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## Visualizing Information in Complex Environments

### Abstracts and contributions

#### A) Visualization and Decision Making in Spatial Environments

Thursday, November 17, Facoltà di Architettura, Castello del Valentino, 14.00-18.30

**Visualization to monitor and supervise spatially distributed systems, such as metropolitan and regional areas.** Attention is paid to how visualization can integrate and make explicit the co-occurrence of different spatially relevant phenomena, such as those concerned with urban security, environmental risks, energy and transport management, thus supporting decision making in complex environments.

CHRISTIANE WEBER, Laboratoire Image des Villes, Strasbourg, *From Observation to Representation toward Decision Making process*

Nowadays the environmental issues are compelling gradually the urban form design, the landscape dynamics, the constitution and the sharing of urban knowledge between various actors. The need to assess environmental quality induce handling series of information sets, to address priorities issues, to identify required heterogeneous data able to fit multiple objectives, finally to reinforce the development of interactive applications to ease the population participation. Several directions of research have emerged these last 10 years in Geography information pointing out the capacities of scientific groups to stimulate and promote new media, new interactive supports, new collaborative actions, to propose new capacities to ease information and dialog sharing, to help decision making process and participation "of and between" actors. The Earth Observation (EO) domain has considerably changed our regard on the world, from successive acquisition by drawing or photographic campaigns to repetitive captures, the increase of information has provided at various scales spatial references, state of the environment or modeling inputs. On urban areas an essential paradigmatic change has appeared close to the 2000 when the spatial resolution element (pixel) passed from bigger than the urban element (a roof, a tree) to smaller than the same element. This has conducted to integrate more heterogeneous information in the methodological approach depending not only on spectral features, but also form, spatial relationship and semantic rules: from the pixel to the object. By the way, despite this enhancement, in many cases, EO is not really used in urban management or urban design, even if environmental information is required and needed to assess quality of resources, Heat Urban Island or urban biodiversity loss. Several challenges thus rise now, regarding the environmental issues, the social demand and the decision-making processes. How to integrate and take benefit of large heterogeneous set of data? How to ease interaction between actors in order to converge towards acceptable scenario of development? How to promote participatory behavior to help collection of data?

Each of these questions is linked: to data extraction or collection, data management, data representation regarding alternative scenarios, which might feed decision-making process.

MICHAEL BATTY (CASA), *Visualising Cities Through Models, Maps & Machines*

you can get this talk at

<http://www.complexcity.info/files/2011/06/models-maps-machines-usa-2011.pdf>

but all the media for my talks is on my web site which you can access at <http://www.complexcity.info/>

MARCO QUAGGIOTTO and WOUTER VAN DEN BROECK (ISI), *Visualisation and interfaces for complex systems research*

In complex systems research contexts, data visualization and representation serve multiple purposes. On the one hand it is an essential component of data exploration and manipulation instruments that provide researchers and experts with workable perspectives into otherwise overwhelming amounts of data. On the other hand, well-designed visualisations of particular phenomena observed in the data can act as efficient communication devices. Either application involves a transformation of the raw data in higher level contents, hiding the lower level complexity and exposing the needed information at the right time. The exact nature of this transformation is determined by the design and implementation of the visualisation instrument. This development involves a balancing of the objectives, opportunities and constraints entailed by the source data, the scientific context, the involved technology, and the representational language. The creation of effective data visualisations therefore necessitates a close collaboration between experts in the concerned scientific domain, communication design and software development. We will discuss these and other issues with the help of various case visualisations developed for the GLEaMviz and SocioPatterns projects at the ISI Foundation through a close collaboration between communication designers, software developers and scientists.

## B) Visualization and Scientific Data Exploration

Friday, November 18, Facoltà di Architettura, Castello del Valentino, 9.00-13.30

**Visualization as a means to look into large data-base** and yield an interpretation about data that can expose complex patterns or correlations. This is the realm of visual analytics a new scientific field which is being established at the crossroads between design and computing.

