of applicable models. Therefore, we need to explore them first to gain insights and eventually find models. This process has already been promoted by John Tukey in his 1977 book on *Exploratory Data Analysis* [3] which has become a branch of the domain of statistics. Whereas EDA is ultimately interested in finding models, data exploration can also reveal relevant facts that are, in themselves interesting and important.

AVIZ (Analysis and VIsualiZation) is a multidisciplinary project that seeks to improve visual exploration and analysis of large, complex datasets by tightly integrating analysis methods with interactive visualization. It focuses on five research themes:

- *Methods to visualize and smoothly navigate through large datasets;*
- *Efficient analysis methods to reduce huge datasets to visualizable size;*
- *Visualization interaction using novel capabilities and modalities;*
- *Evaluation methods to assess the effectiveness of visualization and analysis methods and their usability;*
- *Engineering tools for building visual analytics systems that can access, search, visualize and analyze large datasets with smooth, interactive response.*

2.2. Research Themes

AVIZ's research on Visual Analytics is organized around five main Research Themes:

Methods to visualize and smoothly navigate through large data sets: Large data sets challenge current visualization and analysis methods. Understanding the structure of a graph with one million vertices is not just a matter of displaying the vertices on a screen and connecting them with lines. Current screens only have around two million pixels. Understanding a large graph requires both data reduction to visualize the whole and navigation techniques coupled with suitable representations to see the details. These representations, aggregation functions, navigation and interaction techniques must be chosen as a coordinated whole to be effective and fit the user's mental map.

AVIZ designs new visualization representations and interactions to efficiently navigate and manipulate large data sets.

Efficient analysis methods to reduce huge data sets to visualizable size: Designing analysis components with interaction in mind has strong implications for both the algorithms and the processes they use. Some data reduction algorithms are suited to the principle of sampling, then extrapolating, assessing the quality and incrementally enhancing the computation: for example, all the linear reductions such as PCA, Factorial Analysis, and SVM, as well as general MDS and Self Organizing Maps. AVIZ investigates the possible analysis processes according to the analyzed data types.

[1] Peter Lyman and Hal R. Varian. How much information. Retrieved from http://www.sims.berkeley.edu/how-much-info-2003, 2003.
[2] http://www.searchenginewatch.com
[3] John W. Tukey. *Exploratory Data Analysis*. Addison-Wesley, 1977.

Visualization interaction using novel capabilities and modalities: The importance of interaction to Information Visualization and, in particular, to the interplay between interactivity and cognition is widely recognized. However, information visualization interactions have yet to take full advantage of these new possibilities in interaction technologies, as they largely still employ the traditional desktop, mouse, and keyboard setup of WIMP (Windows, Icons, Menus, and a Pointer) interfaces. At AVIZ we investigate in particular interaction through tangible and touch-based interfaces to data.

Evaluation methods to assess their effectiveness and usability: For several reasons appropriate evaluation of visual analytics solutions is not trivial. First, visual analytics tools are often designed to be applicable to a variety of disciplines, for various different data sources, and data characteristics, and because of this variety it is hard to make general statements. Second, in visual analytics the specificity of humans, their work environment, and the data analysis tasks, form a multi-faceted evaluation context which is difficult to control and generalize. This means that recommendations for visual analytics solutions are never absolute, but depend on their context.

In our work we systematically connect evaluation approaches to visual analytics research—we strive to develop and use both novel as well as establish mixed-methods evaluation approaches to derive recommendations on the use of visual analytics tools and techniques. AVIZ regularly published user studies of visual analytics and interaction techniques and takes part in dedicated workshops on evaluation.

Engineering tools: for building visual analytics systems that can access, search, visualize and analyze large data sets with smooth, interactive response.

Currently, databases, data analysis and visualization all use the concept of data tables made of tuples and linked by relations. However, databases are storage-oriented and do not describe the data types precisely. Analytical systems describe the data types precisely, but their data storage and computation model are not suited to interactive visualization. Visualization systems use in-memory data tables tailored for fast display and filtering, but their interactions with external analysis programs and databases are often slow.

AVIZ seeks to merge three fields: databases, data analysis and visualization. Part of this merging involves using common abstractions and interoperable components. This is a long-term challenge, but it is a necessity because generic, loosely-coupled combinations will not achieve interactive performance.

AVIZ's approach is holistic: these five themes are facets of building an analysis process optimized for discovery. All the systems and techniques AVIZ designs support the process of understanding data and forming insights while minimizing disruptions during navigation and interaction.

2.3. Highlights of the Year

AVIZ received one best paper award and one best paper honorable mention award at the ACM CHI Conference on Human Factors in Computing Systems.

AVIZ received one best paper honorable mention award and one best poster award [31] at the IEEE Visualization conference.

AVIZ received one best paper honorable mention award at the IFIP TC13 Conference on Human-Computer Interaction (INTERACT).

Petra Isenberg co-organized the Dagstuhl seminar on "Interaction with Information for Visual Reasoning", August 25–30.

Aviz hired a Fab manager for Digiscope's Fab Lab (http://fablabdigiscope.wordpress.com/).

Aviz organized a Workshop on The New Statistics: Estimation for Better Research (http://www.aviz.fr/Research/NewStatisticsWorkshop).

Aviz organized a visit with demos for the CHI 2013 conference attendees (http://www.aviz.fr/Research/Visit2013).

Aviz co-organized the International Workshop on Interactive Ultra-High-Resolution Displays (http://www.powerwall.mdx.ac.uk/) as part of CHI 2013.

Yvonne Jansen and Pierre Dragicevic were interviewed by Enrico Bertini and Moritz Stefaner (http://datastori.es/episode17-data-sculptures/) on physical visualizations.

Petra Isenberg was interviewed by Enrico Bertini and Moritz Stefaner (http://datastori.es/ds26-visualization-beyond-desktop/) about her work on Visualization Beyond the Desktop.

BEST PAPERS AWARDS :

[29] **Weighted Graph Comparison Techniques for Brain Connectivity Analysis in Proceedings of the 2013 Annual Conference on Human Factors in Computing Systems (CHI 2013)**. B. ALPER, B. BACH, N. HENRY RICHE, T. ISENBERG, J.-D. FEKETE.

[37] **Evaluation of Alternative Glyph Designs for Time Series Data in a Small Multiple Setting in Proceedings of the Conference on Human Factors in Computing Systems (CHI)**. J. FUCHS, F. FISCHER, F. MANSMANN, E. BERTINI, P. ISENBERG.

[27] **SoccerStories: A Kick-off for Visual Soccer Analysis in IEEE Transactions on Visualization and Computer Graphics**. C. PERIN, R. VUILLEMOT, J.-D. FEKETE.

[39] **PolemicTweet: Video Annotation and Analysis through Tagged Tweets in Proceedings of the IFIP TC13 Conference on Human-Computer Interaction (INTERACT)**. S. HURON, P. ISENBERG, J.-D. FEKETE.

3. Research Program

3.1. Research Program

The scientific foundations of Visual Analytics lie primarily in the domains of Information Visualization and Data Mining. Indirectly, it inherits from other established domains such as graphic design, Exploratory Data Analysis (EDA), statistics, Artificial Intelligence (AI), Human-Computer Interaction (HCI), and Psychology.

The use of graphic representation to understand abstract data is a goal Visual Analytics shares with Tukey's Exploratory Data Analysis (EDA) [78], graphic designers such as Bertin [58] and Tufte [77], and HCI researchers in the field of Information Visualization [56].

EDA is complementary to classical statistical analysis. Classical statistics starts from a *problem*, gathers *data*, designs a *model* and performs an *analysis* to reach a *conclusion* about whether the data follows the model. While EDA also starts with a problem and data, it is most useful *before* we have a model; rather, we perform visual analysis to discover what kind of model might apply to it. However, statistical validation is not always required with EDA; since often the results of visual analysis are sufficiently clear-cut that statistics are unnecessary.

Visual Analytics relies on a process similar to EDA, but expands its scope to include more sophisticated graphics and areas where considerable automated analysis is required before the visual analysis takes place. This richer data analysis has its roots in the domain of Data Mining, while the advanced graphics and interactive exploration techniques come from the scientific fields of Data Visualization and HCI, as well as the expertise of professions such as cartography and graphic designers who have long worked to create effective methods for graphically conveying information.

The books of the cartographer Bertin and the graphic designer Tufte are full of rules drawn from their experience about how the meaning of data can be best conveyed visually. Their purpose is to find effective visual representation that describe a data set but also (mainly for Bertin) to discover structure in the data by using the right mappings from abstract dimensions in the data to visual ones.

