

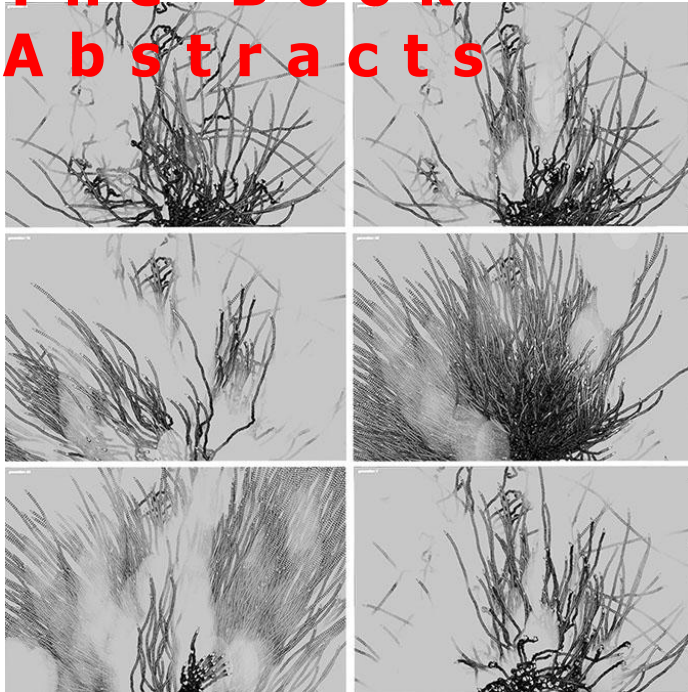


iV2015 – 19<sup>th</sup> International Conference  
 Information Visualisation  
 21, 22, 23 and 24 July 2015  
 The University of Barcelona • Barcelona • Spain •  
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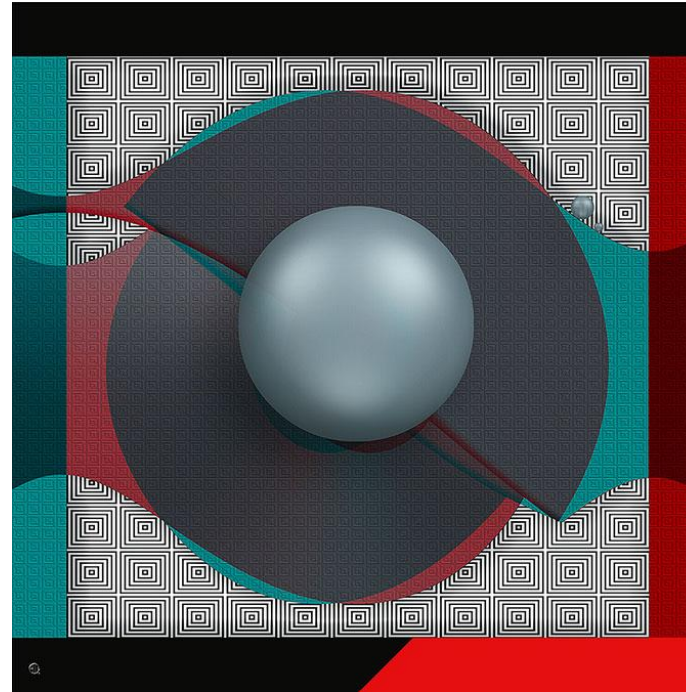


CGiV2015 – 12<sup>th</sup> International Conference  
 Computer Graphics, Imaging and Visualization  
 21, 22, 23 and 24 July 2015  
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# The Book Abstracts



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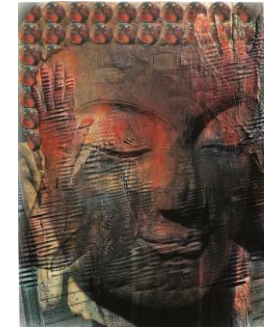
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**iV2015 & cgiv2015 - DIGITAL ART GALLERY Online Exhibition**  
July 2015- June 2016

VIRTUAL GALLERY VENUE  
[www.graphicslink.co.uk/DART.htm](http://www.graphicslink.co.uk/DART.htm)



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**Exhibiting Artists:**

**LiQin Tan**  
**Anna Chupa**  
**Joohyun Pyune**  
**Santiago Echeverry**  
**Harvey Goldman**  
**Daniela Sirbu**  
**John Corbett**  
**Gabriele Peters**  
**Nancy Wood**  
**Heather Freeman**  
**Bogdan Soban**  
**Galt Tomasino**  
**Gina Gibson**  
**Margie Labadie**  
**Dena Elisabeth Eber**  
**Mohammad Majid al-Rifaie**

**Corinne Whitaker**  
**Gloria DeFilipps Brush**  
**Chris Kitchener**  
**Matjuska Teja Krasek**  
**Olivia Koval**  
**Mike Kingan**  
**Jean Constant**  
**John Antoine Labadie**  
**Alan Singer**  
**Anna Ursyn**  
**Neil Howe**  
**Andras Szalai**  
**Chiara Passa**  
**Richard Merritt**



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## **8<sup>th</sup> Doctoral Research Workshop Information Visualisation**

*Organised by*

**Information Visualisation Conference**

*In cooperation with*



**&**

Institute for Media  
and Communications Management



The Information Visualisation Conference (iV) is an international conference that aims to provide a foundation for integrating the human-centred, technological and strategic aspects of information visualisation in order to promote international exchange, cooperation and development. Building upon the reported success of last year's workshop, IVS is pleased to announce the "**8<sup>th</sup> Doctoral Research Workshop**" which will run as part of the 19th International Conference on Information Visualisation (iV2015).

### **Doctoral Research workshop**

This workshop focuses on the issues that doctoral students face during their studies and includes following interactive sessions – the theme for this year Visual Thinking for (PhD) researcher "How to think more clearly, have more engaging conversations, and create richer research

- what visual thinking is and why it is relevant for researchers
- the benefits and risks of visual thinking

- what to visualize (visual templates, basic shapes, symbols)
- how to visualize (abstract vs. pictorial/metaphorical)
- to sketch visual templates (diagrams, metaphors, knowledge maps), basic shapes, symbols
- to apply visual thinking for their own research projects (e.g. the story of your PhD)

Approach:

- value the (visual) process (concept of rapid prototyping from Design Thinking)
- value failure/mistakes as healthy part of that process
- think visually (automatically) when approaching future problems and challenges

The workshop will be hands-on with short inputs from the instructor and time to work on the exercises and own projects visually where the instructor and peers will operate as sparring partner in a friendly environment.

## Tuesday 21 July 2015

10:00	< The University of Barcelona • <b>Facultat de Dret, Avenida Diagonal, 684, 08034, Barcelona</b> >
	<b>Registration</b>
10:30 - 13:00	< The University of Barcelona • Facultat de Dret • <b>Aula 1</b> >
	<b>Doctoral Research Workshop</b>
	Chairs: Banissi, Prof. Ebad, London South Bank University, UK Facilitator: Sebastian Kernbach, Institute of Media and Communications Management at the University of St. Gallen
	09:30 Registration 10.00 Opening & Welcome from discussion Panel members 10:45 what visual thinking is and why it is relevant for researchers / the benefits and risks of visual thinking 11:00 Group Discussion 12:30 what to visualize (visual templates, basic shapes, symbols) / how to visualize (abstract vs. pictorial/metaphorical)
13:00	< The University of Barcelona • Facultat de Dret >
	<i>Lunch Break</i>
14:00 - 17:00	< The University of Barcelona • Facultat de Dret • <b>Aula 1</b> >
	<b>Doctoral Research Workshop</b>
	14.00 to sketch visual templates (diagrams, metaphors, knowledge maps), basic shapes, symbols 14:15 Group Discussion 15:10 to apply visual thinking for their own research projects (e.g. the story of your PhD) 15:30 <b>Break</b> 16:00 value the (visual) process (concept of rapid prototyping from Design Thinking) / value failure/mistakes as healthy part of that process / think visually (automatically) when approaching future problems and challenges 16:45 Group Discussion 17:00 <b>Close</b>

## Wednesday 22 July 2015

09:00	< The University of Barcelona • <b>Facultat de Dret, Avenida Diagonal, 684, 08034, Barcelona</b> > <b>Registration</b>
10:15	< The University of Barcelona • Facultat de Dret • <b>Aula Magna</b> > <b>Opening &amp; Welcome</b> <b>Subject Liaison Committee chairs:</b> Prof. Ramon Torrent, The University of Barcelona, Spain Prof. Ebad Banissi, London South Bank University, UK Prof Randolph Goebel, University of Alberta, Canada
10:30	< The University of Barcelona • Facultat de Dret • <b>Aula Magna</b> > <b>Session iV2015_1.1:</b> Information Visualisation Chair: Prof. Mark Apperley, University of Waikato, New Zealand  <keynote Lecture> <b>And the user said: "Don't leave me alone!"</b> <b>Gilles Venturini</b> University Francois Rabelais of Tours, France
11:35	< The University of Barcelona • Facultat de Dret > <i>Break</i>


12:00	< The University of Barcelona • Facultat de Dret • Aula Magna >
-	<b>Session iV2015_1.2: Visual Analytics</b>
13:00	Chair: Prof. André, Elisabeth, Universität Augsburg, Germany
	<b>Visual Analysis of Car Fleet Trajectories to Find Representative Routes for Automotive Research</b>
	David Spretke <sup>1</sup> , <u>Manuel Stein</u> <sup>1</sup> , Lyubka Sharalieva <sup>1</sup> , Alexander Warta <sup>2</sup> , Valentin Licht <sup>2</sup> , Tobias Schreck <sup>1</sup> , Daniel A. Keim <sup>1</sup>
	<sup>1</sup> University of Konstanz, Germany; <sup>2</sup> Robert Bosch GmbH, Germany
	<b>Visualization Support for Comparing Energy Consumption Data</b>
	<u>Masood Masoodian</u> <sup>1</sup> , Birgit Endrass <sup>2</sup> , René Bühling <sup>2</sup> , Elisabeth André <sup>2</sup>
	<sup>1</sup> The University of Waikato, New Zealand; <sup>2</sup> Augsburg University, Germany
	<b>Recent Advances in Multimedia Forgery and Security</b>
	<u>PUN, Chi Man</u>
	University of Macau, Macau S.A.R., China
13:00	< The University of Barcelona • Facultat de Dret >
	<i>Lunch Break</i>

14:15 - 15:30 cgiv	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b>&gt;</p> <p><b>Session iV2015_1.3: Information Visualisation - Theory &amp; Techniques</b> Chair: Prof. Juergen Doellner, Hasso-Plattner-Institut, German</p> <p><b>Directional Texture for Visualization</b> <u>Manil Maskey</u>, Timothy Newman University of Alabama in Huntsville, United States of America</p> <p><b>Designing and Annotating Metro Maps with Circular Routes</b> <u>Hsiang-Yun Wu</u><sup>1</sup>, Sheung-Hung Poon<sup>2</sup>, Shigeo Takahashi<sup>1</sup>, Masatoshi Arikawa<sup>1</sup>, Chun-Cheng Lin<sup>3</sup>, Hsu-Chun Yen<sup>4</sup> <sup>1</sup>The University of Tokyo, Japan; <sup>2</sup>National Tsing Hua University, Taiwan; <sup>3</sup>National Chiao Tung University, Taiwan; <sup>4</sup>National Taiwan University</p> <p><b>A Visualization Tool for Building Energy Management System</b> <u>Takayuki Itoh</u><sup>1</sup>, Masato Kawano<sup>2</sup>, Shuji Kutsuna<sup>2</sup>, Takeshi Watanabe<sup>2</sup> <sup>1</sup>Ochanomizu University, Japan; <sup>2</sup>NTT Facilities VISUS, Germany</p> <p><b>Layer-Centered Approach for Multigraphs Visualization</b> Denis Redondo<sup>1,2</sup>, Arnaud Sallaberry<sup>1,3</sup>, <u>Dino Ienco</u><sup>4</sup>, Faraz Zaidi<sup>5,6</sup>, Pascal Poncelet<sup>1,2</sup> <sup>1</sup>LIRMM; <sup>2</sup>Université de Montpellier; <sup>3</sup>Université Paul Valéry Montpellier; <sup>4</sup>IRSTEA Montpellier, UMR TETIS; <sup>5</sup>City University of New York; <sup>6</sup>Karachi Institute of Economics and Technology</p>	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 6</b>&gt;</p> <p><b>Session iV2015_1.4: Applications of Graph Theory</b> Chair: Prof. Richard Laing, Scott Sutherland School, RGU, UK</p> <p><b>Fast Graph Drawing Algorithm Revealing Networks Cores</b> <u>Romain Giot</u>, Romain Bourqui Univ. Bordeaux / LaBRI, France</p> <p><b>Mental map models for edges</b> <u>Jana Katreniaková</u>, Martin Ďuriš Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovak Republic</p> <p><b>Distributed Graph Layout with Spark</b> <u>Antoine Hinge</u>, David Auber LaBRI / Université de Bordeaux, France</p>
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14:15	< The University of Barcelona • Facultat de Dret • <b>Aula 7</b> >
-	<b>Session iV2015_1.5: Information Visualisation - Usability &amp; Evaluation</b>
15:20	Chair: Prof. Ebad banissi, London South bank University, UK
	<p><b>Simplified Stress and Simplified Silhouette Coefficient to a Faster Quality Evaluation of Multidimensional Projection Techniques and Feature Spaces</b>  <u>Danilo Medeiros Eler</u>, Jaqueline Batista Martins Teixeira, Priscila Alves Macanhã, Rogério Eduardo Garcia          UNESP, Univ Estadual Paulista, Brazil</p>
	<p><b>Towards the Understanding of Interaction in Information Visualization</b>  <u>Ana Raquel Figueiras</u>          FCSH - Universidade Nova de Lisboa, Portugal</p>
	<p><b>Plot Balalaika: Simple Chart Designs for Long-Tail Distributed Data</b>  <u>Mark Shovman</u><sup>1,2</sup>  <sup>1</sup>Eyeway Vision, Israel; <sup>2</sup>Yahoo Labs Haifa</p>
	<p><b>Heuristic Evaluation of a t-Commerce Prototype</b>  <u>Nikolas Jorge Santiago Carneiro</u><sup>1</sup>, Carlos Gustavo Resque Santos<sup>1</sup>, Tiago Davi Oliveira de Araujo<sup>1</sup>, Brunelli Pinto Miranda<sup>1</sup>, Bianchi Serique Meiguins<sup>1</sup>, Anderson Gregorio Marques Soares<sup>2</sup>  <sup>1</sup>Universidade Federal do Pará, Brazil; <sup>2</sup>Universidade Federal Rural da Amazônia</p>
15:20	< The University of Barcelona • Facultat de Dret >
	<i>Break</i>

<p>15:50 - 17:00 cgiv</p>	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b> &gt;  <b>Session iV2015_1.6: Information Visualisation Theory &amp; Practice</b>  Chair: Prof. Feng Lin, Nanyang Technological University, Singapore</p> <p><b>Visual Analysis of Source Code Similarities</b>  <u>Michael Burch</u>, Julian Strotzer, Daniel Weiskopf  VISUS, University of Stuttgart, Germany</p> <p><b>Indexed dataflow network: A multi-layer and programmable architecture to integrate both visualization pipelines and scene graphs</b>  <u>Romain Guillemot</u>, Stéphanie Prevost, Laurent Lucas  Université de Reims Champagne-Ardenne (URCA) - CReSTIC EA3804, France</p> <p><b>Visualizing the Evolution of Module Workflows</b>  <u>Marcel Hlawatsch</u><sup>1</sup>, Michael Burch<sup>1</sup>, Fabian Beck<sup>1</sup>, Juliana Freire<sup>2</sup>, Claudio Silva<sup>2</sup>, Daniel Weiskopf<sup>1</sup>  <sup>1</sup>VISUS, University of Stuttgart, Germany; <sup>2</sup>Polytechnic School of Engineering, New York University</p>	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 6</b> &gt;  <b>Session CGiV2015_1.7: Geometric Modeling &amp; Imaging</b>  Chair: Prof. Chi Man PUN, University of Macau, Macau (S.A.R China)</p> <p><b>An Immersive and Interactive Visualization System by Integrating Distinct Platforms</b>  <u>Mário Popolin Neto</u><sup>1,2</sup>, Alessandro Moraes<sup>2</sup>, <u>Danilo Medeiros Eler</u><sup>3</sup>, José Remo Ferreira Brega<sup>2</sup>  <sup>1</sup>IFSP - Registro, Brazil; <sup>2</sup>UNESP - Bauru, Brazil; <sup>3</sup>UNESP - Presidente Prudente, Brazil</p> <p><b>Image-based Hair Pre-Processing for Art Creation: A Case Study of Bas-Relief Modelling</b>  <u>Wenshu Zhang</u>, <u>Meili Wang</u>, <u>Jian Chang</u>, Ruofeng Tong, Jian J Zhang  Bournemouth University, UK</p> <p><b>N-polar Visualization: Visual Analytics for Exploring Data Objects with Multiple Interactive Anchors</b>  <u>Taeil Jeon</u>, Jihyun Lee, Wonjong Rhee, Bongwon Suh  Seoul National University, South Korea</p> <p><b>Shape Preserving Positive Rational Trigonometric Spline Surfaces</b>  <u>Muhammad Sarfraz</u>, Farsia Hussain, Malik Zawwar Hussain  Kuwait University, KW</p> <p><b>Interpolation of Discrete time Signals using Cubic Spline Function</b>  <u>Malik Zawwar Hussain</u><sup>1</sup>, Misbah Irshad<sup>2</sup>, <u>Muhammad Sarfraz</u><sup>3</sup>, Nousheen Zafar<sup>1</sup>  <sup>1</sup>University of the Punjab, Pakistan; <sup>2</sup>Lahore College for Women University, Pakistan; <sup>3</sup>Kuwait University, Kuwait</p>
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<p>15:50 - 17:00</p>	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 7</b> &gt;</p> <p><b>Session iV2015_1.8: Information Visualisation – Applications</b></p> <p>Chair: Prof. Shunsuke Kamijo, The Univeresity of Tokyo, Japan</p> <p><b>A Concurrent Architecture proposal for Information Visualization Pipeline</b>  <b>Nikolas Jorge Santiago Carneiro</b>, Carlos Gustavo Resque Santos, Tiago Davi Oliveira de Araujo, Brunelli Pinto Miranda, Bianchi Serique Meiguins          Universidade Federal do Pará, Brazil</p> <p><b>Self-Organizing Map-Based Feature Visualization and Selection for Defect Depth Estimation in Oil and Gas Pipelines</b>  <b>Abduljalil Abdulrahman Mohamed<sup>1</sup>, Mohamed Hamdi<sup>1</sup>, Sofiene Tahar<sup>2</sup></b>  <sup>1</sup>Ahmed Bin Mohamed Military College (ABMMC), Qatar; <sup>2</sup>Concordia University/Electrical and Computer Engineering Department, Montreal, Canada</p> <p><b>The Recommendation Dashboard: A System to Visualise and Organise Recommendations</b>  <b>Gerwald Tschinkel<sup>1</sup>, Cecilia di Sciascio<sup>1</sup>, Belgin Mutlu<sup>1</sup>, Vedran Sabol<sup>1,2</sup></b>  <sup>1</sup>Know Center Gmbh, Austria; <sup>2</sup>Graz University of Technology</p>
<p>17:00 - 17:30</p> 	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • <b>Aula Magna</b> &gt;</p> <p><b>Session iV2015_1.9: Animation, Special Effects and Multimedia Show</b></p> <p>Chair: Prof. Ben Mark Barnett, UPRU, USA</p>