PHILIPP SLUSALLEK, DFK

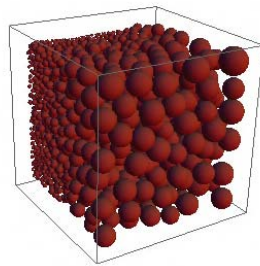
We live in a strange world: We have fast Internet and all of our computing devices now have powerful 3D graphics hardware built into them -- however, there is hardly any interactive 3D content on the Internet and this ubiquitous hardware is almost only used for game content that is broadcast from a few companies. This is in stark contrast to the participatory platform of the Internet as a whole and the strong role of User Generated Content there. Interactive Visualization is the only means to understand the complexity of data about ourselves and our environment. It is vital, therefore, to make it as easy as possible for anyone to create new visualizations of data, instantly share them with the world, and for everyone to see and interact with the data and combine it in new ways. This is currently not possible. With XML3D we have developed a new technology that integrates highly interactive 3D graphics directly into HTML-5 -- enabling the 3D-Internet. Because all graphical elements are first class entities of the HTML-5 DOM and can be created and managed in exactly the same way as today's 2D Web elements, any Web developer can quickly start to extend Web sites with interactive 3D content, to combine 2D and 3D Web content in interesting ways to visualize and explain complex data, and to create mash-ups that allow various data sources to be combined and visualized for everyone to explore via the existing Web infrastructure. Why Does Visual Analytics Work and What is the Underlying Theory?

MIN CHEN, Oxford University

In this speech, the speaker will first give a brief overview of the field of visual analytics, and outline the four dissertations of visual analytics. This is followed by a case study, which illustrates how visual analytics works in practice. The speaker then briefly examines some theoretic frameworks proposed for visual analytics (not many in the literature).

ANNA CARBONE, Politecnico di Torino, *Visualizing fully 3D fractal patterns*

Visualization has become an essential tool to analyze data generated in diverse fields. Experiment and numerical simulations performed on systems belonging to social sciences, climate modeling, biological tissue are some examples of large amounts of data that exhibit complexity features (self similarity over a wide range of spatial and temporal scales). To the scope of quantify and understand features like formation of patterns, clustered structures and provide a realistic representation of such structure, efficient and accurate analytical tools are required. Compact fractal disordered fully 3D media are generated and graphically rendered. The obtained structures are "invasive stochastic fractals", with the Hurst exponent varying as a continuous parameter, as opposed to "lacunar deterministic fractals", such as the Menger sponge.



The Hurst exponent of the generated structure is estimated by using the DMA algorithm. The fractality of such a structure is referred to a property defined over a three dimensional topology rather than to the topology itself.

Consequently, in this framework, the Hurst exponent is an estimator of compactness rather than of roughness.

Applications are envisaged for quantifying complex systems characterized by self-similar heterogeneity across space. In particular, we put forward a three-dimensional fractal for snow. The local microstructure of snow is described by a three-dimensional fractional Brownian field and a few relevant physical parameters are quantified in terms of the Hurst exponent.

[1] *Algorithm to estimate the Hurst exponent of high-dimensional fractals* , A. Carbone, Phys. Rev. E **76**, 056703 (2007)

[2] *Fractal Heterogeneous Media* C. Turk, A. Carbone, B.M. Chiaia, Phys. Rev. E **81**, 026706 (2010) [Selected for the "Virtual J. of Nanoscale Science & Technology (<http://www.vjnano.org/>)" **21**, Issue 9 (2010)]

[3] *Snow Metamorphism: a Fractal Approach* A. Carbone, B.M. Chiaia, B. Frigo, C. Turk, Phys. Rev. E **82**, 036103 (2010)

CAMILLE ROTH, CNRS/EHES, *Reconstructing streams of media issues from large textual corpora*

The platform that will be presented here aims at automatically analyzing the key themes discussed in a large textual corpus over a given period. In its present form it focuses on news related to food security issues in French language media (national and local). It includes an online interface which visualizes and maps key themes and news entries. It aims to look at how news around particular issues evolves over time and answers questions such as: Is an issue (concerning, for example, the impact of climatic change on food security) attracting more attention with time? How does a specific issue relate to similar issues and related events? Does any issue observed at a given time stem from past issue framings or is it a completely new emergent topic?

Text-mining network analysis tools are used to identify the key themes and frames, while news items are also geo-located both by the origin of the story and the places mentioned in the story in order to map how a given theme or issue is distributed over the world. Moreover, themes identified at successive time steps are reconnected into streams of content. A stream visualization illustrates how topics articulate through time.

This platform has been realized by a consortium of French research centers and universities led by the Complex Systems Institute of Paris Ile-de-France.

Link:

- <http://www.unglobalpulse.org/projects/news-awareness-and-emergent-information-monitoring-system-food-security>

## C) Visualization and Communication

Friday, November 18, Virtual Reality Multi Media Park, Corso Lombardia 190, 16.30-19.30

This session is hosted within the FABER event, organized by the Turin City Council

The focus will be on bringing together expert and lay knowledge and on the co-generation of information in locally based communities. The role of information visualization in providing contexts for general public information and thus adding value to it will be specifically addressed.