For the last 25 years, the field of Human-Computer Interaction (HCI) has also shown that interacting with visual representations of data in a tight perception-action loop improves the time and level of understanding of data sets. Information Visualization is the branch of HCI that has studied visual representations suitable to understanding and interaction methods suitable to navigating and drilling down on data. The scientific foundations of Information Visualization come from theories about perception, action and interaction.

Several theories of perception are related to information visualization such as the "Gestalt" principles, Gibson's theory of visual perception [66] and Triesman's "preattentive processing" theory [76]. We use them extensively but they only have a limited accuracy for predicting the effectiveness of novel visual representations in interactive settings.

Information Visualization emerged from HCI when researchers realized that interaction greatly enhanced the perception of visual representations.

To be effective, interaction should take place in an interactive loop faster than 100ms. For small data sets, it is not difficult to guarantee that analysis, visualization and interaction steps occur in this time, permitting smooth data analysis and navigation. For larger data sets, more computation should be performed to reduce the data size to a size that may be visualized effectively.

In 2002, we showed that the practical limit of InfoVis was on the order of 1 million items displayed on a screen [63]. Although screen technologies have improved rapidly since then, eventually we will be limited by the physiology of our vision system: about 20 millions receptor cells (rods and cones) on the retina. Another problem will be the limits of human visual attention, as suggested by our 2006 study on change blindness in large and multiple displays [59]. Therefore, visualization alone cannot let us understand very large data sets. Other techniques such as aggregation or sampling must be used to reduce the visual complexity of the data to the scale of human perception.

Abstracting data to reduce its size to what humans can understand is the goal of Data Mining research. It uses data analysis and machine learning techniques. The scientific foundations of these techniques revolve around the idea of finding a good model for the data. Unfortunately, the more sophisticated techniques for finding models are complex, and the algorithms can take a long time to run, making them unsuitable for an interactive environment. Furthermore, some models are too complex for humans to understand; so the results of data mining can be difficult or impossible to understand directly.

Unlike pure Data Mining systems, a Visual Analytics system provides analysis algorithms and processes compatible with human perception and understandable to human cognition. The analysis should provide understandable results quickly, even if they are not ideal. Instead of running to a predefined threshold, algorithms and programs should be designed to allow trading speed for quality and show the tradeoffs interactively. This is not a temporary requirement: it will be with us even when computers are much faster, because good quality algorithms are at least quadratic in time (e.g. hierarchical clustering methods). Visual Analytics systems need different algorithms for different phases of the work that can trade speed for quality in an understandable way.

Designing novel interaction and visualization techniques to explore huge data sets is an important goal and requires solving hard problems, but how can we assess whether or not our techniques and systems provide real improvements? Without this answer, we cannot know if we are heading in the right direction. This is why we have been actively involved in the design of evaluation methods for information visualization [75], [74], [67], [69], [64]. For more complex systems, other methods are required. For these we want to focus on longitudinal evaluation methods while still trying to improve controlled experiments.

4. Application Domains

4.1. Panorama

AVIZ develops active collaboration with users from various application domains, making sure it can support their specific needs. By studying similar problems in different domains, we can begin to generalize our results and have confidence that our solutions will work for a variety of applications.

Our current application domains include:

- *Genealogy*, in cooperation with North Carolina State University;
- *Biological research*, in cooperation with Institut Pasteur;
- *Digital Libraries*, in cooperation with the French National Archives and the Wikipedia community;
- *Open Data*, in cooperation with Google Open Data and Data Publica;
- *Agrifood Process Modeling*, in cooperation with the DREAM project (see section 8.2.1.1);

5. Software and Platforms

5.1. Graph Cuisine

Participants: Évelyne Lutton [correspondant], Benjamin Bach, André Spritzer, Jean-Daniel Fekete.

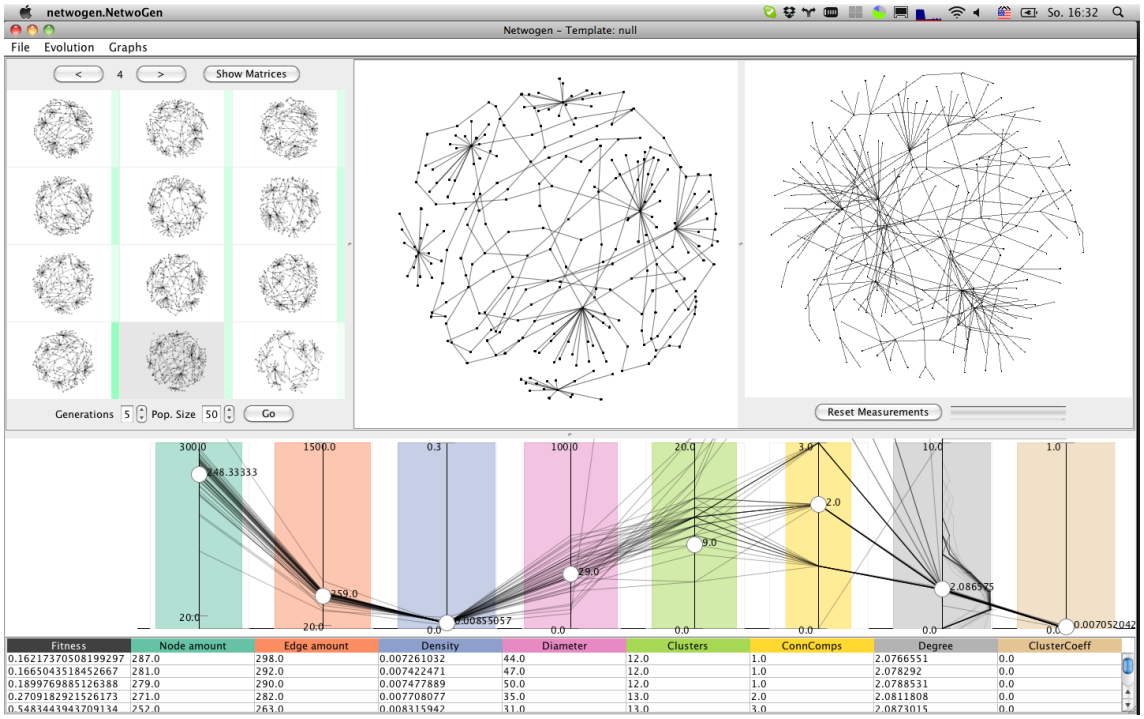


Figure 1. GraphCuisine interface showing one real graph (right), the measures extracted from it (bottom circles), several graphs with similar measures (left) and one of them selected (middle).

GraphCuisine lets users steer an Evolutionary Algorithm (EA) to create random graphs that match user-specified measures. Generating random graphs with particular characteristics is crucial for evaluating graph algorithms, layouts and visualization techniques. Current random graph generators provide limited control of the final characteristics of the graphs they generate. The situation is even harder when one wants to generate random graphs similar to a given one, all-in-all leading to a long iterative process that involves several steps of random graph generation, parameter changes, and visual inspection. Our system follows an approach based on interactive evolutionary computation. Fitting generator parameters to create graphs with pre-defined measures is an optimization problem, while assessing the quality of the resulting graphs often involves human subjective judgment. GraphCuisine has been proved to be able to generate graphs that mimic a given real-world network. http://www.aviz.fr/Research/Graphcuisine

5.2. Histomages

Participants: Fanny Chevalier, Pierre Dragicevic [correspondant], Christophe Hurter.

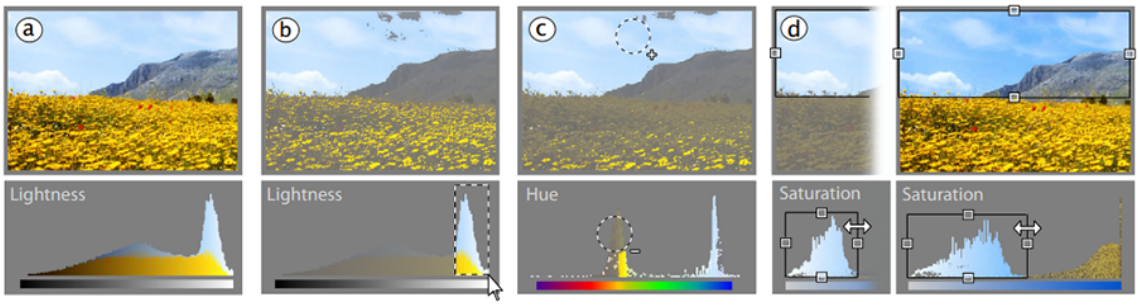


Figure 2. Example of sky enhancement with Histomages: (a) the image is duplicated and its pixels rearranged into a lightness histogram ; (b) bright pixels are selected with the rubber-band selection tool; (c) all pixels are rearranged into a hue histogram and yellow pixels are filtered out with the subtract selection brush (bottom). Missing pixels are added with the add selection brush on the image (top); (d) the sky is enhanced by resizing the selection on the saturation histogram.