## Thursday 23 July 2015

09:00	< The University of Barcelona • Facultat de Dret, Avenida Diagonal, 684, 08034, Barcelona >	
	<i>Registration</i>	
09:30 - 11:15 C	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 1</b> &gt;</p> <p><b>Session iV2015_2.1: Information Visualisation – Theory &amp; Techniques</b> Chair: Gilles Venturini, University Francois Rabelais of Tours, France</p> <p><b>A Color-based Visualization Approach to understand harmonic structures of Musical Compositions</b> <u>Delfina Malandrino</u>, Donato Pirozzi, Gianluca Zaccagnino, Rocco Zaccagnino University of Salerno, Italy</p> <p><b>Edge Visual Encodings in Matrix-Based Diagrams</b> <u>Joris Sansen</u><sup>1</sup>, Romain Bourqui<sup>1</sup>, Bruno Pinaud<sup>1</sup>, Helen Purchase<sup>2</sup> <sup>1</sup>University of Bordeaux, France; <sup>2</sup>University of Glasgow, UK</p> <p><b>Visualizing a set of multiple time series with an aggregate stacked graph</b> <u>Nicolas Greffard</u>, Pascale Kuntz LINA-DUKe, University of Nantes, France</p> <p><b>FATuM - Fast Animated Transitions using Multi-Buffers</b> <u>Alexandre Perrot</u>, David Auber Universite de Bordeaux, France</p> <p><b>Natural User Interface Design in DA-TU: An Interactive Clustered Data Visualization System</b> <u>Shizhe He</u><sup>1</sup>, Mao Lin Huang<sup>1,2</sup>, Lin Zhu<sup>2</sup> <sup>1</sup>University of Technology, Sydney, Australia; <sup>2</sup>Tianjin University, China</p>	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b> &gt;</p> <p><b>Session iV2015_2.2: Knowledge Visualization and Visual Thinking</b> Chair: Sebastian Kernbach, University of St. Gallen, Switzerland</p> <p><b>Value Lab Asia: A Space for Physical and Virtual Interdisciplinary Research and Collaboration</b> <u>Afian Anwar</u><sup>1</sup>, Bernhard Klein<sup>2</sup>, Matthias Berger<sup>2</sup>, Stefan Muller Arisona<sup>2</sup> Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, United States of America; <sup>2</sup>Future Cities Laboratory, Department of Architecture, ETH Zurich, Switzerland</p> <p><b>A Gesture Control Framework targeting High-resolution Video Wall Displays</b> <u>Bernhard Klein</u> Future Cities Laboratory, Singapore-ETH Centre, 1 Create Way, Singapore 138602</p> <p><b>Dynamic Multi-View, Multi-Format, Multi-User Visualizations: For Future Cities</b> <u>Bernhard Klein</u><sup>1</sup>, Remo Burkhard<sup>1</sup>, Christine Meixner<sup>2</sup>, Lukas Treyer<sup>2</sup> <sup>1</sup>Future Cities Laboratory, Singapore-ETH Centre, 1 Create Way, Singapore 138602; <sup>2</sup>ETH Zurich, Chair of Information Architecture, 8093 Zurich, Wolfgang-Pauli-Str 27, Switzerland</p> <p><b>The Design Process: A Visual Model</b> <u>Sabrina Bresciani</u> University of St. Gallen, Switzerland</p>

	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 6</b> &gt;  <b>Session Mediviz2015_2.3: BioMedical Visualization</b>  Chair: Prof. Urska Cvek, Louisiana State University Shreveport, USA</p> <p><b>Semi-automatic compartment extraction to assess 3D bone mineral density and morphometric parameters of the subchondral bone in the tibial knee</b>  <u>Rabaa Youssef</u><sup>1</sup>, <u>Hamid Bouhadoun</u><sup>2</sup>, <u>Jean Denis Laredo</u><sup>3</sup>, <u>Christine Chappard</u><sup>2</sup>  <sup>1</sup>CEA-LIST CEA-LinkLab, Tunisia; <sup>2</sup>Laboratoire de Bioingénierie et Bioimagerie Ostéo-articulaire (B2OA), UMR CNRS 7052, Université Paris Diderot, PRES Sorbonne Paris Cité, Paris, France; <sup>3</sup>Service de Radiologie Ostéo-Articulaire, Hôpital Lariboisière, Paris, France</p> <p><b>Web-based Information Retrieval and Visualization for Diagnostic Radiology</b>  <u>Ben Chua</u><sup>1</sup>, <u>Xiuling Liu</u><sup>2</sup>, <u>Bin Dong</u><sup>2</sup>, <u>Feng Lin</u><sup>1,2</sup>  <sup>1</sup>Nanyang Technological University, Singapore; <sup>2</sup>Hebei University, China</p> <p><b>Augmented representations of clustered fiber bundles for interactive queries</b>  <u>Stefan Philips</u>, <u>Mario Hlawitschka</u>, <u>Gerik Scheuermann</u>  Leipzig University, Germany</p> <p><b>Enhancing Visual Perception and Directing Viewer's Attention in Interactive Direct Volume Rendering</b>  <u>AmirAli Sharifi</u>, <u>Pierre Boulanger</u>  University of Alberta, Canada</p> <p><b>A semantically adaptable integrated visualization and natural exploration of multi-scale biomedical data</b>  <u>Ricardo Millan</u><sup>1</sup>, <u>Asan Agibetov</u><sup>2</sup>, <u>Jan Rzepecki</u><sup>1</sup>, <u>Marta Ondrésik</u><sup>3</sup>, <u>Alexander Vais</u><sup>1</sup>, <u>Joaquim Miguel Oliveira</u><sup>3</sup>, <u>Giuseppe Patané</u><sup>2</sup>, <u>Karl-Ingo Friese</u><sup>1</sup>, <u>Rui L. Reis</u><sup>3</sup>, <u>Michela Spagnuolo</u><sup>2</sup>, <u>Franz-Erich Wolter</u><sup>1</sup>  <sup>1</sup>Leibniz University of Hannover, Germany; <sup>2</sup>Consiglio Nazionale delle Ricerche, Italy; <sup>3</sup>Bs research Group, University of Minho, Portugal</p>	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 7</b> &gt;  <b>Session iV2015_2.4: Visualization, Art, and Design</b>  Chair: Prof. Mao Lin Huang, University of Technology, Sydney, Australia; Tianjin University, China</p> <p><b>User Interface Considerations for Browser-Based Just-in-Time-Retrieval</b>  <u>Christin Seifert</u>, <u>Jörg Schlötterer</u>, <u>Michael Granitzer</u>  Passau University, Germany</p> <p><b>Quick Vis: A Web-Based Visualization Delivering Flexible Exploration of User-Driven Analytics</b>  <u>Alessandro Simone Agnello</u>, <u>Haim Levkowitz</u>  University of Massachusetts Lowell, United States of America</p> <p><b>Visualizing Süleymanname: Analyzing and Visualizing Embedded Spatiotemporal Information in a 16th Century Illustrated Manuscript</b>  <u>Ferhat Sen</u>  Aalto University School of Arts, Design and Architecture, Department of Media, Finland</p> <p><b>Senescence: An Age-Based Character Simulation Framework</b>  <u>Suren Deepak Rajasekaran</u>, <u>Nicoletta Adamo-Villani</u>  Purdue University, United States of America</p> <p><b>Examining User Experiences Through A Multimodal BCI Puzzle Game</b>  <u>Fotis Liarokapis</u><sup>1</sup>, <u>Athanasios Vourvopoulos</u><sup>2</sup>, <u>Alina Ene</u><sup>3</sup>  <sup>1</sup>Masaryk University, Czech Republic; <sup>2</sup>University of Madeira, Portugal; <sup>3</sup>Coventry University, UK</p> <p><b>Perceived Realism of Crowd Behaviour with Social Forces</b>  <u>Stuart O'Connor</u><sup>1</sup>, <u>Fotis Liarokapis</u><sup>2</sup>, <u>Chrisina Jayne</u><sup>1</sup>  <sup>1</sup>Coventry University, United Kingdom; <sup>2</sup>Masaryk University, Czech Republic</p>
11:15	< The University of Barcelona • Facultat de Dret > <i>Break</i>	

11:45 - 13:00	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • Aula Magna &gt;</p> <p><b>Session iV2015_2.5: Visualisation</b> Chair: Prof. Randolph George Goebel, University of Alberta, Canada</p> <p><b>Visual Analysis of Eye Movements by Hierarchical Filter Wheels</b> <u>Marcel Hlawatsch</u>, Michael Burch, Daniel Weiskopf University of Stuttgart, German</p> <p>&lt;keynote Lecture&gt; <b>Simulation and Visualization of Deformation with Anisotropic Materials</b> <u>Feng Lin</u> Nanyang Technological University, Singapore</p>
13:00	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret &gt;</p> <p><i>Lunch Break</i></p>

14:15 - 15:30	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 1</b>&gt;  <b>Session iV2015_2.6: Information Visualisation Application</b>  Chair: Prof. Marjan Trutschl, Louisiana State University Shreveport, USA</p> <p><b>Visualization of Crowd-Powered Impression Evaluation Results</b>  <u>Erika Gomi</u>, Yuri Saito, Takayuki Itoh  Ochanomizu University, Japan</p> <p><b>Web based Time-tunnel: An Interactive Multidimensional Data Visualization Tool Using Genetic Algorithm</b>  <u>Ryuya Akase</u>, Yoshihiro Okada  Kyushu University</p> <p><b>ThreadCity: Combined Visualization of Structure and Activity for the Exploration of Multi-threaded Software Systems</b>  Sebastian Hahn, <u>Matthias Trapp</u>, Nikolai Wuttke, Jürgen Döllner  Hasso-Plattner-Institut, Germany</p> <p><b>ConcentriCloud: Word Cloud Visualization for Multiple Text Documents</b>  <u>Steffen Lohmann</u>, Florian Heimerl, Fabian Bopp, Michael Burch, Thomas Ertl  University of Stuttgart, Germany</p>	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b>&gt;  <b>Session iV2014_2.7: Knowledge Visualization and Visual Thinking</b>  Chair: Bernhard Klein, Future Cities Laboratory, Singapore-ETH Centre, Singapore</p> <p><b>The Role of Visual Templates on Improving Teamwork Performance</b>  <u>Marta Perez Garcia</u><sup>1</sup>, Sabrina Bresciani<sup>2</sup>  <sup>1</sup>Birmingham City University, United Kingdom; <sup>2</sup>University of St. Gallen, Switzerland</p> <p><b>What You See is What You Get: The Impact of Perceived Finishedness (PF) on Visual Contribution Fluency during Electronic Ideation</b>  <u>Lawrence McGrath</u>  University of St. Gallen, Switzerland</p> <p><b>Knowminer Search - a Multi-Visualisation Collaborative Approach to Search Result Analysis</b>  <u>Manuela Rauch</u><sup>1</sup>, Werner Klieber<sup>1</sup>, Ralph Wozelka<sup>1</sup>, Santokh Singh<sup>1</sup>, Vedran Sabol<sup>1,2</sup>  <sup>1</sup>Know Center, Austria; <sup>2</sup>Graz, University of Technology</p> <p><b>Navicons for collaboration: Navigating and augmenting discussions through visual annotations</b>  Martin J. Eppler<sup>1</sup>, Michael H.G. Hoffmann<sup>2</sup>, <u>Sebastian Kernbach</u><sup>1,3</sup>  <sup>1</sup>University of St. Gallen; <sup>2</sup>Georgia Institute of Technology; <sup>3</sup>University of Lugano</p>
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<p>14:15 - 15:30</p>	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 6</b> &gt;  <b>Session iV2015_2.8: Information Visualization</b>  Chair: Prof. Takayuki Itoh, Ochanomizu University, Japan</p> <p><b>Shortpapers:</b>  <b>An experience of information visualization and interaction for aphasic persons</b>  <b>Mariko Sasakura<sup>1</sup>, Saori Iikuma<sup>1</sup>, Yukihiro Izawa<sup>2</sup></b>  <sup>1</sup>Okayama University, Japan; <sup>2</sup>Fukuyama City University, Japan</p> <p><b>Visualization on Agglomerative Information Bottleneck Based Trajectory Clustering</b>  <b>Yang Fan, Qing Xu, Yuejun Guo, Sheng Liang</b>  Tianjin University, Tianjin, China, China, People's Republic of</p> <p><b>Service Oriented Architecture for Data Visualization in Smart Devices</b>  <b>Nikolas Jorge Santiago Carneiro, Carlos Gustavo Resque Santos, Tiago Davi Oliveira de Araujo, Brunelli Pinto Miranda, Jairo de Jesus Nascimento da Silva Junior, Bianchi Serique Meiguins</b>  Universidade Federal do Pará, Brazil</p> <p><b>The Usefulness of the Virtual Speaking Head, as Well as 3D Visualization Tools in the New Communication, Teaching and Presentation Technologies is almost Unlimited.</b>  <b>Eva Pajorova</b>  Slovak Academy of Sciences, Slovak Republic</p>	<p>&lt; The University of Barcelona • Facultat de Dret • <b>Aula 7</b> &gt;  <b>Session iV2015_2.9: Visualisation in Built &amp; Rural Environments</b>  Chair: Prof. Vineet Kamat, University of Michigan, USA</p> <p><b>Impact of Visual Cues on Climate Perception in Virtual Urban Environments: a User Study</b>  <b>Toinon Vigier, Guillaume Moreau, Daniel Siret</b></p> <p><b>Development of a Computational Design Application for Interactive Surfaces</b>  <b>Marianthi Leon, Daniel Doolan, Richard Laing, Julian Malins, Huda Salman</b>  RGU, United Kingdom</p> <p><b>Monuments Visualization: from 3D scanned data to a holistic approach, an application to the city of Aberdeen</b>  <b>Richard Laing, Marianthi Leon, John Isaacs</b>  RGU, United Kingdom</p>
<p>15:15</p>	<p>&lt; The University of Barcelona • Facultat de Dret &gt;  <i>Break</i></p>	



15:45 - 17:00	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 1</b>&gt;</p> <p><b>Session iV2015_2.10: VA - Visual Analytics</b> Chair: Dr Fatma Bouali, University of Lille 2, France</p> <p><b>Hybrid Visualization: A New Approach to Display Instances and Attributes Relationships in a Single View</b> <u>Danilo Medeiros Eler</u>, Renan Augusto Pupin de Oliveira, Lenon Fachiano Silva UNESP, Univ Estadual Paulista, Brazil</p> <p><b>A Visualization of Research Papers Based on the Topics and Citation Network</b> <u>Rina Nakazawa</u><sup>1</sup>, <u>Takayuki Itoh</u><sup>1</sup>, <u>Takafumi Saito</u><sup>2</sup> <sup>1</sup>Ochanomizu University, Japan; <sup>2</sup>Tokyo University of Agriculture Technology, Japan</p> <p><b>Regularity Measure and Influence Weight for Analysis and Visualization of Consumer's attitude</b> <u>Aki Hayashi</u>, Masahiro Kohjima, Tatsushi Matsubayashi, Hiroshi Sawada NTT Service Evolution Laboratories, NTT Corporation, Japan</p> <p><b>A Visualization-Analytics-Interaction Workflow framework for Exploratory and Explanatory Search on Geo-Located Search Data using the Meme Media Digital Dashboard</b> <u>Jonas Sjöbergh</u><sup>1</sup>, <u>Xingkai Li</u><sup>2</sup>, <u>Randolph George Goebel</u><sup>2</sup>, <u>Yuzuru Tanaka</u><sup>1</sup> <sup>1</sup>Hokkaido University, Sapporo, Japan; <sup>2</sup>University of Alberta, Edmonton, Canada</p>	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b>&gt;</p> <p><b>Knowledge Visualization and Visual Thinking Symposium</b> <b>Planning session</b></p>
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15:45 - 17:00	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 6</b> &gt;</p> <p><b>Session iV2015_2.11: Information Visualisation</b> Chair: Prof. Mao Lin Huang, University of Technology, Sydney, Australia; Tianjin University, China</p> <p><b>A Visual Tool to Help Select Photogenic Locations</b> <u>Kouhei Hamada</u><sup>1</sup>, <u>Kazuo Misue</u><sup>2</sup> <sup>1</sup>Department of Computer Science, University of Tsukuba, Ibaraki, Japan; <sup>2</sup>Faculty of Engineering, Information and Systems, University of Tsukuba, Ibaraki, Japan</p> <p><b>A Survey of Visual and Interactive Methods for Air Traffic Control Data</b> <u>Linda Pfeiffer</u>, <u>Nicholas Hugo Müller</u>, <u>Paul Rosenthal</u> Technische Universität Chemnitz, Germany</p> <p><b>An investigation of the environment of schizophrenia genes using Multi-Dimensional Scaling</b> <u>Aparna Basu</u><sup>1</sup>, <u>Suman Ray</u><sup>2</sup>, <u>Frizo Janssens</u><sup>3</sup> <sup>1</sup>Formerly at NISTADS, New Delhi, India, India; <sup>2</sup>National Institute of Science Technology and Development Studies, New Delhi, India; <sup>3</sup>Formerly at Electrical Engineering (ESAT), Katholieke Universiteit Leuven, Leuven, Belgium</p>	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 7</b> &gt;</p> <p><b>Session iV2015_2.12: Information Visualization</b> Chair: Prof. Masood Masoodian, The University of Waikato, New Zealand</p> <p><b>DiagrammaticCHR: A Diagrammatic Representation of CHR Programs</b> <u>Nada Ahmed Hamed Sharaf</u><sup>1</sup>, <u>Slim Abdennadher</u><sup>1</sup>, <u>Thom Frühwirth</u><sup>2</sup> <sup>1</sup>The German University in Cairo, Egypt; <sup>2</sup>University of Ulm</p> <p><b>An ontology-driven visual Question-Answering Framework</b> <u>Hajer Baazaoui-Zghal</u> Riadi, ENSI Campus Universitaire de la Manouba, Tunisia</p> <p><b>Visualizing Timed, Hierarchical Code Structures in AscoGraph</b> <u>Grigore Burloiu</u><sup>1</sup>, <u>Arshia Cont</u><sup>2</sup> <sup>1</sup>University Politehnica of Bucharest; <sup>2</sup>IRCAM STMS UMR, CNRS, INRIA, UPMC</p> <p><b>An Analysis and Visualization Tool for DBLP Data</b> <u>Michael Burch</u>, <u>Daniel Pompe</u>, <u>Daniel Weiskopf</u> VISUS, Germany</p>
17:00	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b> &gt;</p> <p><b>iV2016 - Committee Members Meeting</b></p>	

20:00 **Thursday 23<sup>th</sup> July 2015 - Time: 20:30 – 22:30**

## Visualisation Social Networking Event

Dinning in an ocean view restaurant

Date / fecha: Thursday 23<sup>rd</sup> July 2015  
 Time / tiempo: 20:30

Type of Function: Dinning in an ocean view restaurant, El Tunel Del Port.