JORGE LOUCAS, ANTONIO FONSECA, ISTCE, *Beyond data visualization in communication networks: perceiving collective intelligence*

Visualization has been, since the beginning of science, essential for organising knowledge into distinct disciplines. The use of visual metaphors allowed depicting, in simple ways, the relations between scientific domains. An example of this approach is the tree of knowledge found in the works of Catalan philosopher Ramon Llull, where his "Arbor scientiae", published in 1295, assumed the form of a tree in order to categorize areas of knowledge (1). Sixteen trees designed by Lullus represented the totality of knowledge – including God and man, nature, art and science. The image of a tree has much later inspired Charles Darwin and his followers, expressing the concept of phylogeny, the evolutionary relatedness among species through time, in what was called the Tree of Life (2). Beyond the tree metaphor there is the notion of arborescence, the division of a generic corpus into branches, for instance, the main scientific domains into more specific disciplines. These examples illustrate the importance of conceptualizing visual representations in science. This has become even more relevant in the age of Internet and Big Data (4) attractive visualizations.

The Observatorium lab (3) focuses on complex network dynamics in the Internet, monitoring its evolution in real-time, with the general objective of better understanding the processes of knowledge generation and opinion dynamics. Our research initially allowed some plain visualization of information gathered from Internet, as it happened with the data depicting social networks interaction during the 2011 Portuguese presidential election (5). The actual stage of the research associates social networks methodic observation with theoretical explanations of opinion dynamics phenomena.

We present an evolution of the concept of collective intelligence originally proposed by Szuba (6). The concept was adapted to data from Tweeter, allowing modelling the processes of knowledge propagation in such a network. New knowledge was measured by entropic metrics applied both to individuals and to the social network level. The model were applied to recent tweets and knowledge generation processes can be identified in some simple visual examples.

References and links:

- Raimundus Lullus, "Arbor scientiae", 1295.
- Charles Darwin, "On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life" (1st ed.), London: John Murray, 1859.
- <http://theobservatorium.com>
- Nature, special issue on "Big Data", London: Macmillan, September 2008. Available at <http://www.nature.com/news/specials/bigdata/index.html>

- António Fonseca and Jorge Louçã, "Validation in opinion dynamics modelling: Social Impact Theory and the presidential elections case study", ECCS'11 - European Conference on Complex Systems, Vienna, Austria, 2011.
- Tadeusz Szuba, "Computational Collective Intelligence", New York: Willey, 2001.

ANNA DE LIDDO, Open University, *Visualizing Deliberation to Enable Transparent Decision-Making in Participatory Urban Planning*

In this presentation we argue that in order to enable effective public participation in urban planning processes, the normally ephemeral deliberation process of public consultation needs to be captured and represented so that the information and knowledge gathered during deliberation is visible for all, can be effectively traced, reused, and can actively influence planning decisions. To scaffold this we describe the integration of three technologies (Comendium, FM and CoPe\_it!) to create a collective project memory structured against five dimensions of participatory planning processes: dialogical, social, spatial, temporal and causal. Based on several authentic participatory planning cases, we report that the integrated use of knowledge mapping, online dialogue and video conferencing tools can effectively support deliberation across planning tasks, communication modes, time and environments. The coupled use of online and offline groupware technologies can create a more expressive and transparent participatory knowledge base than is possible with conventional media, and enhance participatory planning by: supporting the effective capture and visualisation of deliberation processes and products; providing a rich picture of the social setting in which planning decision develops and supporting reflection in and on planning actions.

#### Useful Link

- My Website: <http://kmi.open.ac.uk/people/member/anna-de-liddo>
- My PhD dissertation: <http://kmi.open.ac.uk/publications/techreport/kmi-08-07>  
Paper Online Deliberation Conference 2010: <http://oro.open.ac.uk/22279/>
- Presentation and talks:  
<http://people.kmi.open.ac.uk/sbs/2010/07/participatory-multimedia-project-memory>  
Knowledge Mapping and Visualisation tools: <http://people.kmi.open.ac.uk/anna/tools.html>
- Videos:
  - Mapping and Visualising the UK Election Debate with Compendium: <http://projects.kmi.open.ac.uk/hyperdiscourse/ukelection/debatemaps/CompVid-short.mov>
  - Cohere's Social Semantic Network for Online Deliberation: <http://www.youtube.com/user/deliddoa?feature=mhee#p/u/3/LoK0s1QzO18>

#### Participant contributions

Flavio Bonifacio: Numbers. [www.iasistdata.org/downloads/iqvol333bonifacio\\_0.pdf](http://www.iasistdata.org/downloads/iqvol333bonifacio_0.pdf)

Participation is free but registration is recommended.

To register send an e-mail to [editoria@ires.piemonte.it](mailto:editoria@ires.piemonte.it) indicating the sessions you will attend.

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<http://areeweb.polito.it/ricerca/noiselab/FuturICT/Program.html>



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