Histomages is an image editor based on a new interaction model that considers histogram views as spatial rearrangements of image pixels. Users can select pixels on image histograms as they would select image regions and directly manipulate them to adjust their colors. Histomages are affected by other image tools such as paintbrushes. We explored some possibilities offered by this interaction model, and discussed the four key principles behind it as well as their implications for the design of feature-rich software in general. http://www.aviz.fr/histomages/.

5.3. Gliimpse

Participants: Pierre Dragicevic [correspondant], Stéphane Huot, Fanny Chevalier.

Figure 3. Gliimpse: A detail of the animation between an article and its LaTeX source code.

Gliimpse is a quick preview technique that smoothly transitions between document markup code (HTML, LaTeX,...) and its visual rendering. This technique allows users to regularly check the code they are editing in-place, without leaving the text editor. This method can complement classical preview windows by offering rapid overviews of code-to-document mappings and leaving more screen real-estate. A proof-of-concept editor can be downloaded for free at http://www.aviz.fr/gliimpse/.

5.4. The Obvious Toolkit

Participants: Pierre-Luc Hémery, Jean-Daniel Fekete [correspondant].

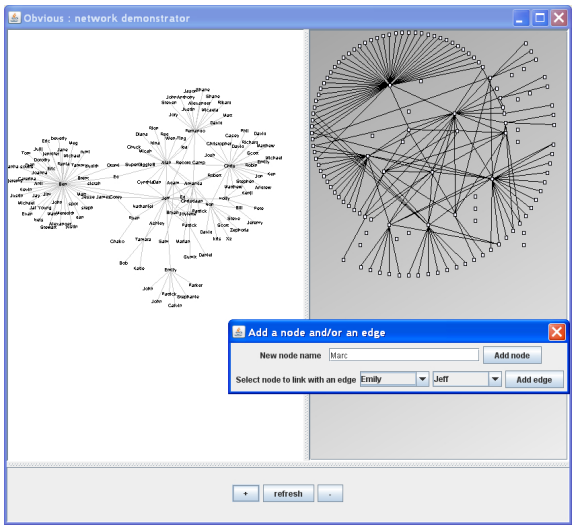


Figure 4. The Obvious toolkit showing the same graph with a Prefuse and an IVTK rendering.

Information Visualization, Java, Toolkit

The Obvious Toolkit is a new Interactive Graphics Toolkit written in Java to facilitate the interoperability between Information Visualization toolkits and components (Fig. 4).

The Obvious Toolkit is an abstraction layer above visualization toolkits. Currently, it connects the most popular toolkits in Java: Prefuse, the InfoVis Toolkit, Improvise, JUNG, as well as other libraries such as the Java Database Communication Toolkit (JDBC) and two Machine-Learning toolkits: Weka and RapidMiner.

It is meant to provide an abstraction layer for information visualization application builders so that they can postpone their choice of a concrete toolkit to use. When faced with the final choice, application builders can use one of the toolkits or connect all of them dynamically to Obvious. A paper on Obvious was presented at the IEEE Visual Analytics Science and Technology conference (VAST 2011) [62]. Obvious is available at http://code.google.com/p/obvious.

5.5. GeneaQuilts

Participants: Jean-Daniel Fekete [correspondant], Pierre Dragicevic, Anastasia Bezerianos, Julie Bae, Ben Watson.

GeneaQuilts [2] is a new genealogy exploration software that allows genealogists and historians to visualize and navigate in large genealogies of up to several thousand individuals (Fig. 5). The visualization takes the form of a diagonally-filled matrix, where rows are individuals and columns are nuclear families. The GeneaQuilts system includes an overview, a timeline, search and filtering components, and a new interaction technique called Bring & Slide that allows fluid navigation in very large genealogies. The tool has been featured in several InfoVis and genealogy Websites and the website has been visited over 9000 times. It has been integrated in commercial and open-source implementations (4 to date). See also the web page http://www.aviz.fr/geneaquilts/.

5.6. Diffamation

Participants: Fanny Chevalier, Pierre Dragicevic [correspondant], Anastasia Bezerianos, Jean-Daniel Fekete.

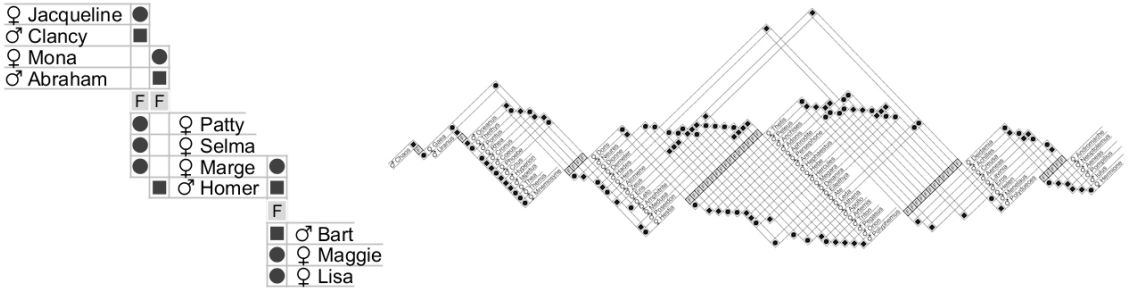


Figure 5. The genealogy of the Simpsons family (left) and of the Greek Pantheon (right), produced by the GeneaQuilts software.

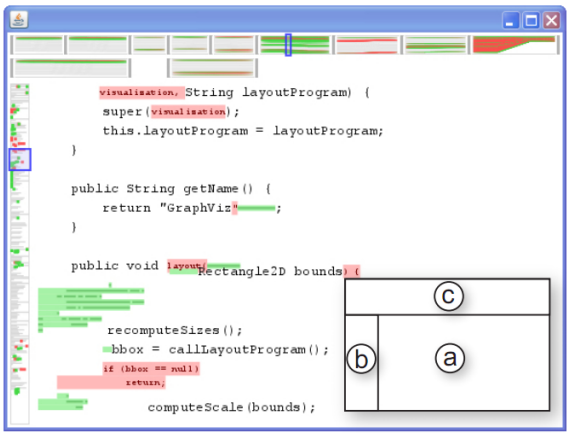


Figure 6. Screenshot the Diffamation system during a transition: (a) the document view, (b) the overview scrollbar and (c) the timeline.

Animation, Edit histories, Wikipedia, Revision Control

The Diffamation system [3] allows rapid exploration of revision histories such as Wikipedia or subversion repositories by combining text animated transitions with simple navigation and visualization tools. Diffamation can be used for example to get a quick overview of the entire history of a Wikipedia article or to see what has happened to one's contributions. Diffamation complements classical diff visualizations: once moments of interest have been identified, classical diff visualizations can come in useful to compare two given revisions in detail.

The Diffamation revision exploration system has been presented at the plenary session of the Ubuntu Developer Summit. It is available at http://www.aviz.fr/diffamation/.

5.7. The InfoVis Toolkit

Participant: Jean-Daniel Fekete [correspondant].

Information Visualization, Java, Toolkit

The InfoVis Toolkit [61] is an Interactive Graphics Toolkit written in Java to facilitate the development of Information Visualization applications and components.

The InfoVis Toolkit implements several visualization techniques, as well as interaction techniques related. It has been used for teaching the Information Visualization course (Masters level, Univ. of Paris-Sud) and is the basis for all AVIZ contracts. It is our main development platform for information visualization; most of our Information Visualization prototypes rely on it. It is available at http://ivtk.sourceforge.net.

In the forthcoming years, it will be superseded by extensions of the Obvious Toolkit (see section 5.4).

5.8. GraphDice

Participants: Jean-Daniel Fekete [correspondant], Pierre Dragicevic, Niklas Elmqvist, Anastasia Bezerianos.