Location / ubicación: Moll de Gregal, 12  
 Port Olímpic, 08005 BARCELONA  
[www.eltuneldelport.com](http://www.eltuneldelport.com)

Nearest Underground Stations: L4 line (yellow) Metro, and get off at "Ciutadella - Vil·la Olímpica" station ~ 10 minutes walk until the restaurant and it is in Avenida Icaria with Ramon Trias Fargas street (not Francisco de Aranda).

**Pre-registration is required for this event – deadline 16<sup>th</sup> July 2015**



## Friday 24 July 2015

09:00	< The University of Barcelona • Facultat de Dret, Avenida Diagonal, 684, 08034, Barcelona >	
	<i>Registration</i>	
09:30 - 11:15 C	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 1</b> &gt;</p> <p><b>Session iV2015_3.1: VA - Visual Analytics</b> Chair: Dr Michael Burch, VISUS, University of Stuttgart, Germany</p> <p><b>POIViz: a fast interactive method for visualizing a large collection of Open datasets</b> <u>Tianyang Liu</u><sup>1</sup>, <u>Fatma Bouali</u><sup>2</sup>, <u>Gilles Venturini</u><sup>1</sup> <sup>1</sup>University Francois Rabelais of Tours, France; <sup>2</sup>University of Lille2, France</p> <p><b>A fast feature vector approach for revealing simplex and equi-correlation data patterns in reorderable matrices</b> <u>Celmar Guimarães da Silva</u>, Bruno Figueiredo Medina University of Campinas - School of Technology, Brazil</p> <p><b>Towards ActionTrack 3.0: The Role of Usefulness, Usability and User Experience in a Startup Company Developing Location-Based Applications</b> <u>Jukka Antero Holm</u>, <u>Kari Laurila</u> Team Action Zone, Finland</p> <p><b>Current Topics in the design of HCI courses with Computer Science Curricula</b> <u>Minoru Nakayama</u> Tokyo Institute of Technology, Japan</p> <p><b>Detecting Criminal Relationships Through SOM Visual Analytics</b> <u>Wen Bo Wang</u><sup>1</sup>, <u>Mao Lin Huang</u><sup>1,2</sup>, <u>Jinson Zhang</u><sup>1</sup>, <u>Wei Lai</u><sup>3</sup> <sup>1</sup>University of Technology Sydney, Australia; <sup>2</sup>Tianjin University; <sup>3</sup>Swinburne University of Technology</p>	<p style="text-align: center;">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 5</b> &gt;</p> <p><b>Session iV2015_3.2: Information Visualisation – Applications</b> Chair: Dr. Bernhard Klein, Singapore ETH Centre, Singapore</p> <p><b>Interactively Uncluttering Node Overlaps for Network Visualization</b> <u>Rie Ishida</u><sup>1</sup>, <u>Shigeo Takahashi</u><sup>2</sup>, <u>Hsiang-Yun Wu</u><sup>2</sup> <sup>1</sup>Graduate School of Frontier Sciences, The University of Tokyo, Chiba 277-8561, Japan; <sup>2</sup>Graduate School of Information Science and Technology, The University of Tokyo, Tokyo 133-8565, Japan</p> <p><b>Multiscale Visualization of Trajectory Data</b> <u>Sheng Liang</u>, <u>Qing Xu</u>, <u>Yuejun Guo</u>, <u>Yang Fan</u> Tianjin University, Tianjin, China, China, People's Republic of</p> <p><b>Adjasankey: Visualization of huge hierarchical weighted and directed graphs</b> <u>Joris SANSEN</u>, <u>Frédéric LALANNE</u>, <u>David AUBER</u>, <u>Romain BOURQUI</u> Université de Bordeaux, France</p> <p><b>Literature Visualization and Similarity Measurement based on Citation Relations</b> <u>HANADI HUMOUD ALFRAIDI</u>, WonSook Lee, David Sankoff University of Ottawa, Canada</p> <p><b>3D Visualization of Multiscale Video Key Frames</b> <u>Shihua Sun</u>, <u>Qing Xu</u>, <u>Yuejun Guo</u>, <u>Sheng Liang</u>, <u>Yang Fan</u> Tianjin University, China, People's Republic of</p>

<p>09:30 - 11:15 Cgiv C</p>	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 6</b> &gt;</p> <p><b>Session iV2015_3.3: Information Visualisation Applications</b></p> <p>Chair: Sebastian Kernbach, University of St. Gallen, Switzerland</p> <p><b>Software Systems as Archipelagos of Atolls</b> <u>Giuseppe Scanniello</u>, Ugo Erra, Maria Caulo University of Basilicata, Italy</p> <p><b>A Visualization Technique to Support Searching and Comparing Features of Multivariate Datasets</b> <u>Hiroaki Kobayashi</u><sup>1</sup>, <u>Hiroko Suzuki</u><sup>2</sup>, <u>Kazuo Misue</u><sup>1</sup> <sup>1</sup>University of Tsukuba, Japan; <sup>2</sup>Fujitsu Laboratories Ltd.</p> <p><b>Focus and Context Awareness Visualization Techniques for 3D Modelling Tasks using Multi-Layered Displays</b> <u>Masood Masoodian</u><sup>1</sup>, <u>Azmi bin Mohd Yusof</u><sup>2</sup>, <u>Bill Rogers</u><sup>1</sup> <sup>1</sup>The University of Waikato, New Zealand; <sup>2</sup>Universiti Tenaga Nasional, Malaysia</p> <p><b>Enhancing Software Visualization with Information Retrieval</b> <u>Rita Francese</u><sup>1</sup>, <u>Michele Risi</u><sup>1</sup>, <u>Giuseppe Scanniello</u><sup>2</sup> <sup>1</sup>University of Salerno, Italy; <sup>2</sup>University of Basilicata, Italy</p>	<p align="center">&lt; The University of Barcelona • Facultat de Dret • <b>Aula 7</b> &gt;</p> <p><b>Session CGiV2015_3.4: Computer Graphics &amp; Imaging &amp; Visualisation</b></p> <p>Chair: Prof. Feng Lin, Nanyang Technological University, Singapore</p> <p><b>Reverse Engineering of Planar Objects using Imperialist Competitive Algorithm</b> <u>Misbah Irshad</u>, <u>Muhammad Sarfraz</u>, <u>Malik Zawwar Hussain</u> Lahore College for Women University, Pakistan</p> <p><b>CosMovis: Semantic Network Visualization by Using Sentiment Words of Movie Review Data</b> <u>Hyoji Ha</u>, <u>Wonjoo Hwang</u>, <u>Sungyun Bae</u>, <u>Hanmin Choi</u>, <u>Hyunwoo Han</u>, <u>Gi-nam Kim</u>, <u>Kyungwon Lee</u> Ajou University, Life Media Interdisciplinary Program, South Korea</p> <p><b>Automatic, Real Time, Unsupervised Spatio-temporal 3D Object Detection Using RGB-D Cameras</b> <u>Manal H. Alassaf</u>, <u>Kamran Kowsari</u>, <u>Jamed K. Hahn</u> The George Washington University, USA</p> <p><b>Video Object Tracking Using Interactive Segmentation and Superpixel Based Gaussian Kernel</b> <u>GUOHENG HUANG</u>, <u>Chi Man PUN</u>, <u>Cong Lin</u> University of Macau, Macau S.A.R. (China)</p> <p><b>A Solution for Making Multiview Videos: from Cameras to Display</b> <u>Jae-Sook Cheong</u>, <u>Sangwon Ghyme</u>, <u>Ilkwon Jeong</u> Electronics and Telecommunications Research Institute, Next Generation Content Research Division, South Korea</p>
<p>11:15</p>	<p align="center">&lt; The University of Barcelona • Facultat de Dret &gt;</p> <p><i>Break</i></p>	

11:45	< The University of Barcelona • Facultat de Dret • Aula Magna >
-	<b>Session iV2015_3.5: Information Visualisation</b>
13:00	Chair: Prof. Urska Cvek, Louisiana State University Shreveport, USA
	<b>A Mobile Personal Residential Electricity Dashboard</b>
	<b>Mark Apperley<sup>1</sup>, Jishaal Kalyan<sup>2</sup></b>
	<sup>1</sup> University of Waikato, New Zealand; <sup>2</sup> Infinity, Auckland, New Zealand
	<keynote Lecture>
	<b>Space, Time and Visual Analytics: a Multiple Perspectives Paradigm</b>
	<b>Gennady Andrienko</b>
	Fraunhofer Institute for Intelligent Analysis and Information systems (IAIS), Germany and City University London, UK
13:00	< The University of Barcelona • Facultat de Dret >
	<i>Lunch Break</i>
14:00	Close

**Session iV2015\_1.1: Information Visualisation**

Chair: Prof. Mark Apperley, University of Waikato, New Zealand

## &lt;keynote Lecture&gt;

**And the user said: "Don't leave me alone"****Gilles Venturini**

University Francois Rabelais of Tours, France

Visual and interactive methods being user-centered approaches, one would expect users to have no difficulties to find a relevant visualization and to configure it. However, in practice, novice users (but not just them) can have problems to find an appropriate visualization that can reach the pursued objectives: users are often alone to solve such design/choice problems, and the consequences of a wrong design or choice can be disastrous. So did we forget something important about users and visualizations? For a given problem to solve (i.e., a dataset and objectives), I will show, with some examples, that the visualization « search space » can be very large and complex, and that finding an « optimal » visualization can be difficult. Then I will enumerate areas of research that aim at providing help to users (or designers) when they use (define) visual and interactive approaches. I will describe user assistants, which are like expert systems and which can be knowledge-based or behavior-based. I will describe history management systems. Then I will present the domain of « visualization optimization » (i.e., turning the design/choice problem into a mathematical optimization problem with automatic evaluation functions). In the conclusions and perspectives, I will discuss the trade-off between methods that entirely rely on the user and methods that are completely automatic. Both approaches can easily fail: with the first ones, the user will be alone, and with the second ones, the mathematical criteria may not encompass the user's needs and objectives.

**Bio-sketch**

Gilles Venturini is Professor of Computer Science at the University François-Rabelais of Tours in France. His research interests are visual data mining, 3D interfaces, 3D data acquisition and biomimetic algorithms for optimization and learning. He is the coeditor in chief of the French New IT Journal (Revue des Nouvelles Technologies de l'Information) and was recently president of the French Data Mining Society (Extraction et Gestion des Connaissances). He is a co-author of a on-line user assistant for visual data mining ([www.vizassist.fr](http://www.vizassist.fr)).

**Session iV2015\_1.2: Session iV2015\_1.2: Visual Analytics**

Chair: Prof. André, Elisabeth, Universität Augsburg, Germany

**Visual Analysis of Car Fleet Trajectories to Find Representative Routes for Automotive Research****David Spretke<sup>1</sup>, Manuel Stein<sup>1</sup>, Lyubka Sharalieva<sup>1</sup>, Alexander Warta<sup>2</sup>, Valentin Licht<sup>2</sup>, Tobias Schreck<sup>1</sup>, Daniel A. Keim<sup>1</sup>**<sup>1</sup>University of Konstanz, Germany; <sup>2</sup>Robert Bosch GmbH, Germany

Testing is an important and wide spread practice in the development of automotive components. For the design of test methods two types of input data are often considered: (1) load data gathered from real life vehicle fleets, and (2) information of the driving routes based on road features. The development of new technologies is though complicated not only by the need to join those two data sources, but also by the too limited knowledge of the parameters and their useful combinations. As a result, information about representative driving profiles is needed. To address these problems we present a visual analytics approach for analyzing multivariate trajectories as a combination of vehicle's location and road elevation data. Our system combines trajectory clustering, interval-based user-driven trip segmentation, and frequent sequences analysis, supported by contingency table and interval-based Parallel Coordinates visualization and enables the expert user to find representative driving profiles for the definition of very compact test courses.

**Visualization Support for Comparing Energy Consumption Data****Masood Masoodian<sup>1</sup>, Birgit Endrass<sup>2</sup>, René Bühling<sup>2</sup>, Elisabeth André<sup>2</sup>**<sup>1</sup>The University of Waikato, New Zealand; <sup>2</sup>Augsburg University, Germany

Providing effective feedback can empower users to change their behaviour and take the necessary actions to reduce their energy consumption. The types of feedback that allow comparison of energy usage seem to be particularly valuable. This paper introduces the time-stack visualization, which has been designed to support comparisons of individual and collective energy usage data. It also describes a user study conducted to compare the effectiveness of time-stack against a similar visualization called time-pie. The results show that although the two visualizations are generally comparable in their effectiveness, users rate time-stack more favourably.

**Recent Advances in Multimedia Forgery and Security****Prof. Chi Man PUN**

University of Macau, Macau S.A.R., China

Along with the development of computer technology and the popularity of software for multimedia information processing, digital forgery is increasingly easily to achieve, which reduces the credibility of the multimedia data such as digital images, videos and audios greatly. Therefore, multimedia forgery detection and information security have been becoming more and more important in recent years. Among the existing kinds of digital forgeries, copy-move forgery

## iV2015 / CGiV2015 \_ Abstract

is one of the most common ones, which is to paste a copied region of an image into another part of the same image. During the copy and move operation, some image processing methods such as rotation, scaling, blurring, compression, and noise addition are applied to ensure the imperceptibility of the copied region; however, which can increase the difficulties of forgery detection at the same time. In this talk, we will study the recent advances of multimedia forgery and the related detection methods such as copy-move or splicing forgeries, and multimedia security techniques such as digital watermarking methods.

**Bio-sketch**

Prof. Pun received his B.Sc. and M.Sc. degrees in Software Engineering from the University of Macau in 1995 and 1998 respectively, and Ph.D. degree in Computer Science and Engineering from the Chinese University of Hong Kong in 2002. He is currently an Associate Professor and Head of the Department of Computer and Information Science of the University of Macau. He has investigated several funded research projects and published more than 150 refereed scientific papers in international journals, books and conference proceedings. He has also served as the editorial member / referee for

many international journals such as IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Image Processing, Pattern Recognition, etc. His research interests include Digital Image Processing; Multimedia Security and Digital Watermarking; Pattern Recognition and Computer Vision. He is also a senior member of the IEEE and a professional member of the ACM.

## Session iV2015\_1.3: Information Visualisation - Theory & Techniques

Chair: Prof. Juergen Doellner, Hasso-Plattner-Institut, German

### Directional Texture for Visualization

**Manil Maskey, Timothy Newman**

University of Alabama in Huntsville, United States of America

The role of a texture's directionality (i.e., orientedness) in multivariate visualization is explored. A key emphasis here is determining if directional textures can be an effective component in the visualization of multiple attribute data, in particular weather data. Toward that end, a new directional texture-based data visualization technique is described and exhibited. Results of user-based evaluations of directional textures in visualization are also reported.

### Designing and Annotating Metro Maps with Circular Routes

**Hsiang-Yun Wu<sup>1</sup>, Sheung-Hung Poon<sup>2</sup>, Shigeo Takahashi<sup>1</sup>, Masatoshi Arikawa<sup>1</sup>, Chun-Cheng Lin<sup>3</sup>, Hsu-Chun Yen<sup>4</sup>**

<sup>1</sup>The University of Tokyo, Japan; <sup>2</sup>National Tsing Hua University, Taiwan; <sup>3</sup>National Chiao Tung University, Taiwan; <sup>4</sup>National Taiwan University

Schematic metro maps provide an effective means of simplifying the geographical configuration of public rapid transportation systems. Nonetheless, travelers still find it difficult to identify routes of specific topology on the maps because it is usually hidden behind the conventional octilinear layout of the entire map. In this paper, we present an approach to designing schematic maps with circular routes, which are drawn as circles together with annotation labels for guiding different traveling purposes. Our idea here is to formulate the aesthetic criteria as mathematical constraints in the mixed-integer programming model, which allows us to either align stations on the circular route at a grid if they are interchange stations or non-interchange stations on a circle otherwise. We then distribute the annotation labels associated with stations on the circular route evenly to the four side boundary of the map domain in order to make full use of the annotation space, while maximally avoiding intersections between leader lines and the metro network by employing a flow network algorithm. Finally, we present several experimental results generated by our prototype system to demonstrate the feasibility of the proposed approach.

### A Visualization Tool for Building Energy Management System

**Takayuki Itoh<sup>1</sup>, Masato Kawano<sup>2</sup>, Shuji Kutsuna<sup>2</sup>, Takeshi Watanabe<sup>2</sup>**

<sup>1</sup>Ochanomizu University, Japan; <sup>2</sup>NTT Facilities

Many public offices and companies manage their energy consumption by Building Energy Management System (BEMS). It is not an easy task to determine whether the past energy consumption was really necessary or just wasted. Visualization for energy consumption is useful to understand the situations of energy consumption to determine their necessity. This paper presents a visualization tool for energy consumption with BEMS. The tool firstly divides the daily variation of the energy usage and environmental measurements (e.g. temperature and humidity) into the meaningful number of patterns. It displays long-term polyline chart to represent the frequency of the daily pattern so that users can easily focus on particular dates at particular places. It also displays one-day polyline chart to represent the daily variation of the recorded values of the particular dates and places specified by users' click operations. The paper introduces the examples of visualization to demonstrate the effectiveness of the presented tool, with a real dataset of business office building.

### Layer-Centered Approach for Multigraphs Visualization

**Denis Redondo<sup>1,2</sup>, Arnaud Sallaberry<sup>1,3</sup>, Dino Ienco<sup>4</sup>, Faraz Zaidi<sup>5,6</sup>, Pascal Poncelet<sup>1,2</sup>**

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Recent advances in network science allows the modeling and analysis of complex inter-related entities. These entities often interact with each other in a number of different ways. Simple graphs fail to capture these multiple types of relationships requiring more sophisticated mathematical structures. One such structure is multigraph, where entities (or nodes) can be linked to each other through multiple edges.

In this paper we describe a new method to manage multiple types of relationships existing in multigraphs. Our approach is based on the concept of pair of nodes (edges) and, in particular, we study how nodes on different layers interact with each other considering the edges they share. We propose a two level strategy that summarizes global/local multigraph features. The global view helps us to gain knowledge related to the characteristics of layers and how they interact while the local view provides an analysis of individual layers highlighting edge



## iV2015 / CGiV2015 \_ Abstract

properties such as cluster structure. Our proposal is complementary to standard node-link diagram and it can be coupled with such techniques in order to intelligently explore multigraphs. The proposed visualization is tested on a real world case study and the outcomes point out the ability of our proposal to discover patterns present in the data.

