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Project-Team IN-SITU

Situated interaction

IN COLLABORATION WITH: Laboratoire de recherche en informatique (LRI)

RESEARCH CENTER
Saclay - Île-de-France

THEME
Interaction and visualization

Table of contents

1. Members	1
2. Overall Objectives	2
2.1. Objectives	2
2.2. Research Themes	3
2.3. Highlights of the Year	3
3. Research Program	3
4. Application Domains	4
5. Software and Platforms	4
5.1. WILD Platform	4
5.2. jBricks	4
5.3. The SwingStates Toolkit	6
5.4. The FlowStates Toolkit	7
5.5. TouchStone	8
5.6. Metisse	9
5.7. The Substance Middleware	10
5.8. Scotty	11
6. New Results	12
6.1. Interaction Techniques	12
6.2. Research Methods	15
6.3. Engineering of interactive systems	16
7. Bilateral Contracts and Grants with Industry	17
8. Partnerships and Cooperations	17
8.1. Regional Initiatives	17
8.2. National Initiatives	18
8.3. European Initiatives	18
8.3.1. FP7 Projects	18
8.3.1.1. CREATIV	19
8.3.1.2. Social Privacy	19
8.3.2. Collaborations in European Programs, except FP7	19
8.3.3. Collaborations with Major European Organizations	19
8.4. International Initiatives	20
8.4.1. Inria Associate Teams	20
8.4.2. Inria International Partners	20
8.4.3. Inria International Labs	20
8.5. International Research Visitors	20
9. Dissemination	20
9.1. Scientific Animation	20
9.2. Teaching - Supervision - Juries	22
9.2.1. Teaching	22
9.2.2. Supervision	23
9.2.3. Juries	24
9.3. Popularization	24
10. Bibliography	24

Project-Team IN-SITU

Keywords: Augmented Reality, Interaction, Interactive Computing, Perception, Visualization

Creation of the Project-Team: 2002 July 01.

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2. Overall Objectives

2.1. Objectives

As computers permeate every aspect of society, the number and variety of computer users has multiplied dramatically as has the quantity and complexity of the data they manage. Computers are now ubiquitous and increasingly diverse, ranging from mobile phones and PDAs to laptops, desktops and wall-sized displays. Computers and telephony have converged to create a new communication medium, providing mobile access to myriad on-line services. This revolution poses major challenges for the design, implementation and deployment of interactive systems. The current failure to address these challenges has resulted in applications that are often difficult to understand or control, lowering productivity and increasing frustration. User interfaces have not kept pace with the rapid progress in other aspects in computing: The desktop metaphor that has driven personal computing for the past 25 years has reached its limits, with no short-term alternative.

The time has come for a new generation of interactive systems. The focus of the InSitu project is to create innovative interactive systems that truly meet the needs of their users. For us, context is critical: we need to provide designers with tools and methods that actively take context into account. This requires a deeper understanding of the complementary characteristics of humans and computers as well as an analysis of specific situations of use. Our goal is to develop and facilitate the creation of such situated interfaces, which take optimal advantage of context to provide users with the particular tools they need to address the problems at hand. Our approach both expands today's graphical user interfaces and explores new possibilities, addressing the following goals:

- *Flexibility* to support end-user customisation and programming as well as adaptation to physical context;
- *Integration of physical and electronic worlds* through the exploration of mixed reality and tangible interfaces;
- *Scalability* with respect to the quantity of data being managed, through the development of multi-scale interfaces and information visualisation techniques;
- *Cooperation and collaboration support* in order to study new forms of person-to-person mediated communication;
- *Integration* of varied interaction styles and techniques into a single coherent environment, using appropriate interaction models and architectures.

The overall goal of InSitu is to develop situated interfaces, i.e. interfaces that are adapted (or adaptable) to their contexts of use by taking advantage of complementary aspects of humans and computers. Our very ambitious longterm goal is to move beyond the current generation of desktop environments and envision the next generation of interactive environments. The specific objective for the next four years is to create one or more prototype interactive environments that begin to explore what this next generation of interactive systems might look like.

Our research strategy is to develop case studies and development tools, in parallel. The case studies allow us to study specific users, in particular application domains, and explore innovative interaction approaches in real-world contexts. The development tools, consisting of architectures and toolkits, allow us to create a development environment for creating novel types of interaction and facilitate the creation of innovative applications. We have identified four research themes, each with separate deliverables, to achieve this objective: Interaction and Visualization Paradigms, Mediated Communication, Research Methods and Engineering of Interactive Systems.

2.2. Research Themes

InSitu addresses three major research themes:

Interaction and visualization paradigms focuses on the trade-off between power and simplicity in interactive systems, both in terms of interaction and in managing and visualizing data. Rather than accepting one or the other, our objective is to shift the trade-off curve, creating systems that provide more power while retaining simplicity. We are currently investigating multi-surface interaction, interactive information visualization, gesture-based interaction, multimedia (video and audio) and tangible interfaces. Our goal is to not only explore these paradigms individually but also to investigate how to integrate them into real-world applications.

Research methods focuses on how multi-disciplinary teams can create effective interactive systems that take context into account. Our objective is to create new research methods that include users throughout the design process, to test these methods in real-world settings and to disseminate these methods to researchers and designers. We are currently investigating participatory design techniques that actively involve users throughout the design process and multidisciplinary design techniques that facilitate communication among researchers from engineering, social science and design disciplines.

Engineering of interactive systems focuses on creating effective tools for building interactive systems. Our objective is to generate libraries, exploratory toolkits and platforms that enable us to quickly implement and work with new concepts, while also enabling researchers within and outside of InSitu to benefit from our research. We are currently investigating tools that facilitate the design and adoption of effective interaction techniques and paradigms and component-based architectures to facilitate dynamic management of distributed interactive systems. Our goal is to develop open source toolkits that enable us and our research colleagues to design and implement advanced interactive systems.