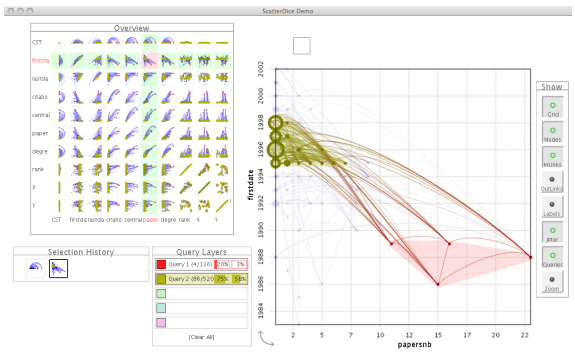


Figure 7. Screenshot the GraphDice system.

GraphDice [1] is a visualization system for exploring multivariate networks (Fig. 7). GraphDice builds upon our previous system ScatterDice (best paper award at the IEEE InfoVis 2008 conference) [60]: it shows a scatter plot of 2 dimensions among the multiple ones available and provides a very simple paradigm of 3D rotation to change the visualized dimensions. The navigation is controlled by a scatter plot matrix that is used as a high-level overview of the dataset as well as a control panel to switch the dimensions.

While ScatterDice works on any tabular dataset (e. g., CSV file), the GraphDice system show networks using a node-link diagram representation as a scatter plot with links drawn between connected nodes. For more information, see the web page at http://graphdice.gforge.inria.fr.

6. New Results

6.1. Hybrid-Image Visualizations

Participants: Petra Isenberg [correspondant], Pierre Dragicevic, Wesley Willett, Anastasia Bezerianos, Jean-Daniel Fekete.

We investigated hybrid-image visualization for data analysis in large-scale viewing environments. Hybrid-image visualizations blend two different visual representations into a single static view, such that each representation can be perceived at a different viewing distance. Our work was motivated by data analysis scenarios that incorporate one or more displays with sufficiently large size and resolution to be comfortably viewed by different people from various distances. Hybrid-image visualizations can be used, in particular, to enhance overview tasks from a distance and detail-in-context tasks when standing close to the display. By taking advantage of humans' perceptual capabilities, hybrid-image visualizations do not require tracking of viewers in front of a display. Moreover, because hybrid-images use a perception-based blending approach, visualizations intended for different distances can each utilize the entire display. In our paper we contributed a design space, discussed the perceptual rationale for our work, provided examples and a set of techniques for hybrid-image visualizations, and described tools for designing hybrid-image visualizations. We will also release software that will help in the construction of hybrid-image visualizations.

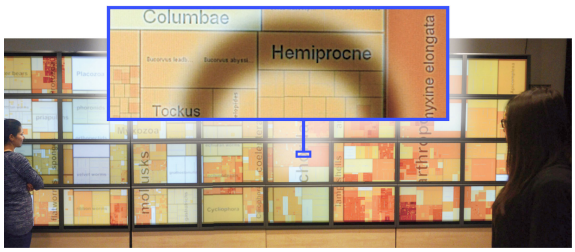


Figure 8. Overview of a treemap showing a subset of the tree of life with a hybrid image visualization. Larger structures are clearly visible from far but do not interfere with reading detail when up close (see in-set).

6.2. Visualization for Interactive Displays

Participants: Tobias Isenberg [correspondant], Petra Isenberg.

Because the access to and analysis of information is becoming increasingly important anywhere and at any time, researchers have begun to investigate the role of interactive displays as data analysis platforms. Visualization applications play a crucial role in data analysis and development of dedicated systems and tools for small to large interactive displays to support such application contexts is underway. We contribute a systematic and quantitative assessment of the literature from ten different venues, an open repository of papers, and a code-set that can be used to categorize the research space [22]. We found just over 100 publications at the intersection of interactive surfaces and visualization in our careful examination of 10 different publication venues related to the topic. We found that research has so far largely focused on the development of interaction techniques, for multi-touch tabletop devices, and 2D spatial and abstract visualizations. Together,

all publications addressed a wide spectrum of research questions and, given the many possible combinations of interactive surfaces and visualization, the research space is still wide open. While several projects developed applications for data analysis with visualization on interactive surfaces, their availability in practice is still rare. Commercial companies and open-source communities have begun to provide ported versions of their products/tools for tablets and mobile phones (e.g., Tableau Mobile 4 and KiwiViewer 5), showing the need for visualization application on surfaces. Nevertheless, the support for data analysis tasks on these and other interactive surfaces can certainly still be improved—a lot more research with respect to the development and evaluation of the fundamentals of data exploration and analysis is needed for interactive displays. Some example directions of future work in this context were outlined in research agendas published in the journal IEEE Computer [24] as well as in IEEE Computer Graphics and Applications [21].

In a specific project investigated an interaction design concept for exploratory 3D data visualization that marries direct-touch interaction with stereoscopic vision. The design is inspired by the mental mapping that occurs for mouse interaction where the physical control space is mapped through a mental rotation to the display space. Similarly, we explore touch interaction on a monoscopic tablet, mapped through a mental rotation to the stereoscopic display space. Because this mental mapping can become increasingly skewed we show when and how to re-synchronize the views (see Figure 9).

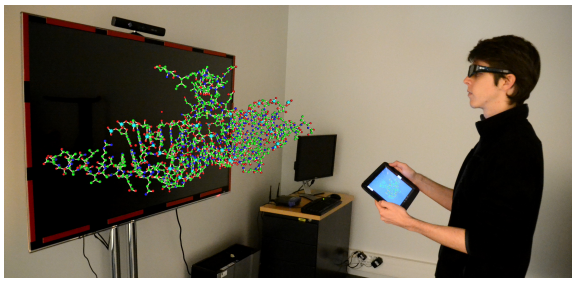


Figure 9. Tablet-based navigation of a stereoscopically displayed 3D dataset.

6.3. Visualization for Soccer Analysis

Participants: Charles Perin, Romain Vuillemot, Jean-Daniel Fekete [correspondant].

A new generation of soccer data is now available, as some companies (http://www.optasports.com/) collect and provide extensive data covering almost all professional soccer championships, with a wealth of multivariate information related to time, player positions, and types of action, to name a few. Currently, most analysis on such data relate to statistics on individual players or teams. For instance, statistics on “team ball possession” and “number of goal attempts for team A or B” are popular on websites, TV and newspapers and often accompanied by bar charts or plots on a soccer field. However, soccer analysts we collaborated with consider that quantitative analysis alone does not convey the right picture of the game, as context, player positions and phases of player actions are the most relevant aspects.

SoccerStories [27] (Figure 10) is a visualization interface to support analysts in exploring soccer data and communicating interesting insights that we designed to support the current practice of soccer analysts and to enrich it, both in the analysis and communication stages. Our system provides an overview+detail interface of game phases, and their aggregation into a series of connected visualizations, each visualization being tailored for actions such as a series of passes or a goal attempt. To evaluate our tool, we ran two qualitative user studies on recent games using SoccerStories with data from one of the world’s leading live sports data providers. The first study resulted in a series of four articles on soccer tactics, by a tactics analyst, who said he would not have been able to write these otherwise. The second study consisted in an exploratory follow-up to investigate

design alternatives for embedding soccer phases into word-sized graphics. For both experiments, we received a very enthusiastic feedback and participants consider further use of SoccerStories to enhance their current workflow. This article received a Best Paper Honorable Mention in VIS 2013.

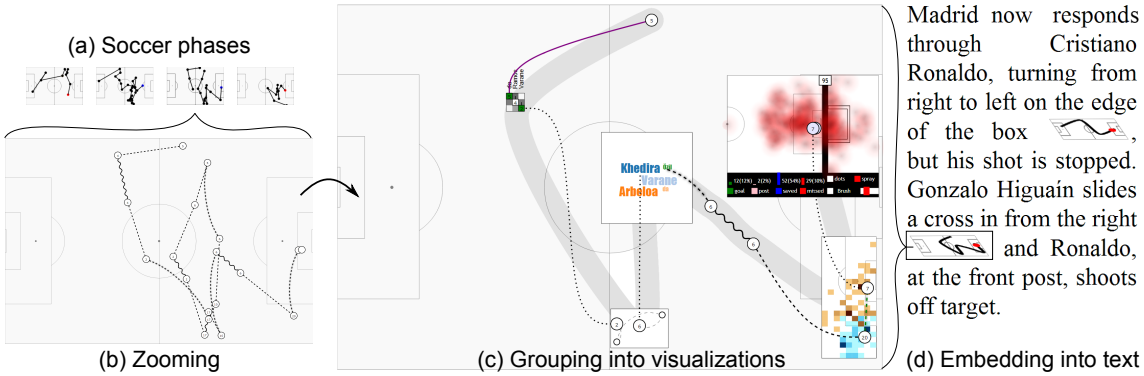


Figure 10. Using SoccerStories: (a) navigating among soccer phases of a game; (b) mapping a phase on a focus soccer field; (c) exploring the phase by grouping actions into tailored visualizations; and (d) communicating using Sportlines embed into text.