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**Session iV2015\_1.4: Applications of Graph Theory**

Chair: Prof. Richard Laing, Scott Sutherland School, RGU, UK

**Fast Graph Drawing Algorithm Revealing Networks Cores**

Romain Giot, Romain Bourqui

Univ. Bordeaux / LaBRI, France

Graph is a powerful tool to model relationships between elements and has been widely used in different research areas. Size and complexity of newly acquired graphs prohibit manual representations and urge a need for automatic visualization methods. We are interested with the node-links diagram which represents each node as a glyph and edge as a line between the corresponding nodes.

We present a novel layout algorithm that emphasizes the cores of very large networks (up to several hundred thousand of nodes and million of edges) in few seconds or minutes. Our method uses a hierarchical coreness decomposition of the graph and a combination of existing layout algorithms according to the clusters topologies. Area-aware drawing algorithms which produce node overlap-free drawings are used to reduce the visual clutter. Edges are bundled along the hierarchy of clusters to highlight the network communities and reduce edge visual clutter.

We validated our approach by comparing our method against one of the fastest method of the state of the art on a benchmark of 23 large graphs extracted from various sources. We have statistically proved that our method performs faster while providing meaningful results.

**Mental map models for edges**

Jana Katreniaková, Martin Ďuriš

Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovak Republic

When drawing a graph, the user's actions on the graph may lead to a drawing which is very different from the drawing before the interaction. The established aesthetic criteria are not sufficient to allow the users to fully track the changes to the graph. The mental map of nodes and edges is lost. We have taken the existing work, which focused on mental maps for nodes, and extended it naturally to the edges. We present two models that allow edges to be drawn to preserve the mental map as much as possible. Our preliminary tests indicate that the produced edge drawing is similar to the original one and the other aesthetic criteria have mostly been preserved.

**Distributed Graph Layout with Spark**

Antoine Hinge, David Auber

LaBRI / Université de Bordeaux, France

This paper presents a novel way to draw very large graph, especially those too big to fit the memory of a single computer. This new method uses the recent advancements in distributed computing, notably using the Apache MapReduce library called Spark. Our implementation of a force-directed graph drawing algorithm and the way to compute repulsive forces in MapReduced are exhibited. We demonstrate the horizontal scalability of this algorithm and show layout obtained with our method on a Hadoop cluster.

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**Session iV2015\_1.5: Information Visualisation - Usability & Evaluation**

Chair: Chair: Prof. Ebad banissi, London South bank University, UK

**Simplified Stress and Simplified Silhouette Coefficient to a Faster Quality Evaluation of Multidimensional Projection Techniques and Feature Spaces**

Danilo Medeiros Eler, Jaqueline Batista Martins Teixeira, Priscila Alves Macanhã, Rogério Eduardo Garcia

UNESP, Univ Estadual Paulista, Brazil

Several multidimensional projection techniques have been proposed in literature over the last years. The quality of those techniques can be evaluated based on the dimensionality reduction or the clusters quality. The first evaluation aim to verify if the similarities from multidimensional space are preserved in projected space. While the second evaluation aim to verify if instances from a same class are placed in a same cluster in projected space. Respectively, Stress and Silhouette Coefficient are the main measures to quality evaluations. In this paper we present two new approaches -- named Simplified Stress and Simplified Silhouette Coefficient -- to speed up the computation of measures, enabling a faster evaluation of multidimensional projection techniques and feature spaces. We present experiments showing the high correlation between results obtained using original approaches and results obtained with those proposed in this paper. In addition, we show how to use Simplified Silhouette Coefficient to perform a fast feature space evaluation and selection.

**Towards the Understanding of Interaction in Information Visualization**

Ana Raquel Figueiras

FCSH - Universidade Nova de Lisboa, Portugal

Over the past few years the web has been responsible for the rise in popularity of visualizations and it seems that interactive or playable visualizations have become more popular and end up standing out more.

The use of interactivity and animation has been extensively discussed in information visualization research, but there has been some controversy in relation to its benefits.

Additionally, there is still little empirical evidence about its efficacy in terms of improving understanding of the data and there is few research that points out guidelines of how to incorporate it successfully and that proves that playable visualizations are indeed more enjoyable and popular among users.

In order to guide future research on the actual benefits of interactivity in visualization it is important to understand what types of interactivity are currently being used in the field and to have a framework to help discuss and evaluate interaction techniques.

After conducting an extensive review of popular visualizations and their interactive capabilities, we propose eleven categories of interaction techniques: filtering, selecting, abstract/elaborate, overview and explore, connect/relate, history, extraction of features, reconfigure, encode, participation/collaboration, and gamification.

### Plot Balalaika: Simple Chart Designs for Long-Tail Distributed Data

**Mark Shovman**<sup>1,2</sup>

<sup>1</sup>Eyeway Vision, Israel; <sup>2</sup>Yahoo Labs Haifa

Current approaches to summarising large arrays of data for presentation and communication mostly comprise reporting means with, e.g., bar-charts. These methods are well-suited for unimodal, ideally normally- or near-normally distributed data, but are misleading for long-tail distributions that comprise most of the Big Data.

We propose a succinct visualisation format, parallel in simplicity to bar-charts, that is suitable for communicating the gist of long-tail distributions, and show its efficiency empirically.

### Heuristic Evaluation of a t-Commerce Prototype

**Nikolas Jorge Santiago Carneiro**<sup>1</sup>, **Carlos Gustavo Resque Santos**<sup>1</sup>, **Tiago Davi Oliveira de Araujo**<sup>1</sup>, **Brunelli Pinto Miranda**<sup>1</sup>, **Bianchi Serique Meiguins**<sup>1</sup>, **Anderson Gregorio Marques Soares**<sup>2</sup>

<sup>1</sup>Universidade Federal do Pará, Brazil; <sup>2</sup>Universidade Federal Rural da Amazônia

The current Brazilian context in television audiovisual communication is in transition from analogical to digital technology. One of the main reasons for this motion towards Interactive Digital Television (iDTV) is the improvement in the user experience over this platform. Considering this motion, this work applied suitable interaction design and usability concepts from the Nielsen's heuristics [5] into a visualization prototype to the support of visual analysis of products in electronic commerce over TV (t-commerce). In this work we conducted a usability check in an existing information visualization prototype, in order establish whether or not it follows usability standards and in order to make it more usable to the user.

## Session iV2015\_1.6: Information Visualisation Theory & Practice

Chair: Prof. Feng Lin, Nanyang Technological University, Singapore

### Visual Analysis of Source Code Similarities

**Michael Burch**, **Julian Strotzer**, **Daniel Weiskopf**

VISUS, University of Stuttgart, Germany

Software systems typically consist of many lines of source code organized in several files hierarchically structured into directories and packages. Since the code is the key data in software development, in many scenarios an overview about it is required, in particular for similar code passages. In this paper we investigate the visual analysis of source code similarities for local as well as global code passages. To reach this goal we first compute all subsequence occurrence frequencies (support metric) and relative occurrence frequencies (confidence metric) in local as well as global code regions. The resulting textual data attached by their occurrence values is displayed in a triangular matrix. Several interaction techniques are integrated in our visualization tool which are illustrated in the corresponding case study illustrating similarities in source code written in Assembler consisting of 10,641 characters.

### Indexed dataflow network: A multi-layer and programmable architecture to integrate both visualization pipelines and scene graphs

**Romain Guillemot**, **Stéphanie Prevost**, **Laurent Lucas**

Université de Reims Champagne-Ardenne (URCA) - CReSTIC EA3804, France

Visualization pipelines and scene graphs are widely used paradigms in rendering applications, the former as a key concept in scientific visualization while the latter provides a powerful representation for 3D scenes in graphics applications. Despite an apparent disparity in

usage, they show structural similarities by both using a graph-based architecture. Nevertheless, few attempts have been made to integrate both visualization pipelines and scene graphs in an unified design. This paper presents an architecture based on an extended dataflow network

which allows implicit invocation of callbacks on network events. Events are then handled by programmable layers on top of the "dataflow layer" to dynamically build scene graph structures and define a multi-paradigm model interface, which forms what we call an "indexed dataflow network". We show an implementation of our architecture using NVIDIA SceniX scene management engine and Qt's model/view framework.

### Visualizing the Evolution of Module Workflows

**Marcel Hlawatsch**<sup>1</sup>, **Michael Burch**<sup>1</sup>, **Fabian Beck**<sup>1</sup>, **Juliana Freire**<sup>2</sup>, **Claudio Silva**<sup>2</sup>, **Daniel Weiskopf**<sup>1</sup>

<sup>1</sup>VISUS, University of Stuttgart, Germany; <sup>2</sup>Polytechnic School of Engineering, New York University

Module workflows are used to generate custom applications with modular software frameworks. They describe data flow between the modular components and their execution under certain parameter configurations. In many cases, module workflows are modeled in a graphical way by

the user. To come up with the final result or to explore multiple solutions, they often undergo many iterations of adaptation. Furthermore, existing workflows may be reused for new applications. We visualize the evolution of module workflows with a focus-and-context approach and visualization techniques for time-dependent data. Our approach provides insight into user behavior and the characteristics of the underlying systems. As our examples show, this can help identify usability issues and indicate options to improve the effectiveness of the system. We demonstrate our approach for module workflows in VisTrails, a modular visualization system that allows building custom visualizations by combining different modules for processing and visualizing data.

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## Session CGiV2015\_1.7: Geometric Modeling & Imaging

Chair: Prof. Chi Man PUN, University of Macau, Macau (S.A.R China)

### An Immersive and Interactive Visualization System by Integrating Distinct Platforms

**Mário Popolin Neto**<sup>1,2</sup>, **Alessandro Moraes**<sup>2</sup>, **Danilo Medeiros Eler**<sup>3</sup>, **José Remo Ferreira Brega**<sup>2</sup>

<sup>1</sup>IFSP - Registro, Brazil; <sup>2</sup>UNESP - Bauru, Brazil; <sup>3</sup>UNESP - Presidente Prudente, Brazil

Visualization applications can be performed on distinct platforms, such as mobile devices and multi-projection systems. Each platform offers specific features to provide further data understanding, and a system that integrates these platforms in a complementary manner is a real challenge. In this paper, we present an immersive and interactive visualization system that aims to explore data from relational databases using 3D graphs representations, where multiple simultaneous users can visualize and interact with the data through a multi-projection system and mobile devices. A single visualization application was created for both platforms using the Unity game engine, and an Unity external package for Virtual Reality applications development, that supports multi-projection system over a PC cluster and passive stereoscopy. Our visualization system aims to provide the users a better data understanding using a 3-screens multi-projection system as data overview, and mobile devices as display and interaction device for navigation and additional information visualization. We also introduce an user case, where the visualization system is used in order to support developers regarding structural problems in a large relational database.

### Image-based Hair Pre-Processing for Art Creation: A Case Study of Bas-Relief Modelling

**Wenshu Zhang**, **Meili Wang**, **Jian Chang**, Ruofeng Tong, Jian J Zhang  
Bournemouth University, UK

To better capture the shapes as well as the rich dynamics of hair, image based modelling techniques have been developed for reconstructing their 3D geometry and important visual features. Most hair images contain inevitable noises which impair reconstructed hair models.

Therefore we propose to pre-process hair images and provide an orientation map of hair strands to enhance the follow-on modelling.

To demonstrate the usage of pre-processing techniques, we apply our pre-processing results for bas-relief stylisation and modelling of hair from image inputs. We compare different techniques to estimate hair orientations, adopting four types of filter mechanisms. Our analysis of their performance sheds insight on designing a suitable pre-processing technique for hair reconstruction from images. Several examples of bas-relief creation validate the effectiveness of the proposed approach.

### N-polar Visualization: Visual Analytics for Exploring Data Objects with Multiple Interactive Anchors

**Taeil Jeon**, Jihyun Lee, Wonjong Rhee, Bongwon Suh  
Seoul National University, (South Korea)

In this paper, we propose N-polar Visualization, an interactive visualization technique to graphically represent how the data objects are related to multiple anchors. This technique allows the users to place a particular set of data objects as anchors on a circle and radially move them around. It enables the users to control the arrangement of the anchors and interactively perform multiple comparisons of the dataset. To evaluate the feasibility and effectiveness of the technique, we performed a series of pilot studies by applying the technique on the UN General Assembly voting data. The exploration allowed us to identify a number of common patterns. In addition, we found that actual historical events can be successfully abstracted in corresponding visual layouts.

### Shape Preserving Positive Rational Trigonometric Spline Surfaces

**Muhammad Sarfraz**, Farsia Hussain, Malik Zawwar Hussain  
Kuwait University, KW

This paper concentrates on shape preservation of 3D positive data. A piecewise rational bi-cubic trigonometric function with six parameters has been built to preserve positive shape of 3D positive data. Four of the parameters are constrained to generate the positivity preserving surface through positive data, whereas, the remaining two parameters serve as free parameters for shape liveness of positive surface.

### Interpolation of Discrete time Signals using Cubic Spline Function

**Malik Zawwar Hussain**<sup>1</sup>, **Misbah Irshad**<sup>2</sup>, **Muhammad Sarfraz**<sup>3</sup>, **Nousheen Zafar**<sup>1</sup>

<sup>1</sup>University of the Punjab, Pakistan; <sup>2</sup>Lahore College for Women University, Pakistan; <sup>3</sup>Kuwait University, Kuwait

In this paper, a technique, which uses cubic spline, is proposed for the interpolation of discrete time signals and illustrated with examples. The results obtained are compared with the results of nearest neighbor interpolation and linear interpolation of discrete time signals. The analysis is made by calculating errors.

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## Session iV2015\_1.8: Information Visualisation – Applications

Chair: Prof. Shunsuke Kamijo, The University of Tokyo, Japan

### A Concurrent Architecture proposal for Information Visualization Pipeline

**Nikolas Jorge Santiago Carneiro, Carlos Gustavo Resque Santos, Tiago Davi Oliveira de Araujo, Brunelli Pinto Miranda, Bianchi Serique Meiguins**

Universidade Federal do Pará, Brazil

This paper identifies an opportunity to reduce the latency in information visualization (InfoVis) systems, exploring the parallelization of the visualization pipeline architecture. We propose a concurrent architecture where the visualization pipeline stages are modified to execute as producers and consumers threads. The threads synchronization is done by memory barriers and the data flow pass the pipeline through a unique data structure, called ring buffer, which reuses a contiguous space pre-allocated in memory. Two InfoVis prototypes were developed in java, the first one using sequential pipeline and the other using concurrent pipeline. The results obtained with concurrent architecture in comparison with sequential pipeline presented less execution time and memory allocation for data visualization rendering.

### Self-Organizing Map-Based Feature Visualization and Selection for Defect Depth Estimation in Oil and Gas Pipelines

**Abduljalil Abdulrahman Mohamed<sup>1</sup>, Mohamed Hamdi<sup>1</sup>, Sofiene Tahar<sup>2</sup>**

<sup>1</sup>Ahmed Bin Mohamed Military College (ABMMC), Qatar; <sup>2</sup>Concordia University/Electrical and Computer Engineering Department, Montreal, Canada

Magnetic Flux Leakage (MFL) sensors are commonly utilized to detect defects in oil and gas pipelines and determine their depths and sizes. As a preprocessing step, MFL data are often reduced into a representative feature set that is capable of accurately estimating pipeline defect depths. However, this estimation capability may vary depending on the features used, which necessitates the need for selecting the most relevant ones. In this paper, self-organizing maps (SOMs) are used as feature visualization tool for the purpose of selecting the most appropriate features. First, a self-organizing map (SOM), i.e., a two-dimensional discretized representation of the input space of the training samples for the features, is produced. The SOM weights for each individual input feature (weight plane) are displayed then visually analyzed. Irrelevant and redundant features can be efficiently spotted and removed. The remaining “good” features (i.e., selected features) are then used as an input to a feedforward neural network for defect depth estimation. Experimental work has shown the effectiveness of the proposed approach. For instance, within  $\pm 5\%$  error-tolerance range, the obtained estimation accuracy, using the SOM-based feature selection, is 86.7%, compared to 74% when all input features are used (i.e., no feature selection is performed); and within  $\pm 10\%$  error-tolerance range, the obtained estimation accuracy, using the SOM-based feature selection, is 97%, compared to 86% when all the input features are used (i.e., no feature selection is performed).

### The Recommendation Dashboard: A System to Visualise and Organise Recommendations

**Gerwald Tschinkel<sup>1</sup>, Cecilia di Sciascio<sup>1</sup>, Belgin Mutlu<sup>1</sup>, Vedran Sabo<sup>1,2</sup>**

<sup>1</sup>Know Center GmbH, Austria; <sup>2</sup>Graz University of Technology

Recommender systems are becoming common tools supporting automatic, context-based retrieval of resources. When the number of retrieved resources grows large visual tools are required that leverage the capacity of human vision to analyse large amounts of information. We introduce a Web-based visual tool for exploring and organising recommendations retrieved from multiple sources along dimensions relevant to cultural heritage and educational context. Our tool provides several views supporting filtering in the result set and integrates a bookmarking system for organising relevant resources into topic collections. Building upon these features we envision a system which derives user's interests from performed actions and uses this information to support the recommendation process. We also report on results of the performed usability evaluation and derive directions for further development.

## Session iV2015\_2.1: Information Visualisation – Theory & Techniques

Chair: Gilles Venturini, University Francois Rabelais of Tours, France

### A Color-based Visualization Approach to understand harmonic structures of Musical Compositions

**Delfina Malandrino, Donato Pirozzi, Gianluca Zaccagnino, Rocco Zaccagnino**

University of Salerno, Italy

Music expertise is the ability to understand the structural elements of music compositions by reading musical scores or even by simply listening to music performance. Although the most common way to learn music is through the study of musical scores, this approach is demanding in terms of learning ability, given the required implicit knowledge of music theoretical notations and concepts.

In this work we define a two-level color-based approach, that exploits graphical visualization techniques to represent data structures of classical music, and to perform harmonic analysis of musical compositions. Our main goal is to make easier and very quick the study of classical notations (recognized as a tedious and difficult task in the field), by providing individuals with a mechanism that clarifies complex relationships in music using visual clues.

We performed a preliminary study to evaluate the effectiveness of our approach as well as participants' perceptions about its usefulness and pleasantness. The results of the study provided us with positive and useful feedback on the effectiveness of our approach as well as further directions to explore.

### Edge Visual Encodings in Matrix-Based Diagrams

**Joris Sansen<sup>1</sup>, Romain Bourqui<sup>1</sup>, Bruno Pinaud<sup>1</sup>, Helen Purchase<sup>2</sup>**

<sup>1</sup>University of Bordeaux, France; <sup>2</sup>University of Glasgow, UK

The most common depictions of graphs are node-link diagrams (NLDs) and matrix-based diagrams (MBDs). Making valid comparisons between these two visualisation techniques is difficult because they are each subject to a variety of representation parameters with respect to graph layout (NLD) and node ordering (MBD), meaning that any given choice of layout and order (even if they fulfil some aesthetic criteria) may influence experimental results. To overcome this problem, we propose a MBD-based technique which hybridises the entity visual encoding of a MBD with the edge visual encoding of a NLD. Using a typical MBD, we propose three edge visual encoding evolutions to ultimately render edges like in a NLD while preserving nodes depiction and order. Such encoding evolutions allow us to perform an experimental evaluation of user performances for a path finding task without the above limitations.