We also explored how spectators of a live soccer game can collect detailed data while watching the game [47]. Our motivation arouse from the lack of free detailed sport data, contrasting with the large amount of simple statistics collected for every popular games and available on the web. Assuming many spectators carry a smart phone during a game, we implemented a series of input interfaces for collecting data in real time. In a user study, we asked participants to use those interfaces to perform tracking tasks such as locating players in the field, qualifying ball passes, and naming the player with ball while watching a video clip of a real soccer game. Our two main results are 1) the crowd can collect detailed and fairly complex data in real-time with reasonable quality while each participant is assigned a simple task, and 2) a set of design implications for crowd-powered interfaces to collect live sport data. We also discuss the use of such data into SoccerStories, and the design implications coming with the visual communication of missing and uncertain detailed data.

Finally, we presented R2S2 [46] in the SportVis workshop (VIS 2013), a hybrid visualization technique as an intermediate step between Rank Chart and Slope Graph to better understand and analyze team evolutions during soccer championships. Currently used rank tables for soccer are relative (ranked-based) and do not convey the absolute difference between teams. R2S2 provides a way to visualize these differences using the Slope Graph technique (value-based). By interactively setting the parameters of R2S2, we make the distance between teams appear, minimizing the overlaps caused by the Slope Graph technique.

More information about these projects is available at http://www.aviz.fr/soccer.

6.4. Interaction Model for Visualizations Beyond the Desktop

Participants: Yvonne Jansen [correspondant], Pierre Dragicevic.

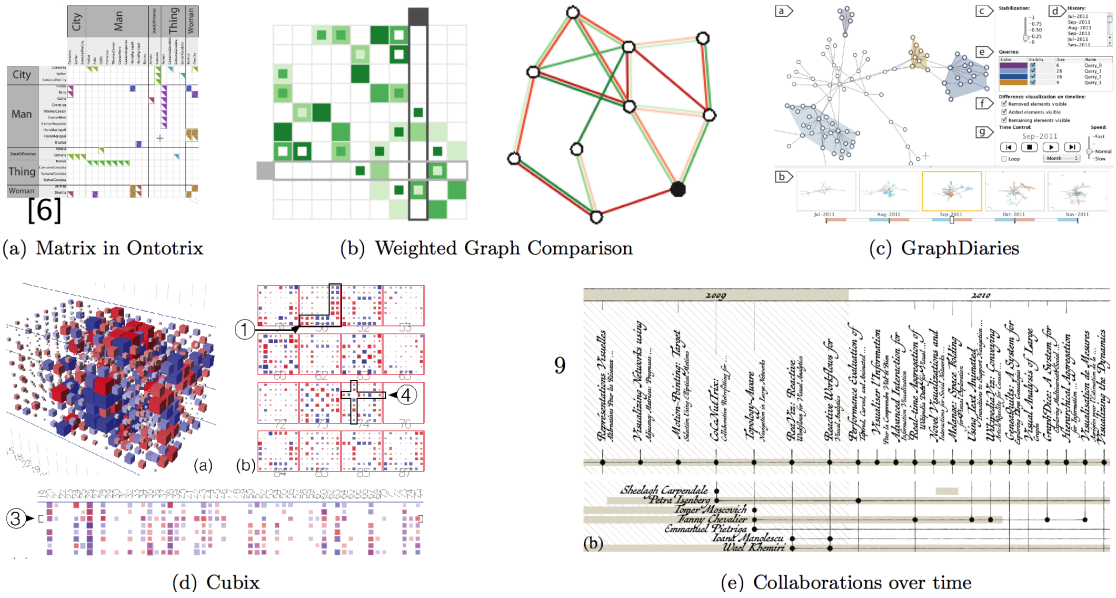
We introduced an interaction model for beyond-desktop visualizations that combines the visualization reference model with the instrumental interaction paradigm. Beyond-desktop visualizations involve a wide range of emerging technologies such as wall-sized displays, 3D and shape-changing displays, touch and tangible input, and physical information visualizations. While these technologies allow for new forms of interaction, they are often studied in isolation. New conceptual models are needed to build a coherent picture of what has been done and what is possible. We described a modified pipeline model where raw data is processed into a visualization and then rendered into the physical world. Users can explore or change data by directly manipulating

visualizations or through the use of instruments. Interactions can also take place in the physical world outside the visualization system, such as when using locomotion to inspect a large scale visualization. Through case studies we illustrated how this model can be used to describe both conventional and unconventional interactive visualization systems, and compare different design alternatives.

6.5. Network Visualization

Participants: Benjamin Bach [correspondant], Basak Alper, Andre Spritzer, Emmanuel Pietriga, Nathalie Henry-Riche, Tobias Isenberg, Jean-Daniel Fekete.

Although much research has been done on finding efficient ways to visualize different kinds of networks (social networks, computer networks, brain networks, etc), many problems are still open. Rather than trying to find optimal layouts, we focus on novel representation and navigation techniques to explore such networks. Our research focusses on three major problems: (i) heterogeneous networks, (ii) comparison of graphs, (iii) dynamic networks, and (iv) generating networks for controlled user evaluations.



(a) Matrix in Ontotrix (b) Weighted Graph Comparison (c) GraphDiaries

(d) Cubix (e) Collaborations over time

Figure 11. Examples for network visualizations

Heterogeneous Networks: Heterogeneous networks are networks with multiple node and edge types, such as ontologies in the Semantic Web. Ontologies also provide means to describe type hierarchies on node and edge types as well as other set theoretic relations between these types. Such heterogeneous networks can be explored on two levels, the model (types and possible relations between types), and instances (actual nodes and their connections). In order to allow for interactive exploration of such data, we extended the NodeTrix technique [68] to visualize ontologies. Our prototype is called *OntoTrix* [11] (Figure 11(a), which allows for reorganizing matrices by splitting and merging them, traversing node and edge hierarchies and visualize different types of connection between nodes.

Graph Comparision: Analyzing brain networks, which can represent anatomical fibers as well as functional correlation between brain regions, is complex in many ways. By analysing brain scientists tasks we concluded that many user tasks can actually performed by comparing two networks. In [29](Figure 11(b)) we design and discuss several ways to compare two weighted graphs and finally compare the two most promising designs in

a controlled user study. We found that our encoding for adjacency matrices outperforms the one for node-link diagrams, even for sparse networks. The implications for brain analysis tools are manyfold and our results generalize to other domains that are concerned with comparing (dense and weighted) networks.

Dynamic Networks: A very common technique to explore dynamic networks are animations and small multiples, each of which being supporting different tasks, while falling short on others. With *GraphDiaries* [10](Figure 11(c)), we design an interface based on the combination of both techniques while offering flexible temporal navigation techniques as well as enhanced perceptive feedback to understand changes between time steps. *GraphDiaries* supports further navigation techniques such as temporal aggregation, direct difference views and layout adjustment. While *GraphDiaries* is highly extensible, its techniques are designed to be integrated in existing visualization tools.

While animations and the techniques in *GraphDiaries* are useful for many networks, dense dynamic networks are still an important open problem. We hence generalized the idea of matrices to visualize temporal networks, by describing a visualization and interaction model based on the space time cube metaphor (Figure 11(d)). In analogy with the physical world, this *Matrix Cube* can be manipulated and decomposed in order to explore the network, while the cube model serves as a consistent visual and mental model of the data and visualization. We implemented an interface called *Cubix* that allows us to perform simple view switches and decomposition operations in the cube. Cubix and the Matrix Cube was evaluated with two experts, an astronomer and brain scientist, exploring their own real world data. With the Matrix Cube and its decomposition operations, we are able to visualize and navigate within very dense dynamic networks such as brain networks, trading flows and technical networks. The design space of possible visualizations that the Matrix Cube and its operations offer is both, huge but structured at the same time. It allows us to explore many future designs.

As part of the effort of visualizing publications and work of Jean-Daniel Fekete, we designed a visualization to show his collaborations over the past years, relating his papers and his collaborators [30](Figure 11(e)). A poster was presented at part of a poster submission to IEEE Vis, 2013 in Atlanta. To the best of our knowledge, no such technique to visualize any sort of dynamic ego networks have been published so far.

Network Generation: As any controlled user study, evaluating network visualizations requires control over the data. However, it is hard to found real world data with the desired properties and in reasonable amount for a controlled user study. Synthetic data can help but the output of random graph generators is hard to control and hardly resembles actual real-world data. With GraphCuisine [57] we present and interactive approach to generate graphs. In an iterative process, the computer generates suggestions while the user selects her preferred graphs and graph measures.

6.6. GridVis: Visualisation of Island-Based Parallel Genetic Algorithms

Participants: Waldo Cancino [correspondant], Hugo Gilbert, Benjamin Bach, Evelyne Lutton, Pierre Collet.

Island Model parallel genetic algorithms rely on various migration models and their associated parameter setting. A fine understanding of how the islands interact and exchange informations is an important issue for the design of efficient algorithms. GridVis, is an interactive tool that has been developed for visualising the exchange of individuals and the propagation of fitness values between islands. GridVis has been developed in Java, to monitor how the islands communicate: when and how much individuals of which fitness they effectively exchange during a run. We model the computer cluster that is running the island model, as dynamic network and use an adjacency matrix to show the relations (exchange between individuals) between nodes (computers) in the cluster (Figure 12(a)). Several experiments have been performed on a grid and on a cluster to evaluate GridVis' ability to visualise the activity of each machine and the communication flow between machines. Experiments have been made on the optimisation of a Weierstrass function using the EASEA language, with two schemes: a scheme based on uniform islands and another based on specialised islands (Exploitation, Exploration and Storage Islands).

7. Bilateral Contracts and Grants with Industry

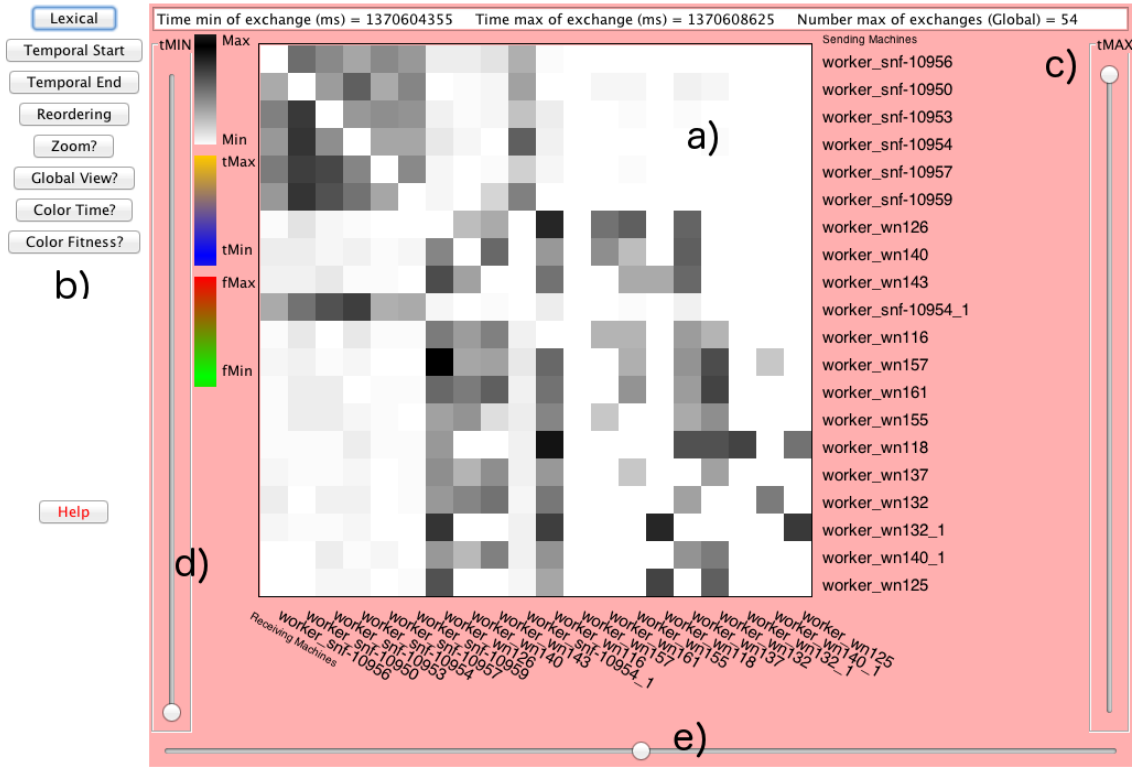


Figure 12. Visualisation of a grid with 20 machines: Each computer in the cluster appears twice in the matrix, once as row and once as column. Cells inside the matrix indicate information about the interaction of computers during evolution, for example, the amount of individuals exchanged (read from row to column). Similar to heat maps activity (exchange of individuals) is mapped to darkness (dark cells indicate high exchange, bright cells show low exchange).

7.1. Google Research Award

Participants: Jean-Daniel Fekete [correspondant], Petra Isenberg, Jeremy Boy, Heidi Lam.

Offering data access to the public is a strong trend of the recent years. Several free data providers or repositories are now online (e.g. http://data.gov.uk, http://stats.oecd.org, http://publicdata.eu, http://opendata.paris.fr, http://www.google.com/publicdata, http://www.data-publica.com), offering a rich set of data to allow citizens to build their own understanding of complex political and economic information by exploring information in its original form. However, these initiatives have had little impact directly on the public since working with this open data is often cumbersome, requires additional data wrangling, and the spreadsheets themselves take a long time to understand before useful further work can be done with them. This proposal focuses on public data visualization to offer more engaging environments for exploration of public data and to enable stronger democratic discourse about the data contents.

The goal of this proposed research project is to bridge the gap between generic visualization sites for public data and engaging content-specific visualization of this data which can be used and individually adapted to tell a story about public data. Through the design and deployment of rich and engaging interactive visualizations from public data sources we want to truly reach the goal of the public data movement: empowering the citizens and social actors by allowing them to better understand the world they are living in, to make informed decisions on complex issues such as the impact of a medical treatment on a dangerous illness or the tradeoffs offered of power plant technologies based on facts instead of assumptions.

For more information, see http://peopleviz.gforge.inria.fr/trunk.

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR FITOC: From Individual To Collaborative Visual Analytics

Participants: Petra Isenberg [correspondant], Jean-Daniel Fekete, Pierre Dragicevic, Wesley Willett.

The project addresses fundamental problems of technological infrastructure and the design of data representation and interaction to build a bridge between individual and team work for visual data analysis. In collaboration with the University of Magdeburg we have begun to tackle this challenge through the design of tangible widgets that help to bridge the gap between individual and collaborative information seeking.

8.1.2. ANR EASEA-Cloud

Participants: Evelyne Lutton [correspondant], Waldo Cancino, Hugo Gilbert, Pierre Collet.

The aim of the EASEA-CLOUD project is to exploit the massively parallel resources that are offered by clusters or a grid of modern GPU-equipped machines in order to find solutions to inverse problems whose evaluation function can be intrinsically sequential. Massive parallelization of generic sequential problems can be achieved by evolutionary computation, that can efficiently exploit the parallel evaluation of thousands of potential solutions (a population) for optimization or machine-learning purposes. The project consists in turning the existing EASEA (EAsy Specification of Evolutionary Algorithms, http://easea.unistra.fr/) research platform into an industrial-grade platform that could be exploited by running in “cloud” mode, on a large grid of computers (ISC-PIF/CREA is the current manager of the French National Grid). The necessary steps are to develop:

- a professional-grade API, development environment and human-computer interface for the existing academic EASEA platform,
- cloud-management tools (in order to launch an experiment on a grid of computers, monitor the experiment and bill the laboratories or companies that will be using EASEA-CLOUD for intensive computation,
- novel visualisation tools, in order to monitor an evolutionary run, potentially launched on several hundred heterogeneous GPU machines.

The consortium is made of thee partners: LSIIT/UDS (which is developing the EASEA platform), ISCPIR/ CREA (for its experience in grid and cloud computing), AVIZ/Inria (for its experience in visualization tools for evolutionary computation) and two subcontractors: LogXLabs (a software development company in order to create industrial-grade code and interfaces) an BIOEMERGENCE-IMAGIF, the "valorisation" department of CNRS Gif s/Yvette. Valorisation will take place in strong collaboration with UNISTRA VALO, the valorisation structure of Université de Strasbourg. The project started on October 1st, 2012, for 2 years. AVIZ is in charge of developing new visualisation tools adapted to the monitoring of the optimization process.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. DREAM

Program: FP7

Project acronym: **DREAM**

Project title: Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition

Duration: 2009–2013

Coordinator: INRA - CEPIA department, Monique Axelos

Other partners: Technical Research Centre of Finland, Actilait France, ADRIA Développement France, CNRS, INRA Transfert, Société de Recherche et Développement Alimentaire Bongrain, Campden BRI Magyarország Nonprofit Kft. Hungary, Central Food Research Institute Hungary, Teagasc - Agriculture and Food Development Authority Ireland, Consiglio Nazionale delle Ricerche - Istituto di Scienze delle Produzioni Alimentari Italy, Top Institute Food and Nutrition The Netherlands, Wageningen University (WUR) The Netherlands, University of Ljubljana, Biotechnical Faculty Slovenia, Institute for Food and Agricultural Research and Technology Spain, Campden BRI UK, Institute of Food Research UK, United Biscuits (UK) Limited.