We show that for a path finding task, our edge visual encoding evolutions tend to improve the user experience when analysing and interacting with a MBD.

### Visualizing a set of multiple time series with an aggregate stacked graph

**Nicolas Greffard, Pascale Kuntz**

LINA-DUKe, University of Nantes, France

Time series analysis is the centerpiece of numerous research fields from stock analysis to topic mining. While the univariate case is still commonplace, there is an increasing need for tools providing features to study the relationships between multiple time series.

Initially motivated by a interdisciplinary research agenda with sociologists and musicologists, we propose an extension of the famous stacked graph to display an overview of a set of multiple and item-set time series. This visualization allows the exploration of the general tendencies observed on a population and the comparison of patterns between groups. A proof-of-concept is presented on real-life data extracted from a recent study on the daily music listening behavior.

### FATuM - Fast Animated Transitions using Multi-Buffers

**Alexandre Perrot, David Auber**

Universite de Bordeaux, France

The rise of Big Data and powerful mobile devices calls for libraries able to render a large number of visual elements and make fast animations without loss of frame rate. We introduce the FATuM library as a middleware for visualization. With a single abstraction for visual elements based on the work of Bertin and adaptation of the double buffering technique, we enable animated visualization of large datasets in native applications and in the browser using the same codebase. Our system does not differentiate animated from static rendering, thus reducing code complexity and guaranteeing smooth animation. We show that our system maintains 60fps for up to 200.000 visual elements in a native application and 30fps for 100.000 visual elements in a web browser.

### Natural User Interface Design in DA-TU: An Interactive Clustered Data Visualization System

**Shizhe He<sup>1</sup>, Mao Lin Huang<sup>1,2</sup>, Lin Zhu<sup>2</sup>**

<sup>1</sup>University of Technology, Sydney, Australia; <sup>2</sup>Tianjin University, China

Clustered Graph Visualization, such as DA-TU [2], has been successfully applied in the field of large scale relational data visualization for data analytics. However, it was very inefficient in interactions by using WIMP based HCI in DA-TU, in which a Control Panel was required to swap among eight different modes of operation. In this paper, we attempt to use a new multi-touch enabled NUI method for supporting interactions in DA-TU. We aim to increase the efficiency of HCI process in DA-TU. To achieve this, we first transplanted DA-TU from WIMP based PC to NUI based iPad. We then designed a set of new multi-finger gesture vocabularies to support DA-TU navigations in tablet environment. Adopting such set of rich HCI vocabularies achieves better efficiency and user experience in data exploration. We have conducted usability studies that demonstrated our hypothesis.

## Session iV2015\_2.2: Knowledge Visualization and Visual Thinking

Chair: Sebastian Kernbach, University of St. Gallen, Switzerland

### A Gesture Control Framework targeting High-resolution Video Wall Displays

**Bernhard Klein**

Future Cities Laboratory, Singapore-ETH Centre, 1 Create Way, Singapore 138602

Recent advances in display and user interface technologies create new opportunities for participatory urban planning. Whereas touch screens enable direct screen interactions for intuitive remodeling of urban simulations, high resolution video walls offer true-to-life or human-scale scenario visualizations. Multi-touch screen environments finally function as an interactive user interface for the entire urban simulation pipeline. However intuitive and preferably natural interactions for simple reconfiguration, overarching tool management or complex tool interaction remain a major challenge.

For this reason we have implemented a gesture control framework that uses multi-modal input devices to satisfy all gesture use cases and integrates a display management system for seamless interaction with our multi-screen infrastructure.

To understand the implications of this novel approach, we conducted preliminary user trials with urban planning experts and technicians. The results indicated that the system provides a fluid and natural user experience for exploring and analyzing urban planning data.

### Value Lab Asia: A Space for Physical and Virtual Interdisciplinary Research and Collaboration

**Afian Anwar<sup>1</sup>, Bernhard Klein<sup>2</sup>, Matthias Berger<sup>2</sup>, Stefan Muller Arisona<sup>2</sup>**

<sup>1</sup>Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, United States of America; <sup>2</sup>Future Cities Laboratory, Department of Architecture, ETH Zurich, Switzerland

Many contemporary research tasks require complex decision making and interdisciplinary collaboration among different groups of experts and stakeholders. Nowhere is this more apparent than in the planning and design of future cities - rapidly growing cities where the development and allocation of energy, housing, transportation and other scarce resources requires the active participation of architects, urban planners, government stakeholders and private citizens. In this paper, we show how recent advances in display technology can facilitate such collaboration and create new opportunities for participatory urban planning. We introduce the Value Lab Asia as a model for cooperative planning and value creation, and show how a multi-screen display management framework called the Tool Library integrates the laboratory's physical and software infrastructure with the planning process.

### The Design Process: A Visual Model

**Sabrina Bresciani**

University of St. Gallen, Switzerland

Knowledge visualizations are often created by practitioners and managers, not necessarily by expert graphic designers. Non-experts – as well as novice designers – can be puzzled and overwhelmed by the complexity of the design process: it is unclear how to start and which are the main phases and their sequence. Often times even experienced designers mistakenly start by selecting a tool or a solution, instead of considering the audience and its needs. The aim of this conceptual piece is to assemble the main phases (and related procedures and tools) of the design process to provide a pragmatic visual guide for students and practitioners. It also highlights the highly cyclical nature of designing through a structured iterative process of prototyping and testing. The model can be utilized for a broad spectrum of applications, including the creation of knowledge visualization, information visualizations, graphic design or other types of product. The examples provided in this paper are specifically related to knowledge visualization.

### Dynamic Multi-View, Multi-Format, Multi-User Visualizations: For Future Cities

**Bernhard Klein<sup>1</sup>, Remo Burkhard<sup>1</sup>, Christine Meixner<sup>2</sup>, Lukas Treyer<sup>2</sup>**

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This paper introduces the concept of a dynamic Multi-View, Multi-Format, Multi-User Visualizations. It also suggests aligning all visualization branches to a common problem, namely the design and implementation of future cities, such as Jakarta.

While a lot of visualization research has extensively discussed the emotional, cognitive and coordinative benefits of visual representations, the application of such tool to solve a grand societal problem has been neglected. We suggest focusing on Future Cities, since they need solutions and because the field seems to be ideal to align the various subgroups of visualization research. We derived this insight from about 1000 events in our physical value lab and our own software developments, the Visual Manager and the Shuffler, a framework to put together complementary coordinated views. The innovative part of this framework is that different visual representations, complementary business logics and datasets can be distributed to different views, which calls for more transdisciplinary work in the design of dynamic multi-view, multi-format and multi-user software.

This paper is relevant for researchers in all subgroups of visualization research, especially Knowledge Visualization and Information Visualization.

**Session Mediviz2015\_2.3: BioMedical Visualization**

Chair: Prof. Urska Cvek, Louisiana State University Shreveport, USA

**Semi-automatic compartment extraction to assess 3D bone mineral density and morphometric parameters of the subchondral bone in the tibial knee****Rabaa Youssef<sup>1</sup>, Hamid Bouhadoun<sup>2</sup>, Jean Denis Laredo<sup>3</sup>, Christine Chappard<sup>2</sup>**<sup>1</sup>CEA-LIST CEA-LinkLab, Tunisia; <sup>2</sup>Laboratoire de Bioingénierie et Bioimagerie Ostéo-articulaire (B2OA), UMR CNRS 7052, Université Paris Diderot, PRES Sorbonne Paris Cité, Paris, France; <sup>3</sup>Service de Radiologie Ostéo-Articulaire, Hôpital Lariboisière, Paris, France

We present a new semi-automatic method to extract the bone mineral density (BMD) and bone proportion (BV/TV) with the aim to analyze subchondral bone changes due to knee osteoarthritis in clinically relevant compartments (medial versus lateral) and (anterior versus posterior). This method based on convex hull is developed initially on high resolution peripheral computed tomography but can potentially be applied in clinical CT with sufficient resolution.

**Web-based Information Retrieval and Visualization for Diagnostic Radiology****Ben Chua<sup>1</sup>, Xiuling Liu<sup>2</sup>, Bin Dong<sup>2</sup>, Feng Lin<sup>1,2</sup>**<sup>1</sup>Nanyang Technological University, Singapore; <sup>2</sup>Hebei University, China

To improve safety and ease operations in using the medical imaging devices and increase the influx of digital imagery, there is a need for Radiology Information System (RIS) and Picture Archiving and Communication System (PACS) to be used in conjunction to establish a secure network for transmission of patient information. We present a web-based RIS and PACS information retrieval and visualization system implemented for diagnostic radiology, addressing its benefits in workflow improvements, operational efficiencies and convenience for the users. The web application is based on the functional and non-functional requirements elicited on three major user groups, namely, patient, referring physician and radiologist. Novel methodology in the system design and visual analytics is also reported, including Use Case Design, Use Case Descriptions, Database Design, Web Navigation and Activity Diagrams. Experimental results are given to show its effective applications in a clinical setup.

**Augmented representations of clustered fiber bundles for interactive queries****Stefan Philips, Mario Hlawitschka, Gerek Scheuermann**

Leipzig University, Germany

Hierarchical fiber clustering is a promising way to analyze brain connectivity. A disadvantage of hierarchical fiber clustering is its difficult visualization. The simple presentation as a 2D tree is because of the amount of several thousand leaves visually too complex. We present a framework that allows the modification of the dendrogram visualization in a flexible way. The modified dendrogram visualization can convey additional information that grant an easier orientation within the hierarchical clustering. Beside the interaction with the dendrogram itself, it is also possible to make use of a 3D view and a clustering preview. To illustrate potential use cases, we present two usage examples that show the versatility of our framework.

**Enhancing Visual Perception and Directing Viewer's Attention in Interactive Direct Volume Rendering****AmirAli Sharifi, Pierre Boulanger**

University of Alberta, Canada

Interactive visualization of medical data plays an increasingly vital role in clinical diagnosis. Cluttered views, lack of visual cues, etc. are some of the problems that exist specially when projecting a 3D rendering of a Computed Tomography data on a 2D screen. In this paper we proposed two synthetic visual cues. They facilitate perception by removing visual clutter while maintaining context, directing viewers' attention to the object of interest, and consequently enhancing clinical diagnosis. Our proposed cues can be used both individually or combined with any other existing cues. Although our methods have been created with medical visualization in mind, it is possible to use them in other volume rendering applications as well.

**A semantically adaptable integrated visualization and natural exploration of multi-scale biomedical data****Ricardo Millan<sup>1</sup>, Asan Agibetov<sup>2</sup>, Jan Rzepecki<sup>1</sup>, Marta Ondrésik<sup>3</sup>, Alexander Vais<sup>1</sup>, Joaquim Miguel Oliveira<sup>3</sup>, Giuseppe Patané<sup>2</sup>, Karl-Ingo Friese<sup>1</sup>, Rui L. Reis<sup>3</sup>, Michela Spagnuolo<sup>2</sup>, Franz-Erich Wolter<sup>1</sup>**<sup>1</sup>Leibniz University of Hannover, Germany; <sup>2</sup>Consiglio Nazionale delle Ricerche, Italy; <sup>3</sup>Bs research Group, University of Minho, Portugal

The exploration of biomedical data which involves heterogeneous sources coming from different spatial scales and medical domains is a challenging topic in current research. In this work, we combine efforts regarding multi-scale visualization, multimodal interaction and knowledge formalization for the exploration of multi-scale biomedical data. The knowledge formalization stores and organizes the information sources, the integrated visualization captures all relevant information for the domain expertise of the user and the multimodal interaction provides a natural exploration. We present a concrete example of use of the proposed exploratory system for a biologist investigating multi-scale pathologies.

**Session iV2015\_2.4: Visualization, Art, and Design**

Chair: Prof. Mao Lin Huang, University of Technology, Sydney, Australia; Tianjin University, China

**User Interface Considerations for Browser-Based Just-in-Time-Retrieval****Christin Seifert, Jörg Schlötterer, Michael Granitzer**

Passau University, Germany

With the availability of free online enrichment services injection of additional, external resources in existing Web content becomes more and more wide-spread. For the specific area of just-in-time retrieval of digital resources based on web page content, there are no specific guidelines of how to design and integrate the additional user interface components. In this paper, we

conceptualize related user interface issues, investigating the central questions: (i) how can a user be visually notified that additional results are available, and (ii) with which user interface elements should the results be presented. Concretely, we identified four different notification styles and six different result presentation styles. In a survey-based study with 75 participant we elicited the users' preferences, revealing a clear preference for the representation style (split pane) and a strong preference for three notification styles (notification bubble, icon appearance and change of icon's appearance). The latter preferences are related to the preferred browser. The results can serve as guideline for designing web-based user interfaces for just-in-time retrieval.

### Quick Vis: A Web-Based Visualization Delivering Flexible Exploration of User-Driven Analytics

**Alessandro Simone Agnello, Haim Levkowitz**

University of Massachusetts Lowell, United States of America

Web visualizations have become an integral tool for representing data in an accessible and intelligible format. This paper presents a new workflow, Quick Vis, which enables an analyst to inspect data sets and manipulate properties within any data set. This subsequently engages our analytic engine, saves each property set as a profile, and allows comparisons between profiles for further findings. In addition to describing our proposed techniques, we provide a case study that demonstrates the usefulness of Quick Vis for real life problems.

### Visualizing Süleymanname: Analyzing and Visualizing Embedded Spatiotemporal Information in a 16th Century Illustrated Manuscript

**Ferhat Sen**

Aalto University School of Arts, Design and Architecture, Department of Media, Finland

In this paper, we present the analysis and the visualization process of spatiotemporal information in a 16th century illustrated manuscript. The purpose of this research is to find alternative ways of exploring the illustrations of a 16th century manuscript. Using the artifact analysis methods, we analyzed 69 illustrations in the manuscript of Süleymanname from the point of view of time and space. Employing media visualization techniques, we generated three visualizations based on the created dataset containing the metadata about the illustrations. In the visualizations, we used the actual media artifacts as representation of data instead of the graphical primitives like points. The resulting visualizations enable to explore the collection of the illustrations in historical and geographical contexts.

### Senescence: An Age-Based Character Simulation Framework

**Suren Deepak Rajasekaran, Nicoletta Adamo-Villani**

Purdue University, United States of America

The paper presents the development and initial validation of the Senescence character framework, a simulation tool that can be used for rigging muscle deformer-based humanoid characters, with support for age. The senescence framework allows the user to rig any bipedal

3D character and manipulate skeleton and muscle parameters in order to render the age of the character realistically. The framework was developed using Python, Maya Embedded Language and PyQt. A study with 100 subjects was conducted to determine whether participants were able to perceive the age of the characters simulated with the Senescence framework. Findings show that while subjects were able to perceive age differences, they were not able to identify the age of the simulated characters with high level of accuracy. Results also show that subjects with animation expertise were able to identify the age of the characters more accurately than subjects without animation experience.

### Examining User Experiences Through A Multimodal BCI Puzzle Game

**Fotis Liarokapis<sup>1</sup>, Athanasios Vourvopoulos<sup>2</sup>, Alina Ene<sup>3</sup>**

<sup>1</sup>Masaryk University, Czech Republic; <sup>2</sup>University of Madeira, Portugal; <sup>3</sup>Coventry University, UK

This paper presents a study of user's experiences in low cost multimodal brain-computer interface (BCI) games. A 2D puzzle game (Tetris) was designed featuring two modes (non-BCI and BCI input) which require users to meditate in order to change the game difficulty. Thirty participants were asked to report on the two modes separately. Results indicate that a one-sensor BCI device in games positively contributes to enjoyability but raises mental demand. There was no reported drop in performance in a hybrid system where direct control is not handled by BCI input. It was found that meditation could not be self-regulated making short-term direct control a bad design decision in future BCI gaming scenarios for one-sensor headsets.

### Perceived Realism of Crowd Behaviour with Social Forces

**Stuart O'Connor<sup>1</sup>, Fotis Liarokapis<sup>2</sup>, Chrisina Jayne<sup>1</sup>**

<sup>1</sup>Coventry University, United Kingdom; <sup>2</sup>Masaryk University, Czech Republic

This paper investigates the development of an urban crowd simulation for the purposes of psychophysical experimentation. Whilst artificial intelligence (AI) is advancing to produce more concise and interesting crowd behaviours, the number or sophistication of the algorithms implemented within a system does not necessarily guarantee its perceptual realism. Human perception is highly subjective and does not always conform to the reality of the situation. Therefore it is important to consider this aspect when dealing with AI implementations within a crowd system aimed at humans. In this research an initial two-alternative forced choice (2AFC) with constant stimuli psychophysical experiment is presented. The purpose of the experiment is to assess whether human participants perceive crowd behaviour with a social forces model to be more realistic. Results from the experiment suggest that participants do consider crowd behaviour with social forces to be more realistic. This research could inform the development of crowd-based systems, especially those that consider viewer perception to be important, such as for example video games and other media.



**Session iV2015\_2.5: Visualisation**

Chair: Prof. Randolph George Goebel, University of Alberta, Canada

**Visual Analysis of Eye Movements by Hierarchical Filter Wheels****Marcel Hlawatsch, Michael Burch, Daniel Weiskopf**

University of Stuttgart, Germany

The algorithmic and visual exploration of spatio-temporal eye movement data is a challenging task, especially if we are interested in the movement patterns of a large number of study participants. For example, if prominent visualization techniques like heat maps or gaze plots are used we either lose the temporal information or get lost in visual clutter. In this work, we propose an approach for filtering saccadic eye movement data called hierarchical filter wheels. It supports the analysis of sequences of saccades by filtering them with respect to direction and length. The hierarchical filters are interactively generated on users' demand by creating a hierarchy of multiple filter wheels each filtering one element of the sequence. We use a bubble tree layout to represent the generated filter hierarchy. The node positions in our layout directly represent the spatial properties of the filter criteria allowing an intuitive incremental generation and understanding of filter hierarchies. We illustrate the approach by applying it to eye movement data formerly recorded in an eye tracking study investigating the readability of different node-link tree diagrams. We demonstrate how the hierarchical filter wheels can be used in combination with standard prominent gaze plots typically integrated into eye tracking software.

&lt;keynote Lecture&gt;

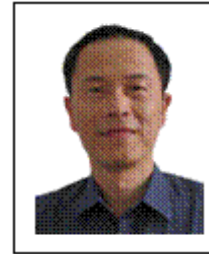
**Simulation and Visualization of Deformation with Anisotropic Materials****Prof. Feng Lin**

Nanyang Technological University, Singapore

Physically based deformable models have been a hot topic in the computer graphics and visualization community. However, most of the implemented models work only for isotropic materials, leaving the more general anisotropic materials less studied. We look into the challenging issues in dynamics simulation and realtime visualization for anisotropic materials, and present our theoretic and practical work along the way to provide an ultimate solution to deformation with such materials. First, our models are based on continuum mechanics and approximated by the Finite Element Method, and different approaches such as corotated, invertible, and total Lagrangian explicit dynamic. Secondly, for controls of the deformation, we have focused on materials that have their own internal structures (fibers) that determine the dynamics behaviors. We propose a fibers incorporated deformable model that can approximate the anisotropic elastic material properties. The orientation information is combined into the existing deformable models by element transformations along the given directions, which provide a control of the desired deformation. Thirdly, constraints for the strain density in linear elastic models are analyzed, and a positive-definite elasticity tensor is derived for an anisotropic material. Fourthly, an orthotropic deformation controlling frame-field is conceptualized and the frame construction tool is developed for the user to define the desired material properties. A

quaternion Laplacian smoothing algorithm is designed for propagating the rotation minimization frames into the entire object. And finally, the corotational linear FEM model is coupled with the orthotropic frame-field to realize a dynamics system, which can deal with large anisotropic deformations.