Abstract:

The overall goal of DREAM (Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition) is to develop realistic, physical and mathematical models to be used as standards that can be exploited across all major food categories to facilitate development of common approaches to risk assessment and nutritional quality for food research and industry.

The partnership involves 18 partners from 9 european countries, among which two multinationals. The project is lead by INRA, CEPIA department, and Inria participation is managed by delegation by the ISC-PIF (CNRS-CREA, UMR 7656).

See more at http://dream.aaeuropae.org/.

The role of AVIZ has been to develop evolutionary techniques adapted to the modeling of agrifood process. In 2012, the work was focussed on the development:

- of robust evolutionary methods to learn the structure of Bayesian Networks when experimental data are rare (in collaboration with Alberto Tonda, Cédric Baudrit and Nathalie Perrot of INRA/GMPA and Pierre-Henri Wuillemin od LIP6/DESIR), applied to cheese making and biscuit baking process,
- of a model of milk gel based on partial differential equations, where numerical parameters were learn by artificial evolution (in collaboration with Julie Foucquier, Sébastien Gaucel Alberto Tonda, and Nathalie Perrot of INRA/GMPA).

8.2.1.2. CENDARI

Program: Infrastructures

Project acronym: **CENDARI**

Project title: Collaborative EuropeaN Digital/Archival Infrastructure

Duration: 01/2012 - 12/2015

Coordinator: Trinity College, Dublin (IE),

Other partners: Freie Universitaet Berlin (DE), Matematicki Institut Sanu u Beogradu (Serbia), University of Birmingham (UK), King's College London (UK), Georg-August-Universitaet Goettingen Stiftung Oeffentlichen Rechts (DE), Narodni Knihovna Ceske Republiky (Czech Republic), Societa Internazionale per lo Studio del Medioevo Latino-S.I.S.M.E.L. Associazione (IT), Fondazione Ezio Franceschini Onlus (IT), Ministerium fur Wissenschaft, Forschung und Kunst Baden-Wurttemberg (DE), Consortium of European Research Libraries (UK), Koninklijke Bibliotheek (NL), UNIVERSITA DEGLI STUDI DI CASSINO (IT).

Abstract:

The Collaborative EuropeaN Digital Archive Infrastructure (CENDARI) will provide and facilitate access to existing archives and resources in Europe for the study of medieval and modern European history through the development of an 'enquiry environment'. This environment will increase access to records of historic importance across the European Research Area, creating a powerful new platform for accessing and investigating historical data in a transnational fashion overcoming the national and institutional data silos that now exist. It will leverage the power of the European infrastructure for Digital Humanities (DARIAH) bringing these technical experts together with leading historians and existing research infrastructures (archives, libraries and individual digital projects) within a programme of technical research informed by cutting edge reflection on the impact of the digital age on scholarly practice.

The enquiry environment that is at the heart of this proposal will create new ways to discover meaning, a methodology not just of scale but of kind. It will create tools and workspaces that allow researchers to engage with large data sets via federated multilingual searches across heterogeneous resources while defining workflows enabling the creation of personalized research environments, shared research and teaching spaces, and annotation trails, amongst other features. This will be facilitated by multilingual authority lists of named entities (people, places, events) that will harness user involvement to add intelligence to the system. Moreover, it will develop new visual paradigms for the exploration of patterns generated by the system, from knowledge transfer and dissemination, to language usage and shifts, to the advancement and diffusion of ideas.

See more at http://cendari.eu/ and http://www.aviz.fr/Research/CENDARI.

8.2.2. Collaborations with Major European Organizations

Fraunhofer Institute, IGD (DE)

We are collaborating on visual analytics, setting up European projects and coordinating European initiatives on the subject.

University of Dresden, (DE)

We have been collaborating with Raimund Dachselt on stackable tangible devices for faceted browsing [71], [70].

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

AVIZ researchers collaborate with a number of international partners, including:

- Google, Mountain View, USA
- Microsoft Research, Redmond, USA

- New York University, USA
- University of Toronto, Canada
- University of Calgary, Canada
- University of British Columbia, Canada
- University of Kent, UK
- University of Konstanz, Germany
- University of Magdeburg, Germany

8.3.1.2. Informal International Partners

- Arizona State University, USA
- University of Groningen, the Netherlands
- University of Granada, Spain

8.3.2. Inria International Labs

- *Massive Data team*, Inria Chile.

8.3.3. Collaboration with Google

AVIZ collaborates with Google on several projects, related to the Google Research Grant (see Section 7.1) and to evaluation methodology in information visualization [72]. Heidi Lam from Google spent 3 months at AVIZ to collaborate more closely.

8.3.4. Collaboration with Microsoft Research

AVIZ collaborates with several researchers from Microsoft Research Redmond, in particular on the topic of new interactions for information visualization [73] and brain connectivity visualization.

8.3.5. Collaboration with New-York University

Jean-Daniel Fekete collaborates with Claudio Silva and Juliana Freire from NYU-Poly on the VisTrails workflow system for visual analytics (http://www.vistrails.org). Rémi Rampin, intern from the Univ. Paris-Sud Master in HCI, has spent one month at Orsay and 5 months at NYU-Poly to allow VisTrails to run Java-based applications and Toolkits. Rémi successfully connected the traditional Python-C implementation of VisTrails to the Java virtual machine using the JPype package. Jean-Daniel Fekete is not porting the Obvious Toolkit [62] in this environment to integrate all its components [65].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Stefan Manegold, in May, from CWI Amsterdam on Big-Data Visual Analytics

8.4.1.1. Internships

- Candemir Doger, from June 2013 to September 2013
  Subject: Interactive Visualization on Tablet-sized Devices
  Institution: Sabanci University, Istanbul, Turkey
- Qi Lan, from April 2013 to September 2013
  Subject: Multi-touch selection for data graphics
  Institution: Université Paris Sud, France
- Sai Ganesh Swaminathan, from June 2013 to October 2013
  Subject: Software Tools for Physical Visualizations
  Institution: none – student from M1 HCID / M2R Interaction

8.4.2. Visits to International Teams

- Tobias Isenberg: University of Granada, Spain, April 2013

9. Dissemination

9.1. Scientific Animation

AVIZ members are active worldwide in the domains of Visualization, Visual Analytics, HCI, and computer graphics.

9.1.1. Keynotes and Invited Talks

- Jean-Daniel Fekete: Panel "Dataviz, pour quel buzz ?" at Ouverture des données massives scientifiques. Quels risques, quels bénéfices ?, ISCC, CNRS, Paris, Dec. 6, 2013
- Jean-Daniel Fekete: Advanced Interaction for Information Visualization, Bergen, Norway, Nov. 21, 2013
- Jean-Daniel Fekete: ANF - Fréjus 2013 La carte, le territoire et l'explorateur : où est la visualisation ?, Fréjus, 23 Sep. 2013 Ecole d'été de Lille en Méthodes Quantitatives des Sciences Sociales,
- Jean-Daniel Fekete: "Visualisation pour l'exploration de données relationnelles", Lille, July 4, 2013,
- Jean-Daniel Fekete: Invited talk for the 25th anniversary of Fraunhofer IGD: Visual Analytics of Large Social Networks, Darmstadt, Germany, Nov. 14, 2013
- V. Puig and Samuel Huron: "La visualisation comme vecteur de contribution", CEA Saclay, November 2013.

9.1.2. Scientific Associations

- Jean-Daniel Fekete is a member of the Steering Committee of EuroVis (Eurographics WG on Data Visualization).
- Jean-Daniel Fekete is a member of the Steering Committee of the IEEE Information Visualization Conference.
- Jean-Daniel Fekete is the president of the French-Speaking HCI Association.
- Tobias Isenberg is a member of the Steering Committee of the Expressive conference.