Keywords - Deformable Models, Anisotropic Materials, FEM, Dynamics Simulation, Visualization

**Bio-sketch**

**Dr Lin Feng** is currently an Associate Professor at School of Computer Engineering, Nanyang Technological University. His research interest includes biomedical informatics, imaging and visualization, computer graphics, as well as high-performance computing. He has worked for more than twenty funded research projects since joining NTU twenty years ago and has published about 200 technical papers. He has also won several prestigious research awards. Dr Lin is a Senior Member of IEEE.

**Session iV2015\_2.6: Information Visualisation - Application**

Chair: Prof. Marjan Trutschl, Louisiana State University Shreveport, USA

**Visualization of Crowd-Powered Impression Evaluation Results****Erika Gomi, Yuri Saito, Takayuki Itoh**

Ochanomizu University, Japan

There has been much collective knowledge on the Web, such as evaluation of restaurants, hotels, and manufactured products. Even though each of the participants on such Web sites usually just evaluate the small number of contents, these kinds of crowd-powered contents evaluation services bring us fruitful information. Visualization is a useful tool to carefully observe the evaluation results and discover complex trends of the evaluation. This paper presents our study on visualization of the crowd-powered contents evaluation. Firstly we developed a contents evaluation technique applying an interactive genetic algorithm, which presents contents estimated to be highly or poorly evaluated. Then we had a case study with various appearances of female face images to collect the evaluations. Finally, we visualized the result by applying an image browser CAT. This paper discusses how the visualization result depicts the trends of the evaluation on appearance of women.

**Web based Time-tunnel: An Interactive Multidimensional Data Visualization Tool Using Genetic Algorithm****Ryuuya Akase, Yoshihiro Okada**

Kyushu University

We present web based Time-tunnel that renders 3D charts of time series multidimensional data in a browser. The system supports to find differences and similarities between charts by

overlapping some charts. Nonetheless, it can be difficult to distinguish the charts if we overlap many charts. Therefore, our system optimizes data selection by using genetic algorithm, and it visualizes some charts that has a strong relation between data. In addition, users can share the visualized result with other users by using a specific URL generated by the system. Finally, we analyze actual data sets in order to test usability of the system.

### **ThreadCity: Combined Visualization of Structure and Activity for the Exploration of Multi-threaded Software Systems**

**Sebastian Hahn, Matthias Trapp, Nikolai Wuttke, Jürgen Döllner**

Hasso-Plattner-Institut, Germany

This paper presents a novel visualization technique for the interactive exploration of multi-threaded software systems. It combines the visualization of static system structure based on the EvoStreets approach with an additional traffic metaphor to communicate the runtime characteristics of multiple threads simultaneously. To improve visual scalability with respect to the visualization of complex software systems, we further present an effective level-of-detail visualization based on hierarchical aggregation of system components by taking viewing parameters into account. We demonstrate our technique by means of a prototypical implementation and compare our result with existing visualization techniques.

### **ConcentriCloud: Word Cloud Visualization for Multiple Text Documents**

**Steffen Lohmann, Florian Heimerl, Fabian Bopp, Michael Burch, Thomas Ertl**

University of Stuttgart, Germany

Word clouds provide a simple and effective means to visually communicate the most frequent words of text documents. However, only few word cloud visualizations support the contrastive analysis of multiple texts. This paper introduces ConcentriCloud, a structured word cloud that merges the words from several text documents into a single visualization. The weighted words are arranged in a concentric layout, with those representing the individual documents on the outer circle and the merged ones on inner circles. Interaction techniques allow to further analyze the word cloud and to provide details on demand. The approach has been implemented and tested on several examples. A qualitative evaluation confirms the general value of ConcentriCloud and reveals benefits and limitations.

### **Session iV2014\_2.7: Knowledge Visualization and Visual Thinking**

Chair: Bernhard Klein, Future Cities Laboratory, Singapore-ETH Centre, Singapore

#### **The Role of Visual Templates on Improving Teamwork Performance**

**Marta Perez Garcia<sup>1</sup>, Sabrina Bresciani<sup>2</sup>**

<sup>1</sup>Birmingham City University, United Kingdom; <sup>2</sup>University of St. Gallen, Switzerland

Knowledge Visualization can be a valuable support for facilitating a number of cognitive and collaborative tasks in organizations. The aim of this paper is to provide concrete evidence of how visual templates provide useful support for teams, which lead to higher quality of idea generation and sharing, compared to unstructured meetings. Evidence is provided through the illustration of a field study conducted in a multinational telecommunication company and a series of laboratory experiments. Results show that visually structuring meetings improves the number of high quality ideas developed, and increased knowledge shared and remembered.

#### **What You See is What You Get: The Impact of Perceived Finishedness (PF) on Visual Contribution Fluency during Electronic Ideation**

**Lawrence McGrath**

University of St. Gallen, Switzerland

Micro-level visual phenomena significantly impact visually-supported interactions, and require further exploration. This study uses a laboratory experiment with managerial participants to examine the impact of the perceived finishedness (PF) of an electronic ideation platform on participant contributions. Lowered PF was expected to lead to a rise in contributions as a result of an increase in on-task social metacognitive interaction. Contrary to expectations, this study found that low PF significantly lowered the amount of on-task contributions made by participants. In contrast, ideation fluency was unaffected by PF levels. This study examines the complementary new ideation metric of contribution fluency in light of the social metacognitive process structuring benefits.

#### **Knowminer Search - a Multi-Visualisation Collaborative Approach to Search Result Analysis**

**Manuela Rauch<sup>1</sup>, Werner Klieber<sup>1</sup>, Ralph Wozelka<sup>1</sup>, Santokh Singh<sup>1</sup>, Vedran Sabol<sup>1,2</sup>**

<sup>1</sup>Know Center, Austria; <sup>2</sup>Graz, University of Technology

The amount of information available on the internet and within enterprises has reached an incredible dimension. Efficiently finding and understanding information and thereby saving resources remains one of the major challenges in our daily work.

Powerful text analysis methods, a scalable faceted retrieval engine and a well-designed interactive user interface are required to address the problem. Besides providing means for drilling-down to the relevant piece of information, a part of the challenge arises from the need of

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analysing and visualising data to discover relationships and correlations, gain an overview of data distributions and unveil trends. Visual interfaces leverage the enormous bandwidth of the human visual system to support pattern discovery in large amounts of data.

Our Knowminer search builds upon the well-known faceted search approach which is extended with interactive visualisations allowing users to analyse different aspects of the result set. Additionally, our system provides functionality for organising interesting search results into portfolios, and also supports social features for rating search results and for sharing and annotating portfolios.

### Navicons for collaboration: Navigating and augmenting discussions through visual annotations

Martin J. Eppler<sup>1</sup>, Michael H.G. Hoffmann<sup>2</sup>, Sebastian Kernbach<sup>1,3</sup>

<sup>1</sup>University of St. Gallen; <sup>2</sup>Georgia Institute of Technology; <sup>3</sup>University of Lugano

As discussions move online, we need means that compensate for what we take for granted in face-to-face meetings: voice modulation, mimics, or gestures. There are three functions of these 'metadiscursive' expressions: 1) to navigate conversations and to direct the attention of our interlocutors, deciding what to discuss, reviewing what has been said, or how things are framed 2) to signal attitudes such as agreement or disagreement, or the level of certainty or commitment and 3) to annotate (visual) content with comments. These functions are crucial for the quality of discussions and can benefit from information visualization. To do this, we propose a classification of navigational moves and attitudes and their visual representation in form of "Navicons" and "Atticons". These icons help to improve the quality of online or face to face discussions, to plan conversations in advance, or to analyze past discussions. An example and outlook conclude the paper.

## Short Papers

### Session iV2015\_2.8: Information Visualization

Chair: Prof. Takayuki Itoh, Ochanomizu University, Japan

#### An experience of information visualization and interaction for aphasic persons

Mariko Sasakura<sup>1</sup>, Saori Iikuma<sup>1</sup>, Yukihiko Izawa<sup>2</sup>

<sup>1</sup>Okayama University, Japan; <sup>2</sup>Fukuyama City University, Japan

Aphasia is a collection of language disorders, which are about speaking, listening, reading and/or writing. The cause of aphasia is damages of brain mainly by cerebral stroke. Language therapy with speech therapists (ST) can be a rehabilitation for aphasia persons to recover their language skills.

Our interests are in the method to achieve language therapy for aphasia persons by using a tablet computer. In this paper, we report a prototype of rehabilitation system and the evaluation of the system by aphasia persons and speech therapists (STs). Aphasia persons have troubles

to understand language. Most of them have troubles to read sentences. Also most of them of paralysis in right side of body because the cause of aphasia is damages to the left part of brain. Therefore most of them have troubles to write characters and also lines in hand. The proposed rehabilitation system allows aphasia persons to undergo treatment without writing characters or lines. Since they are not good at reading sentences, the user interface is designed especially using information visualization, as few characters. The evaluation of the system by aphasia persons and STs result good grade and both of them want to use the rehabilitation system by tablet computers much further.

#### Visualization on Agglomerative Information Bottleneck Based Trajectory Clustering

Yang Fan, Qing Xu, Yuejun Guo, Sheng Liang

Tianjin University, Tianjin, China, China, People's Republic of

Undoubtedly, visualization of the trajectory clustering outputs is very important and some researches have been done on visualization of the clustering results. Still importantly, the research on visualizing the procedure of clustering, which is also of great value, is little touched. In this paper, we propose a novel 3D visualization tool, which comprehensively illustrates the Agglomerative Information Bottleneck (A/B) based clustering scheme, to help users understand the clustering approach vividly and clearly. The point of the proposed metaphor makes use of the visualization, together with rich interactions, to demonstrate the iterative clustering procedure, the corresponding results and the clustering results. The experiment demonstrates the effectiveness of our 3D visualization tool for trajectory analysis.

#### Service Oriented Architecture for Data Visualization in Smart Devices

Nikolas Jorge Santiago Carneiro, Carlos Gustavo Resque Santos, Tiago Davi Oliveira de Araujo, Brunelli Pinto Miranda, Jairo de Jesus Nascimento da Silva Junior, Bianchi Serique Meiguins

Universidade Federal do Pará, Brazil

The Internet has played an important role as a knowledge-sharing network and in this context some service oriented architecture (SOA) applications have emerged in all kind of study fields. Therefore, this work aims the design and development of a service aggregation that will favor ubiquity and pervasiveness in data visualization applications, allowing users to build domain-specific data visualizations in an easy and intuitive way. With this kind of service, it is possible to build data visualization applications for different smart devices such as smartphones, tablets, desktop, smart TV's, etc. A Web API that supports the main functionalities of an information visualization tool in different platforms has been proposed to reach these purposes. The REST (REpresentational State Transfer) Style has been employed in the service conception as the architectural communication model. Client-side and server-side applications were developed using Java with a data visualization generator engine called PRISMA.

### **The Usefulness of the Virtual Speaking Head, as Well as 3D Visualization Tools in the New Communication, Teaching and Presentation Technologies is almost Unlimited.**

**Eva Pajorova**

Slovak Academy of Sciences, Slovak Republic

The usefulness of the Slovak-speaking virtual head as well as 3D visualization tools in the new communication, teaching and presentation technologies, as well as in a variety of audiovisual communications software technologies is almost unlimited. One of the options is the learning through technologies for hearing impaired people. Other, which is a most desired technology, is the use of a virtual head in the field of different communication forms. In the field of crisis management, where the virtual head present the warning messages and navigates during the evacuation of people from reproducing the public institutions such as schools, theatres, etc. 3D visualization tools, as well as Slovakspeaking head and Slovak speech visemas have been designed and tested in our Institute.

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### **Session iV2015\_2.9: Visualisation in Built & Rural Environments**

Chair: Prof. Vineet Kamat, University of Michigan, USA

#### **Impact of Visual Cues on Climate Perception in Virtual Urban Environments: a User Study**

**Toinon Vigier, Guillaume Moreau, Daniel Siret**

Virtual reality is a good tool to design and assess urban projects and to study perception in cities. Climate perception significantly influences the perception and use of urban spaces; however, virtual urban environments are scarcely represented with different climatic aspects.

In this paper, we study the role that visual cues (sky aspect, shadows, sun location, and light effects) specifically play in climate perception (season, daytime and temperature) in virtual urban environments. We present and discuss the data we collected from a recent virtual reality experiment in which ten variations of the climatic context in the same urban space were assessed.

The results prove the feasibility of suggesting complex climatic perceptions and thermal feelings by processing only sky, shadow and lighting effects. Furthermore, our results highlight the role of subjective interpretation, personal background and current real-world environment in interpretation and understanding of visual cues. Finally, we show that perceived climate influences global perception of virtual urban environments.

### **Development of a Computational Design Application for Interactive Surfaces**

**Marianthi Leon, Daniel Doolan, Richard Laing, Julian Malins, Huda Salman**

RGU, United Kingdom

This paper presents the development and testing of a computational design tool applicable on a Tangible User Interface for conceptual design stages. Drawing and sketching are spatial and haptic processes for conceptualizing and communicating ideas especially within design teams of Architecture, Engineering and Construction Industry. Therefore, the application of interactive surfaces within co-located collaborative design teams provides an integration of different sensory modalities, including visual and haptic, thus resulting into a richer and more coherent design experience. The paper explores the evolution of technology related to design systems and describes the development of a conceptual design application for a M.S. PixelSense. This development was part of an action-based research and the evolution of the software during a number of tests with design professionals is presented accordingly. Eventually, the paper concludes with suggestions for further research on augmented reality applications for design processes within the built environment.

Keywords--- Tangible User Interfaces, Conceptual Design Stages, Architecture, Engineering and Construction Industry.

### **Monuments Visualization: from 3D scanned data to a holistic approach, an application to the city of Aberdeen**

**Richard Laing, Marianthi Leon, John Isaacs**

RGU, United Kingdom

This paper aims to present the process of visualizing historic statues of the city of Aberdeen. 3D laser scanning was the main method utilized to obtain the 3D data, which was then transformed into a series of 3D surface models. A laser scanner typically has a range of over 100m (300m for the equipment used here), and records data to levels of accuracy almost impossible to achieve using 'traditional' surveying techniques. The data recorded by a scanner takes the form of a 'point cloud', which can be combined with on-site photographs to build up a realistic and accurate virtual model.

The paper concludes with discussion of how such data can be readily transferred into industry-standard Architecture, Engineering and Construction (AEC) models, thus, allowing the compilation of a buildings and monuments 'library' available to the city council and to the public for future urban projects and city regeneration. It is argued that the ability to incorporate data extracted from 3D scan-based models will promote the easier implementation of the 3D information within digital arts, architecture, structural engineering or other purposes.

The paper represents an interesting collaboration between disciplines from architecture and computing, and provides a practical and innovative case study which sits between technical advances, and electronic and visual arts.

**Session iV2015\_2.10: VA - Visual Analytics**

Chair: Dr Fatma Bouali, University of Lille 2, France

**Hybrid Visualization: A New Approach to Display Instances and Attributes Relationships in a Single View****Danilo Medeiros Eler, Renan Augusto Pupin de Oliveira, Lenon Fachiano Silva**

UNESP, Univ Estadual Paulista, Brazil

Visualization techniques have been widely used in dataset exploration. A common strategy is to employ different techniques to facilitate the exploratory process, enabling different perspectives from the same dataset. In case, a coordination mechanism helps the user in the context changing among different views. However, to keep track of the highlighted data elements among multiple views is an unclear task. To reach a better exploration by using distinct visualization techniques and graphical representations, some approaches have adopted the strategy of combining different techniques in a single view, creating a Hybrid Visualization which can avoid the use of coordination. This paper proposes a new Hybrid Visualization approach that integrates Multidimensional Projection and Parallel Coordinates to display the instances and attributes relationships in a single view. As presented in this paper applications, this approach enables a better feature space exploration, aiding users to understand why instances from the same or distinct classes are grouped.

**A Visualization of Research Papers Based on the Topics and Citation Network****Rina Nakazawa<sup>1</sup>, Takayuki Itoh<sup>1</sup>, Takafumi Saito<sup>2</sup>**<sup>1</sup>Ochanomizu University, Japan; <sup>2</sup>Tokyo University of Agriculture Technology, Japan

Novice researchers are not good at finding all appropriate keywords for the survey of their own research fields. Moreover, it is not easy for them to understand positions of papers in their research fields instantly even when they use a search engine like Google Scholar; it may often take a long time for them to find scholarly literature.

On the other hand, many researchers have presented citation visualization techniques for surveying research papers. However, it is still often difficult to observe the complicated relations across multiple research fields or traverse the entire relations in their interest. In this paper, we proposed a visualization technique for citation networks applying topic-based paper clustering. Our technique categorizes papers applying LDA (Latent Dirichlet Allocation), and constructs clustered networks consisting of the papers.

**Regularity Measure and Influence Weight for Analysis and Visualization of Consumer's attitude****Aki Hayashi, Masahiro Kohjima, Tatsushi Matsubayashi, Hiroshi Sawada**

NTT Service Evolution Laboratories, NTT Corporation, Japan

Recently, analysis of massive purchase histories is thought to be effective for marketing science. For successful sales strategies and advertisements, understanding of consumer's attitude (motivation toward purchasing) is important. However, marketers could obtain merely

static attitude for the limited consumers using subjective questionnaires. We focus on purchase rhythm (regularity) as one approach to automatically extracting dynamic attitude transition.

We propose "regular behavior measure" which quantifies how well each purchase corresponds to the user's own daily habits. It considers non-periodic habits as well as periodic habits using multiple probabilistic models; we consider purchase probability and the number of purchased dates simultaneously. We also define "influence weight" to quantify whether each item is purchased on a fixed day of the week (DoW) or year-month (YM) using Normalized Mutual Information. We analyze actual purchase data to show the effectiveness of our visualization that considers consumer's regularity transitions.

**A Visualization-Analytics-Interaction Workflow framework for Exploratory and Explanatory Search on Geo-Located Search Data using the Meme Media Digital Dashboard****Jonas Sjöbergh<sup>1</sup>, Xingkai Li<sup>2</sup>, Randolph George Goebel<sup>2</sup>, Yuzuru Tanaka<sup>1</sup>**<sup>1</sup>Hokkaido University, Sapporo, Japan; <sup>2</sup>University of Alberta, Edmonton, Canada

Modern geo-position system (GPS) enabled smart phones are generating an increasing volume of information about their users, including geo-located search, movement, and transaction data. While this kind of data is increasingly rich and offers many grand opportunities to identify patterns and predict behaviour of groups and individuals, it is not immediately obvious how to develop a framework for extracting plausible inferences from these data. In our case, we have access to a large volume (more than half a billion individual records) of real user data from the Poynt smart phone application, and we have developed a generic and layered system architecture to incrementally find aggregate items of interest within that data. "Interest" is based on the semantics of the data, so include time and space correlations, e.g., are people searching for dinner and a movie; distributions of usage patterns and platforms, e.g., geographic distribution of Android, Apple, and Black-Berry users; and clustering to identify interesting and relatively complex search and movement patterns, e.g., consumer trajectories from key word searches.

Our integration of a variety of modern visualization tools is thus guided top-down, by semantic concepts in the domain from which data is extracted, rather than by bottom-up tool development. Our presentation here is preliminary in that we provide sketches of case-studies that demonstrate the integration of the three major components of modern visual analytics: visualization, analytics, and interaction (VAI).

Our development of a variety of VAI workflows is driven by the classes of patterns we expect to emerge from the Poynt geo-spatial data records. This approach has helped guide our choice of both conceptual and visual tools to aid our investigation of the geo-located data, and to use a hypothesis-driven process to find both interesting and useful patterns in that data. Included in our VAI workflow system architecture is the ability to consider the difference between exploratory and explanatory searches on data pat-

terns, as well as the ability to simultaneously exploit visualization alternatives to help expose patterns. Unlike previous work that has distinguished "exploratory" and "explanatory" visualization interaction, ours is based on a foundation where visual inference is characterized in a logical way, to provide the interactor with the alternatives of generating new abstract visual

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inferences to expose visual hypotheses, as well as visual querying to confirm hypotheses with visual explanations.

Our case-study sketches show how an interactive system for visual data exploration can be used to alternate between exploratory search – looking for ideas and new hypothesis in data – and explanatory search – looking for evidence to support a hypothesis. While we have not yet formulated experiments to directly measure the cognitive efficacy of our experimental system, we believe that our development of a variety of VAI workflows and the integration of visual methods and interaction provides some useful ideas about how to extend current visual analytics systems.

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**Poster Papers**
**Session iV2015\_2.11: Information Visualisation**

Chair: Prof. Mao Lin Huang, University of Technology, Sydney, Australia; Tianjin University, China

**A Visual Tool to Help Select Photogenic Locations**

Kouhei Hamada<sup>1</sup>, Kazuo Misue<sup>2</sup>

<sup>1</sup>Department of Computer Science, University of Tsukuba, Ibaraki, Japan; <sup>2</sup>Faculty of Engineering, Information and Systems, University of Tsukuba, Ibaraki, Japan

A photogenic location is a good place to take photos. It generally has beautiful scenery, historical structures, etc. When amateur photographers plan a photo trip, they often decide beforehand on photogenic locations to visit. They collect information about the locations and consider various aspects.

The aim of the authors is to assist amateur photographers in planning a photo trip. Information and procedures have been organized to help select photogenic locations from the perspective of information design. In addition, an interactive visual tool has been developed to help select photogenic locations. The tool displays information on photogenic locations extracted from a large collection of geotagged photos, provided by a photo-sharing site. The tool allows us to select locations while referring to their geographic relationships. Consequently, the process of selecting photogenic locations becomes easy.

**A Survey of Visual and Interactive Methods for Air Traffic Control Data**

Linda Pfeiffer, Nicholas Hugo Müller, Paul Rosenthal

Technische Universität Chemnitz, Germany

The StayCentered project at Technische Universität Chemnitz has the goal to improve the overall security of air traffic controllers. Therefore, we attempt to empirically comprehend the usual controller workspace and their dyadic team structure. Within this context, the following paper describes actual interfaces and visualization, discusses recent research within this field and outlines the project's intention.

**An investigation of the environment of schizophrenia genes using Multi-Dimensional Scaling**

Aparna Basu<sup>1</sup>, Suman Ray<sup>2</sup>, Frizo Janssens<sup>3</sup>

<sup>1</sup>Formerly at NISTADS, New Delhi, India, India; <sup>2</sup>National Institute of Science Technology and Development Studies, New Delhi, India; <sup>3</sup>Formerly at Electrical Engineering (ESAT), Katholieke Universiteit Leuven, Leuven, Belgium

A set of candidate genes for schizophrenia are selected and the chromosomal region around them (+/-3mb) is explored. The genes/ORF's in the vicinity of the candidate genes are searched for their properties using Gene Ontology. The data is processed and projected on a 2-dimensional map using Multi Dimensional Scaling. We find cholinergic receptors which are strongly associated with schizophrenia, and several other associated properties, including olfactory receptors, nicotinic receptors, etc. which may need to be investigated for co-occurrence with schizophrenia.

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**Session iV2015\_2.12: Information Visualization**

Chair: Prof. Masood Masoodian, The University of Waikato, New Zealand

**DiagrammaticCHR: A Diagrammatic Representation of CHR Programs**

Nada Ahmed Hamed Sharaf<sup>1</sup>, Slim Abdennadher<sup>1</sup>, Thom Frühwirth<sup>2</sup>

<sup>1</sup>The German University in Cairo, Egypt; <sup>2</sup>University of Ulm

Recently, a new approach for embedding visualization features into Constraint Handling Rules (CHR) programs has been proposed. It allows CHR programmers to animate and visualize different algorithms implemented in CHR. Such features have become essential with CHR being a general purpose language. In this paper, we present a new diagrammatic representation for CHR programs to account for the embedded visual features.

**An ontology-driven visual Question-Answering Framework**

Hajer Baazaoui-Zghal

Riadi, ENSI Campus Universitaire de la Manouba, Tunisia

Question Answering systems aim at providing answers to natural language questions and provide a solution to the problem of response accuracy. This paper describes a visual QA framework based on ontologies that relies on two main components: question analysis component and answer extraction component. Our goal consists on performing an efficient question answering by: (1) Improving the representation of the question's structure using question ontology and typed attributed graphs, (2) Improving the results of question reformulation using domain ontologies and lexico-syntactic patterns (3) Extracting answers based on the question graph, lexico-syntactic patterns and score computation and (4) Offering a visual

representation of the graphs and ontologies. Our framework has been implemented and evaluated.

### Visualizing Timed, Hierarchical Code Structures in AscoGraph

**Grigore Burloiu<sup>1</sup>, Arshia Cont<sup>2</sup>**

<sup>1</sup>University Politehnica of Bucharest; <sup>2</sup>IRCAM STMS UMR, CNRS, INRIA, UPMC

*Antescofo* is a state-of-the-art software package for mixed music authorship and performance. In this paper, we apply an information visualisation perspective to a set of revisions in the timeline-based representation of action items in *AscoGraph*, the dedicated user interface to *Antescofo*. Our contribution is two-fold: (a) a design study of the proposed new model, and (b) a technical, algorithmic component. In the former, we show how our model relates to principles of information coherence and clarity, facility of seeking and navigation, hierarchical distinction and explicit linking. In the latter, we frame the problem of arranging action rectangles in a 2D space as a *strip packing* problem, with the additional constraint that the (horizontal) time coordinates of each block are fixed. We introduce three algorithms of increasing complexity for automatic arrangement, estimate their packing performance and analyse their strengths and weaknesses. We evaluate the systemic improvements achieved and their applicability for other time-based datasets, while noting the limitations of the model and resulting directions for future research.

### Visual Analysis of Source Code Similarities

**Michael Burch, Julian Strotzer, Daniel Weiskopf**

VISUS, University of Stuttgart, Germany

Software systems typically consist of many lines of source code organized in several files hierarchically structured into directories and packages. Since the code is the key data in software development, in many scenarios an overview of it is required, in particular for similar code passages. In this paper, we investigate the visual analysis of source code similarities for local as well as global code passages. To this end, we first compute all subsequence occurrence frequencies (support metric) and relative occurrence frequencies (confidence metric) in local as well as global code regions. The resulting textual data attached by its occurrence values is displayed in a triangular matrix. Several interaction techniques are integrated in our visualization tool which are illustrated in the corresponding case study illustrating similarities in source code written in Assembler consisting of 10,641 characters.

### Session iV2015\_3.1: VA - Visual Analytics

Chair: Dr Michael Burch, VISUS, University of Stuttgart, Germany

#### POIViz: a fast interactive method for visualizing a large collection of Open datasets

**Tianyang Liu<sup>1</sup>, Fatma Bouali<sup>2</sup>, Gilles Venturini<sup>1</sup>**

<sup>1</sup>University Francois Rabelais of Tours, France; <sup>2</sup>University of Lille2, France

We study in this paper the visualization of large multidimensional datasets with a focus on Open Data. Starting from our early work in which we defined a visualization based on points of interest, we improve this method in several ways with the aim of dealing with larger datasets and especially Open datasets. We propose the parallelization, using CPU and GPU, of the most costly steps of our method, like the computation of the data layout. We improve the visualization with a density rendering so as to keep the display informative for large datasets and for Open Data. We propose a layered visualization with interactions that can support several users tasks such as data filtering and labeling. We show that, even with common hardware, the performances of our approach are such that any user graphical queries can be processed in a few seconds. We detail how we were able to visualize and explore a collection of 300,000 Open datasets from the French Open Data web site. With the resulting visualization, we were able to improve our previous results.

#### A fast feature vector approach for revealing simplex and equi-correlation data patterns in reorderable matrices

**Celmar Guimarães da Silva, Bruno Figueiredo Medina**

University of Campinas - School of Technology, Brazil

Some matrix reordering algorithms permute directly the data matrix, instead of its row- and column-proximity matrices. We present a data matrix reordering method (Feature Vector-based Sort – FVS), which reorder a data matrix aiming to reveal Simplex and Equi patterns. Our approach extracts feature vectors from data matrix and uses it to calculate row and column permutations to data matrix. We observed that FVS is faster than other known matrix reordering algorithms and produces results with approximately the same quality (in terms of stress function) when these patterns are hidden in data matrix.

#### Towards ActionTrack 3.0: The Role of Usefulness, Usability and User Experience in a Startup Company Developing Location-Based Applications

**Jukka Antero Holm, Kari Laurila**

Team Action Zone, Finland

This paper discusses the role of usefulness, usability, and user experience in a startup company focusing on location-based applications. In just three years, the emphasis of design moved from usefulness to UX, resulting in opening new market segments, getting several new licensees, and learning quite a lot along the way. The learning process is discussed by the means of ActionTrack, a versatile but user-friendly authoring tool for developing location-based activities.

### Current Topics in the design of HCI courses with Computer Science Curricula

Minoru Nakayama

Tokyo Institute of Technology, Japan

The Human-Computer Interaction (HCI) environment, which includes topics taught, teaching resources and evaluation procedure, is changing rapidly. As the body of knowledge about HCI is periodically redefined, course content should be adapted in response to these changes. This position paper presents trends in topics taught, course content and assessment procedures using examples of HCI courses. Methods which encourage students to develop their learning activities and the assessment procedures are discussed in regards to course content and the current situation in the HCI learning environment.

### Detecting Criminal Relationships Through SOM Visual Analytics

Wen Bo Wang<sup>1</sup>, Mao Lin Huang<sup>1,2</sup>, Jinson Zhang<sup>1</sup>, Wei Lai<sup>3</sup>

<sup>1</sup>University of Technology Sydney, Australia; <sup>2</sup>Tianjin University; <sup>3</sup>Swinburne University of Technology

Feature analysis is always beneficial to the detection of anonymous criminals in digital forensics, including people and activities, where vast amount of features extracted from databases are involved. Not all features extracted are continuous or different; some of them are discrete or have the same value with others. We discovered that using visual analytics to select features for forensic investigations is not only improve the analysis time of selection, but can also deeply and obviously display the slight changes of features and criminals and also the relationship between features and criminals in order to find the target with significant difference with others, and also predict the more active features to be used in the future. Experiments show that visual feature analysis can help to catch the desire results quickly and clearly.

## Session iV2015\_3.2: Information Visualisation – Applications

Chair: Dr. Bernhard Klein, Singapore ETH Centre, Singapore

### Interactively Uncluttering Node Overlaps for Network Visualization

Rie Ishida<sup>1</sup>, Shigeo Takahashi<sup>2</sup>, Hsiang-Yun Wu<sup>2</sup>

<sup>1</sup>Graduate School of Frontier Sciences, The University of Tokyo, Japan; <sup>2</sup>Graduate School of Information Science and Technology, The University of Tokyo, Japan

Visual interaction with networks have been promising in the sense that we can successfully elucidate underlying relationships hidden behind complicated mutual relationships such as co-authorship networks, product co-purchasing networks, and scale-free social networks. However, it is still burdensome to alleviate visual clutter arising from overlaps among node labels especially in such interactive environments as the networks become dense in terms of the topological connectivity. This paper presents a novel approach for dynamically rearranging the network layouts by incorporating centroidal Voronoi tessellation for better readability of node

labels. Our idea is to smoothly transform the network layouts obtained through the conventional force-directed algorithm to that produced by the centroidal Voronoi tessellation to seek a plausible compromise between them. We also incorporated the Chebyshev distance metric into the centroidal Voronoi tessellation while adaptively adjusting the aspect ratios of the Voronoi cells so that we can place rectangular labels compactly over the network nodes. Finally, we applied the proposed approach to relatively large networks to demonstrate the feasibility of our formulation especially in interactive environments.

### Multiscale Visualization of Trajectory Data

Sheng Liang, Qing Xu, Yuejun Guo, Yang Fan

Tianjin University, Tianjin, China, China, People's Republic of

This paper proposes a novel 3D visualization tool for the trajectory analysis, helping users understand the trajectory data from different perspectives. The details of a single and a set trajectories are well covered in multiscale views by the four main linked windows, namely TrajView, ColorBar, MultiProperty and TrackMap. We take advantage of the color bar and the parallel coordinates and further improve them to present the important attributes and their relationships of trajectories. In addition, the iterative actions, such as keyboard and mouse operations, provide a rich and wonderful user experience.

### Adjasankey: Visualization of huge hierarchical weighted and directed graphs

Joris SANSEN, Frédéric LALANNE, David AUBER, Romain BOURQUI

Université de Bordeaux, France

Visualization of hierarchical weighted and directed graphs are usually done with node-link or adjacency matrix diagrams.

However, these representations suffer from various drawbacks: low readability in a context of Big Data, high number of edge crossings, difficulty to efficiently represent the weighting. With the stated goal of reducing these drawbacks, we designed Adjasankey, a hybrid visual representation of weighted and directed graphs using hierarchical abstractions.

This technique combines adjacency matrices readability of large graphs and flow diagrams visual design efficiency for weighting depiction. Associated to Big Data computing and light-weight web rendering, our tool allows to depict and to interact in real time on huge dataset and supports user multi-scale exploration and analysis. To show the efficiency of Adjasankey, we present a case study on the analysis of a *Customer to Customer* website.

### Literature Visualization and Similarity Measurement based on Citation Relations

HANADI HUMOUD ALFRAIDI, WonSook Lee, David Sankoff

University of Ottawa, Canada

While similar documents are, traditionally, found using Natural Language Processing, we observe citation/reference information by authors indicates better insight of similarity. Our system is to retrieve publications from Google Scholar (GS) and visualize them as a 2D graph



using the citation relation, where the nodes represent the documents while the links represent the citation/reference relation between them. We measure the similarity score between each pair of papers based on both the number of paths and the length of each path. More paths and shorter the lengths higher the similarity score. We compared them with another similarity scores from Scurtu's Document Similarity API [1] that uses Natural Language Processing. We use the average of the similarity scores collected from 15 users as a ground truth to determine how good the scores from two methods are. The result shows that our citation network approach gives better results than the ones by Scurtu's.

### 3D Visualization of Multiscale Video Key Frames

**Shihua Sun, Qing Xu, Yuejun Guo, Sheng Liang, Yang Fan**

Tianjin University, China, People's Republic of

In this paper, an innovative 3D visualization tool is proposed to facilitate the quickly browsing and understanding of the video sequence for users. Taking advantage of the major windows, our tool presents the multiscale key frames and the video content clearly and effectively. Namely, *KFView* provides a wonderful navigation of the video key frames with different levels of details. *FrameView* presents an interesting view of the whole video content. *SIMView* allows an expressive exploration of the similarities between key frames and also between key frames and the video frames. Importantly, together with many convenient and attractive interactions, this tool is quite efficient to help users grasp the video information soundly.

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## Session iV2015\_3.3: Information Visualisation – Applications

Chair: Gilles Venturini, University Francois Rabelais of Tours, France

### Software Systems as Archipelagos of Atolls

**Giuseppe Scanniello, Ugo Erra, Maria Caulo**

University of Basilicata, Italy

We present a new metaphor that takes advantages of concepts such as archipelagos, atolls, and palms. Each package of a software system is represented as an atoll that maintainers can navigate and interact with. Atolls that form an archipelago represent the entire system. Maintainers can pass from an atoll to another one, so understanding how the entire software and its packages are related with one another. Palms on an atoll graphically depict salient information of the classes contained in the package associated to that atoll. The metaphor has been implemented as a 3D interactive environment tool to allow a fine- and large- grained understanding of a subject software system implemented in Java. Finally, we have used our 3D environment on a number of open-source object-oriented software systems and the obtained results are preliminarily presented in this paper.

### A Visualization Technique to Support Searching and Comparing Features of Multivariate Datasets

**Hiroaki Kobayashi<sup>1</sup>, Hiroko Suzuki<sup>2</sup>, Kazuo Misue<sup>1</sup>**

<sup>1</sup>University of Tsukuba, Japan; <sup>2</sup>Fujitsu Laboratories Ltd.

In exploratory analysis of multivariate datasets, it is often necessary to perform an analytical task such as to extract some characteristic subsets and to compare these subsets. So we supported searching and comparing features of multivariate datasets. We developed Blade Graph that is the visualization technique for comparing distributions by emphasizing coloring according to the size of the difference. In addition, we developed the visual analysis tool with the representations for comparing the data distributions. In a case study of the analysis tool, we analyzed the collective tendency from a social media dataset.

### Focus and Context Awareness Visualization Techniques for 3D Modelling Tasks using Multi-Layered Displays

**Masood Masoodian<sup>1</sup>, Azmi bin Mohd Yusof<sup>2</sup>, Bill Rogers<sup>1</sup>**

<sup>1</sup>The University of Waikato, New Zealand; <sup>2</sup>Universiti Tenaga Nasional, Malaysia

Creating complex 3D polygonal models using existing modelling software can be challenging. Most 3D Modelling software have been designed for 2D displays and lack support for effective perception of depth ordering. Studies have shown that users of these types of software encounter a range of focus and context awareness problems while performing their 3D modelling tasks. We have previously developed a number of visualization and interaction techniques to better support focus and context awareness using multi-layered displays. A user study of these techniques has demonstrated that they need further improvements. Here, we present three modified visualization techniques, which as shown by a user study, improve the effectiveness of these previous alternatives.