9.1.3. Conference Organization

- Jean-Daniel Fekete is a member of the ACM SIGCHI Conference Management Committee, in charge of Data Analysis.
- Jean-Daniel Fekete co-organized the International Workshop on Interactive, Ultra-High-Resolution Displays.
- Petra Isenberg was workshop co-chair for IEEE VIS.
- Tobias Isenberg was tutorials and workshops co-chair for ACM Interactive Tabletops and Surfaces (ITS).

9.1.4. Conference Program Committees

- Pierre Dragicevic was a member of the program committee for CHI 2013,
- Pierre Dragicevic was a member of the program committee for VIS 2013,
- Pierre Dragicevic was a member of the doctoral consortium for IHM 2013,
- Jean-Daniel Fekete was a member of the program committee for Interact 2013,
- Jean-Daniel Fekete was a member of the program committee for IEEE InfoVis 2013,
- Jean-Daniel Fekete was a member of the program committee for IEEE VAST 2013,

- Petra Isenberg was a member of the program committee for the BLEND 2013 workshop,
- Petra Isenberg was a member of the program committee for the CMI 2013 workshop,
- Petra Isenberg was a member of the program committee for the EuroRVVV 2013 workshop,
- Petra Isenberg was a member of the program committee for the ITS 2013 workshop on collaboration meets interactive surfaces,
- Petra Isenberg was a member of the program committee for EuroVA 2013,
- Petra Isenberg was a member of the program committee for EuroVis 2013,
- Petra Isenberg was a member of the program committee for CHI 2013,
- Petra Isenberg was a member of the program committee for IEEE InfoVis 2013,
- Petra Isenberg was a member of the program committee for ACM ITS 2013,
- Tobias Isenberg was a member of the program committee for ISIS3D 2013,
- Tobias Isenberg was a member of the program committee for ACM/Eurographics Expressive 2013,
- Tobias Isenberg was a member of the program committee for IEEE InfoVis 2013,
- Tobias Isenberg was a member of the program committee for the EuroRVVV 2013 workshop,
- Tobias Isenberg was a member of the program committee for ACM SUI 2013,
- Tobias Isenberg was a member of the program committee for EuroVis full papers 2013,
- Tobias Isenberg was a member of the program committee for EuroVis short papers 2013,
- Wesley Willett was a member of the program committee of CHI 2013 Works-in-Progress.

9.1.5. Journal Editorial Board

- Jean-Daniel Fekete is associate editor of IEEE Transactions on Visualization and Computer Graphics.
- Tobias Isenberg is associate editor of Elsevier Computers & Graphics.
- Tobias Isenberg was a guest editor of a special issue of Sage Publishing's Information Visualization on visualization evaluation.

9.1.6. Conference Reviewing

3DUI IEEE Symposium on 3D User Interfaces: Tobias Isenberg

BioVis IEEE Symposium on Biological Data Visualization: Tobias Isenberg

CAe International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging: Tobias Isenberg

CGI Computer Graphics International: Tobias Isenberg

CHI ACM Conference on Human Factors in Computing System: Benjamin Bach, Pierre Dragicevic, Jean-Daniel Fekete, Petra Isenberg, Tobias Isenberg, Welsey Willet

CHI-WIP ACM Conference on Human Factors in Computing Systems—Work in Progress: Petra Isenberg

CSCW ACM Conference on Computer Supported Cooperative Work: Petra Isenberg, Welsey Willet

EG Annual Conference of the Eurographics Association: Tobias Isenberg

EuroVA EuroVis Workshop on Visual Analytics: Jean-Daniel Fekete, Petra Isenberg

EuroVis Eurographics/IEEE Conference on Visualization: Jean-Daniel Fekete, Petra Isenberg, Tobias Isenberg, Welsey Willet

GD Graph Drawing: Pierre Dragicevic

IHM Conférence Francophone sur l'Interaction Homme-Machine: Pierre Dragicevic, Tobias Isenberg

InfoVis IEEE Information Visualization Conference: Benjamin Bach, Pierre Dragicevic, Petra Isenberg, Tobias Isenberg, Welsey Willet

Interact IFIP Conference on Human-Computer Interaction: Petra Isenberg

ITS ACM Conference on Interactive Tabletops and Surfaces: Petra Isenberg, Tobias Isenberg

NPAR ACM Symposium on Non-Photorealistic Animation and Rendering: Tobias Isenberg

PacificVis IEEE Pacific Visualization Symposium: Tobias Isenberg

Pervasive IEEE Conference on Pervasive Computing: Welsey Willet

SciVis IEEE Scientific Visualization Conference: Tobias Isenberg

SIGGRAPH ACM Conference on Computer Graphics and Interactive Techniques: Tobias Isenberg

SIGGRAPH Asia ACM Conference on Computer Graphics and Interactive Techniques in Asia: Tobias Isenberg

SUI ACM Symposium on Spatial User Interaction: Tobias Isenberg

UbiComp ACM International Joint Conference on Pervasive and Ubiquitous Computing: Welsey Willet

UIST ACM Symposium on User Interface Software and Technology: Petra Isenberg, Welsey Willet

VR IEEE Virtual Reality: Tobias Isenberg

9.1.7. Journal Reviewing

C&G Elsevier Computers and Graphics: Petra Isenberg, Tobias Isenberg

IJHCS : Pierre Dragicevic, Petra Isenberg

InfoVis Journal Palgrave's InfoVis Journal: Petra Isenberg

IWC Journal Interacting with Computers: Petra Isenberg

JOCCH ACM Journal on Computing and Cultural Heritage: Tobias Isenberg

PUC Journal of Personal and Ubiquitous Computing: Petra Isenberg

ToCHI ACM Transactions on Computer-Human Interaction: Pierre Dragicevic, Petra Isenberg, Tobias Isenberg

TVCG IEEE Transactions on Visualization and Computer Graphics: Benjamin Bach, Pierre Dragicevic, Tobias Isenberg

9.2. Teaching - Supervision - Juries

9.2.1. Teaching

- Module "Interactive Information Visualization" of Univ. Paris-Sud (M2, 24h, taught by Pierre Dragicevic, Jean-Daniel Fekete, Petra Isenberg, Wesley Willett, Charles Perin), Master course
- "Innovative Interactive Systems" taught by Tobias Isenberg at the University of Groningen, the Netherlands
- "Non-Photorealistic Rendering" taught by Tobias Isenberg at the University of Granada, Spain
- "Interaction with 3D visualizations" taught by Tobias Isenberg at the summer school of the EU Data Intensive Visualization and Analysis project at Göteborg (Gothenburg), Sweden

9.2.2. Supervision

- PhD in progress: Yvonne Jansen, Physical and Tangible Information Visualization, Pierre Dragicevic, Jean-Daniel Fekete (will defend on 10 March 2014)
- PhD in progress: Benjamin Bach, Visualization of Dynamic Networks, Emmauel Pietriga, Jean-Daniel Fekete (will defend May 2014)
- PhD in progress: Charles Perin, Visualization and interaction with Multidimensional and Temporal Data, Jean-Daniel Fekete & Frédéric Vernier
- PhD in progress: Jeremy Boy, Visualization for the Poeple, Jean-Daniel Fekete & Fraçoise Detienne

- PhD in progress: Nicolas Heulot, Visualization and Interaction of High-Dimensional Data, Jean-Daniel Fekete & Michael Aupetit
- PhD in progress: Pascal Goffin, From Individual to Collaborative Work, Petra Isenberg, Jean-Daniel Fekete

9.2.3. Juries

- Pierre Dragicevic was external examiner for Raphae¨l Hoarau's PhD defense: "Interaction et visualisation avec des liens de de´pendances," Universite´ de Toulouse, Aug. 2013
- Jean-Daniel Fekete was external examiner for Cyprien Pindat, "A Content-Aware Design Approach to Multiscale Navigation," Univ. Paris-Sud, Dec. 20, 2013
- Jean-Daniel Fekete was external examiner for Çağatay Turkay, "Integrating Computational Tools in Interactive and Visual Methods for Enhancing High-dimensional Data and Cluster Analysis", Univ. of Bergen, Nov. 22, 2013
- Tobias Isenberg was external examiner for Tiffany Inglis, "Pixelating Vector Art," University of Waterloo, Canada, December 2013
- Tobias Isenberg was external examiner for Hua Li, "Perception-Motivated High Quality Stylization," Carleton University, Canada, January 2013

9.3. Popularization

Samuel Huron: 9.3. News Paper and press cover : 04/2013, "Zeitgeist Borders shows a world of Google searches", NewScientist, Hal Hodson 11/2013, "Les flux de données visualisés en temps réel", La Recherche, Samuel Huron, Romain Vuillemot, Jean Daniel Fekete

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