### Enhancing Software Visualization with Information Retrieval

**Rita Francese<sup>1</sup>, Michele Risi<sup>1</sup>, Giuseppe Scanniello<sup>2</sup>**

<sup>1</sup>University of Salerno, Italy; <sup>2</sup>University of Basilicata, Italy

We have enhanced MetricAttitude. It is a visualization tool based on static analysis that provides a mental picture by viewing an object-oriented software system by means of polymetric views. In particular, we have integrated an Information Retrieval engine and named this new version of visualization tool as MetricAttitude++. It allows the user to formulate a textual query and to show on the visual representation of the subject software the elements that are more similar to that query. This could be useful in all those cases in which a user needs to identify (or to localize) features implemented in the source code. Several filters are also available to hide possibly irrelevant details and to ease the browsing and then the comprehension of a software system. Finally, we have applied MetricAttitude++ on a number of object-oriented software systems. In this paper, we report preliminary results of a quantitative study on a widely studied open-source software, namely JEdit. On the basis of our results it seems that MetricAttitude++ can be effectively applied to different kinds of source code comprehension tasks and to concept location in source code, in particular.

## Session CGiV2015\_3.4: Computer Graphics & Imaging & Visualisation

Chair: Dr. Danilo Medeiros Eler, Univ Estadual Paulista, Brazil

### Reverse Engineering of Planar Objects using Imperialist Competitive Algorithm

**Misbah Irshad, Muhammad Sarfraz, Malik Zawwar Hussain**

E-mail: [misbah.irshad@lcwu.edu.pk](mailto:misbah.irshad@lcwu.edu.pk)

Soft computing techniques have drawn plenty of attention to solve complicated optimization problems. Reverse Engineering is an area which is also affected by these techniques. This paper introduces an algorithm for reverse engineering of planar objects using a soft computing technique known as Imperialist Competitive Algorithm (ICA). Cubic spline with shape parameters is used to obtain optimized curves to the boundary of the planar image.

### CosMovis: Semantic Network Visualization by Using Sentiment Words of Movie Review Data

**Hyoji Ha, Wonjoo Hwang, Sungyun Bae, Hanmin Choi, Hyunwoo Han, Gi-nam Kim, Kyungwon Lee**

This paper facilitates the understanding of each node's features through Heatmap visualization in creating network visualization, and suggests a clustering of nodes by connecting the sentiment words MDS Map and Social Network. This study on network visualization aims to design an efficient network analysis which enables users to discover a movie based on sentiment words. Movie review data from online resources were applied in this research, and the process is as follows:

- 1) Calculated a frequency of sentiment words from each movie review.
- 2) Designed a Heatmap visualization to effectively discover the main emotions on each online movie review.
- 3) Formed a Sentiment-Movie Network combining the MDS Map and Social Network in order to fix the movie network topology, while creating a network graph to enable the clustering of similar nodes.
- 4) Applied the asterism graphic in order to impart the meaning in accordance with the characteristics of clustering for better cognitive interpretation.
- 5) Progressed pilot test: a cognition level pilot test varying with whether the sentiment words asterism is fixed.

### Automatic, Real Time, Unsupervised Spatio-temporal 3D Object Detection Using RGB-D Cameras

**Manal H. Alassaf, Kamran Kowsari, Jamed K. Hahn**

The evolution and affordability of depth cameras like Microsoft Kinect make it a great source for object detection and surveillance monitoring. Information available from depth cameras includes depth in addition to color. Using depth cameras, the provided depth information can be

incorporated for object detection in still and video images, but needs special care to pair it with color information. In this work, we propose a simple, yet novel real time unsupervised object detection method in spatio-temporal videos. The RGB color frame is mapped into HunterLab color space to reduce emphasis on image illuminations, while the depth frame is back-projected into the 3D real world coordinate in order to distinguish between objects in space. Once combined, the mapped color information and the back-projected depth information are fed into automatic, unsupervised clustering framework in order to detect scene objects. The framework runs in parallel to provide real time spatio-temporal object detection.

### Video Object Tracking Using Interactive Segmentation and Superpixel Based Gaussian Kernel

**GUOHENG HUANG, Chi Man PUN, Cong Lin**

A novel non-rigid video object tracking based on interactive segmentation and superpixel Gaussian kernel is proposed in this paper. In the initialization stage, instead of using the traditional bounding box to locate the targeted object, we employed an interactive segmentation with user-defined marker to segment the object accurately in the first frame of the input video to avoid the background influence in the traditional bounding box. During the tracking stage, using a Gaussian kernel as movement constraint, each superpixel is tracked independently to locate the object in the next frame. Experimental results show that the proposed method compared to state of the art methods can achieve better robustness and accuracy for various challenging video clips.

### A Solution for Making Multiview Videos: from Cameras to Display

**Jae-Sook Cheong, Sangwon Ghyme, Ilkwon Jeong**

Multiview videos are an attractive media, especially for advertising and exhibition market. Expanding its territory needs big quantity of multiview videos. Unfortunately the cost of making multiview videos is still high. Tools for stereoscopic videos are used to make multiview contents, which often involves manual work to synchronize multiview images. Since the number of views of multiview video should increase to make the images more realistic and comfortable to the eyes, manual working method is extremely tedious, time-consuming, and tiring from intense staring at screens.

We propose a solution to produce multiview videos—from 15 cameras to a 16-view display, in our case. We used inexpensive consumer-grade camcorders without calibration in advance. The proposed solution includes the following four components: timeline and color synchronizations, image alignment and depth control of the scene.

**Session iV2015\_3.5: Information Visualisation**

Chair: Prof. Urska Cvek, Louisiana State University Shreveport, USA

**A Mobile Personal Residential Electricity Dashboard****Mark Apperley<sup>1</sup>, Jishaal Kalyan<sup>2</sup>**<sup>1</sup>University of Waikato, New Zealand; <sup>2</sup>Infinity, Auckland, New Zealand

The growing use of smart electricity meters means that real-time information relating to residential electricity consumption is readily available. The globally recognized need to manage and improve the efficiency of our use of electricity, and the need in most jurisdictions to increase the integration and utilization of non-dispatchable renewable energy sources, provides a strong motivation for individuals to be aware of their electricity consumption in real-time, and to manage that consumption according to need (imperative or discretionary activities) and availability of energy. This paper describes the development and preliminary evaluation of a dashboard-like display, implemented on a mobile platform (phone or tablet), which provides both an instant overview and awareness of consumption and availability, and facility to drill down to determine detail, and potentially to control individual appliances.

**<keynote Lecture>****Space, Time and Visual Analytics: a Multiple Perspectives Paradigm****Gennady Andrienko**

Fraunhofer Institute for Intelligent Analysis and Information systems (IAIS), Germany and City University London, UK

Visual analytics aims to combine the strengths of human and computer data processing. Visualization, whereby humans and computers cooperate through graphics, is the means through which this is achieved. Sophisticated synergies are required for analyzing spatio-temporal data and solving spatio-temporal problems. It is necessary to take into account the specifics of the geographic space, time, and spatio-temporal data.

While a wide variety of methods and tools are available, it is still hard to find guidelines for considering a data set systematically from multiple perspectives. To fill this gap, we systematically consider the structure of spatio-temporal data, possible transformations, and demonstrate several workflows of comprehensive analysis of different data sets, paying special attention to the investigation of data properties.

We finish the talk by outlining directions for future research, including semantic level analysis and big data.

**Bio-sketch**

**Gennady Andrienko** ([www.geoanalytics.net/and](http://www.geoanalytics.net/and)) is lead scientist responsible for the visual analytics research at Fraunhofer Institute for Intelligent Analysis and Information systems (IAIS) and full professor (part time) at City University London, UK. He co-authored monographs Exploratory Analysis of Spatial and Temporal Data (Springer, 1996) and Visual Analytics of Movement (Springer, 2013) and more than 70



peer-reviewed journal papers and 20 book chapters. Since 2007, Gennady Andrienko is chairing the Commission on GeoVisualization of the ICA - International Cartographic Association. He co-organized scientific events on visual analytics, geovisualization and visual data mining, and co-edited 11 special issues of major journals. Gennady Andrienko was poster chair of IEEE VAST 2013-2014 and is paper chair of IEEE VAST 2015.

Gennady Andrienko is associate editor of three journals, Information Visualization, IEEE Transactions on Visualization and Computer Graphics, and International Journal of Cartography, and editorial board member of Cartography and Geographic Information Science. Gennady Andrienko received best paper awards at AGILE 2006 and IEEE VAST 2011 and 2012, honorable mention award at IEEE VAST 2010, VAST challenge awards 2008 and 2014, and best poster awards at AGILE 2007 conference.



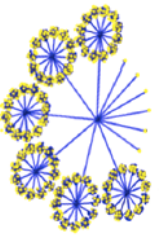
# Knowledge test!

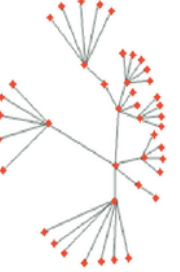
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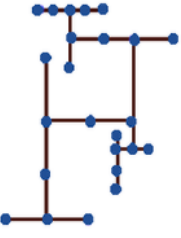
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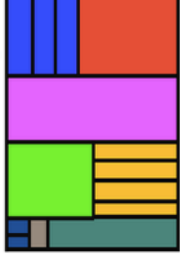
Question 1 of 10

Which one of the following is an example of a balloon layout in graph drawing?

A 

B 

C 

D 

A

B

C

D

Give up

1 2 3 4 5 6 7 8 9 10

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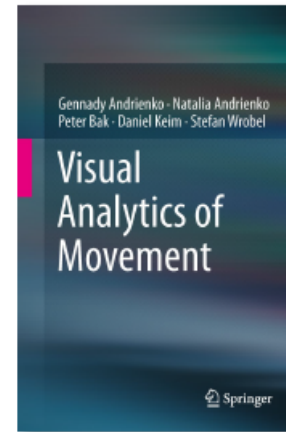
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G. Andrienko, N. Andrienko, P. Bak, D. Keim, S. Wrobel

## Visual Analytics of Movement

- ▶ Presents a multidisciplinary approach, combining methods e.g. visualization, data mining, cartography, and geographical information science
- ▶ Introduces a general conceptual framework for the analysis movement data from various sources
- ▶ Illustrates all algorithms and methods with the help of sam applications from various domains

Many important planning decisions in society and business depend on proper and a correct understanding of movement, be it in transportation, logistics, bi life sciences. Today the widespread use of mobile phones and technologies lik RFID provides an immense amount of data on location and movement. What are new methods of visualization and algorithmic data analysis that are tightly and complement each other to allow end-users and analysts to extract useful from these extremely large data volumes.

This is exactly the topic of this book. As the authors show, modern visual analy techniques are ready to tackle the enormous challenges brought about by mc data, and the technology and software needed to exploit them are available t

The authors start by illustrating the different kinds of data available to describ movement, from individual trajectories of single objects to multiple trajectori objects, and then proceed to detail a conceptual framework, which provides tl for a fundamental understanding of movement data. With this basis, they mo more practical and technical aspects, focusing on how to transform movemen make it more useful, and on the infrastructure necessary for performing visual practice. In so doing they demonstrate that visual analytics of movement data exciting insights into the behavior of moving persons and objects, but can als understanding of the events that transpire when things move. Throughout th use sample applications from various domains and illustrate the examples wit depictions of both the interactive displays and the analysis results.

In summary, readers will benefit from this detailed description of the state of t in visual analytics in various ways. Researchers will appreciate the scientific pr involved, software technologists will find essential information on algorithms systems, and practitioners will profit from readily accessible examples with de illustrations for practical purposes.



Information visualisation is the field of study that is concerned with the development of methods for transforming abstract, complex data into visual representations in order to make that data more easily communicable and understandable. This volume reviews recent developments in information visualisation techniques, their application, and methods for their evaluation. It offers a wide range of examples of applied information visualisation from across disciplines such as history, art, the humanities, science and technology. Beginning with an examination of its medieval origins, it presents theoretical and applied approaches to information representation, including two and three-dimensional cartographic rendering and navigation techniques. In addition, it explores the language of shapes and how it can be employed to further the visualisation of multifaceted data. As a whole, this collection emphasises the important role that the visualisation process plays in extracting, analysing, and presenting the hidden layers of meaning found within large and complex data sets.

**Topics and Features:**

- Contributions from an international collection of researchers and authors.
- An introduction to the discipline of information visualisation, its current state of affairs, and its future trends.
- A discussion of information visualisation's origins, providing an important historical context for the field.
- A comprehensive review of methods for shaping and rendering two and three-dimensional representations of abstract information.
- The visualisation of interconnected networks of data in order to extract their causal relationships.
- An approach to hierarchical structuring and re-structuring of information by applying methods of two-dimensional data mapping.
- Application of common metaphors for visualizing computer code.
- Visualisation analysis of historical events and their relationships.
- A review of methods for evaluating information visualization tools, concepts, and methodologies, and recommendations for their application.

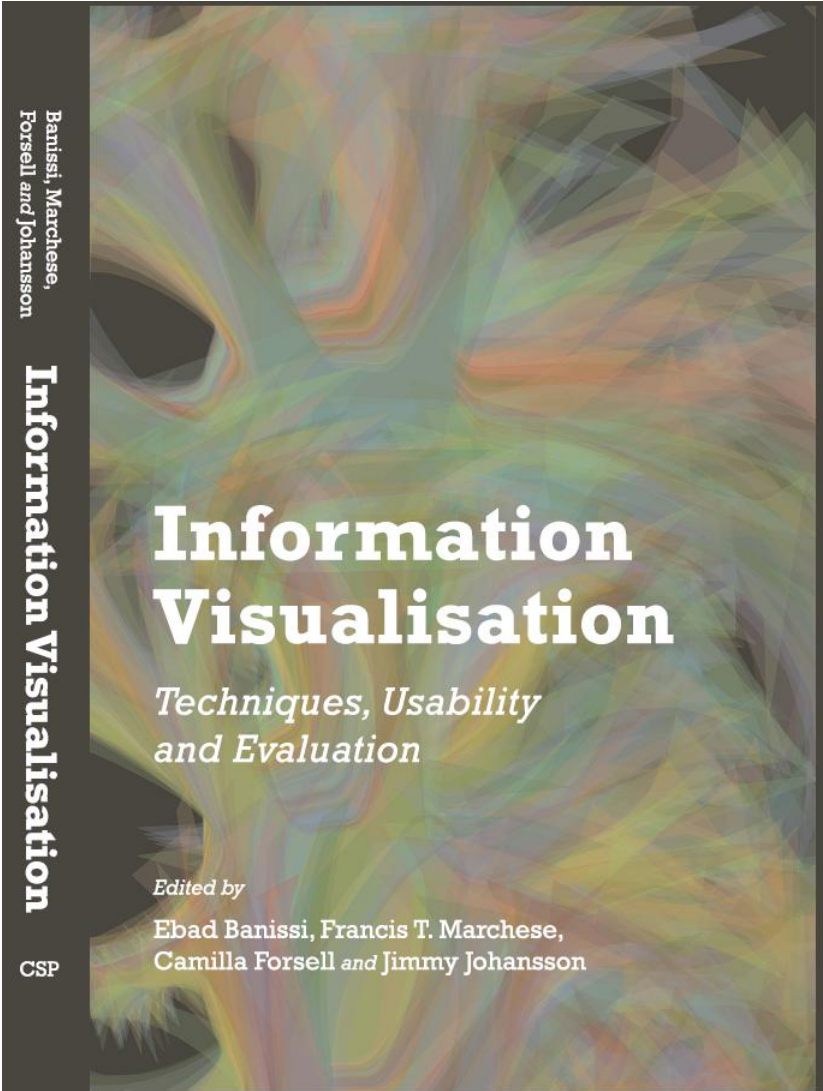
**Dr Ebad Banissi** is Professor of Informatics at London South Bank University, UK, where he heads the Visualisation and Graphics Research Unit.

**Dr Francis T. Marchese** is Professor of Computer Science at Pace University, New York, USA, where he is founder and director of Pace's Center for Advanced Media, and founder and co-director of the Pace Digital Gallery.

**Dr Camilla Forsell** and **Dr Jimmy Johansson** are researchers and academics at the Norrköping Visualization Centre, and members of the Department of Science and Technology, Linköping University, Sweden.

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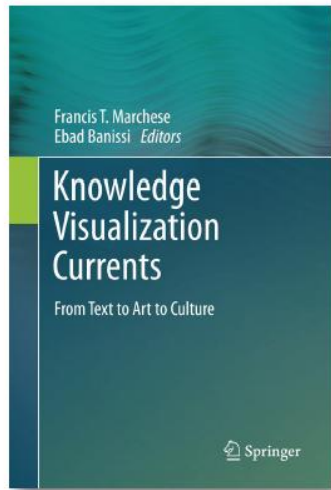
Information Visualisation

CSP

# Information Visualisation

*Techniques, Usability  
and Evaluation*

Edited by  
Ebad Banissi, Francis T. Marchese,  
Camilla Forsell and Jimmy Johansson



2013, XV, 224 p. 96 illus., 64 illus. in color.

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**Knowledge Visualization Currents**

From Text to Art to Culture

- ▶ **Presents the state of the art in visualization research and development**
- ▶ **Highlights research developing at key intersections with other disciplines and its applicability to addressing complex real-world problems**
- ▶ **Discusses how visualization researchers are addressing complex issues of representation in knowledge, art, and culture**

Lying at the intersection of education, art, and cultural heritage, visualization is a powerful tool for representing and interpreting complex information.

This unique text/reference reviews the evolution of the field of visualization, providing innovative examples of applied knowledge visualization from disciplines as varied as law, business management, the arts and humanities. With coverage of theoretical and practical aspects of visualization from ancient Sumerian tablets through to twenty-first century legal contracts, this work underscores the important role that the process of visualization plays in extracting, organizing, and crystallizing the concepts found in complex data.

Topics and features:

- Contains contributions from an international selection of preeminent authorities
- Presents a thorough introduction to the discipline of knowledge visualization, its current state of affairs and possible future developments
- Examines how tables have been used for information visualization in historical textual documents
- Discusses the application of visualization techniques for knowledge transfer in business relationships, and for the linguistic exploration and analysis of sensory descriptions
- Investigates the use of visualization to understand orchestral music scores, the optical theory behind Renaissance art, and to assist in the reconstruction of an historic church
- Describes immersive 360 degree stereographic visualization, knowledge-embedded embodied interaction, and a novel methodology for the analysis of architectural forms

This interdisciplinary collection of the state of the art in knowledge visualization will be of considerable interest to researchers from a broad spectrum of backgrounds in both industry and academia.









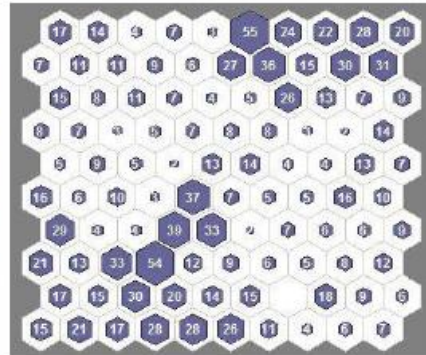
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