Although we articulate each theme separately, we often intermix them within actual projects. We also work across disciplines, providing us with research breadth, and at the same time, seek to obtain depth in particular projects. We apply our own research methods to the design of new interaction techniques, develop our own tools for developing these techniques and integrate these techniques in the design of innovative interactive systems, which we test in real-world settings. Our long-term goal is to create a new generation of interactive environments that provide a compelling alternative to the current generation of desktop computers.

2.3. Highlights of the Year

- InSitu received two best paper awards, one at INTERACT [21] (Brian Shackel award) and the other at IEEE/VRST [28], and one honorable mention at ACM/CHI [34].
- InSitu (Wendy Mackay, General Chair, Michel Beaudouin-Lafon, Technical Program co-chair) organised the 31st ACM Conference on Human Factors in Computing Systems (CHI '13), which took place in Paris and was a great success (3500 participants, 1000 presentations).
- W. Mackay's ERC Advanced Grant, "CREATIV: Creating Human Computer Partnerships", started on June 1, 2013

BEST PAPERS AWARDS :

[21] **Storytelling in Visual Analytics tools for Business Intelligence in INTERACT 2013 - 14th IFIP TC13 Conference on Human-Computer Interaction.** M. ELIAS, M.-A. AUFAURE, A. BEZERIANOS.

[28] **Drilling into Complex 3D Models with Gimlenses in VRST '13: 19th ACM Symposium on Virtual Reality Software and Technology.** C. PINDAT, E. PIETRIGA, O. CHAPUIS, C. PUECH.

[34] **A Body-centric Design Space for Multi-surface Interaction in CHI'13 - 31st International Conference on Human Factors in Computing Systems.** J. WAGNER, M. NANCEL, S. GUSTAFSON, S. HUOT, W. E. MACKAY.

3. Research Program

3.1. Multi-disciplinary Research

InSitu uses a multi-disciplinary research approach, including computer scientists, psychologists and designers. Working together requires an understanding of each other's methods. Much of computer science relies on formal theory, which, like mathematics, is evaluated with respect to its internal consistency. The social sciences are based more on descriptive theory, attempting to explain observed behaviour, without necessarily being able to predict it. The natural sciences seek predictive theory, using quantitative laws and models to not only explain, but also to anticipate and control naturally occurring phenomena. Finally, design is based on a corpus of accumulated knowledge, which is captured in design practice rather than scientific facts but is nevertheless very effective.

Combining these approaches is a major challenge. We are exploring an integrative approach that we call *generative theory*, which builds upon existing knowledge in order to create new categories of artefacts and explore their characteristics. Our goal is to produce prototypes, research methods and software tools that facilitate the design, development and evaluation of interactive systems [39].

4. Application Domains

4.1. Application Domains

InSitu works on general problems of interaction in multi-surface environments as well as on challenges associated with specific research groups. The former requires a combination of controlled experiments and field studies; the latter involves participatory design with users. We are currently working with highly creative people, particularly designers and music composers, to explore interaction techniques and technologies that support the earliest phases of the design process. We are also working with research scientists, particularly neuroscientists and astrophysicists, in our explorations of interaction in multisurface environments, and with doctors and nurses to support crisis management situations.

5. Software and Platforms

5.1. WILD Platform

Participants: Michel Beaudouin-Lafon [correspondant], Olivier Chapuis, Stéphane Huot, Romain Primet, Amani Kooli, Monireh Sanaei, Gabriel Tezier, Jonathan Thorpe.

WILD (Wall-Size Interaction with Large Datasets) is InSitu's experimental ultra-high-resolution interactive platform for studying collaborative interaction and the visualization of very large datasets [2] (Figure 1). It features a wall-sized display with thirty-two 30" LCD screens, i.e. a 5m50 x 1m80 (18' x 6') wall displaying $20\,480 \times 6\,400 = 131$ million pixels, powered by a 16-computer cluster and two front-end computers. The platform also features a camera-based motion tracking system supporting interaction with the wall as well as within the surrounding space, a multitouch table and various mobile devices. WILD provides a unique experimental environment for interactive visualization and is part of the DIGISCOPE Equipment of Excellence. In addition to using WILD for our research, we have also developed software architectures and toolkits that enable developers to run applications on such multi-device, cluster-based systems.

5.2. jBricks

Participants: Stéphane Huot [correspondant], Mathieu Nancel, Romain Primet.

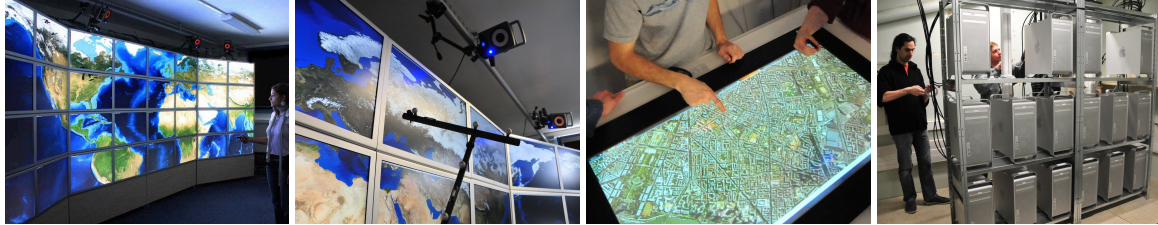


Figure 1. The WILD platform (clockwise): wall display, motion tracking system, display cluster, interactive table.



Figure 2. jBricks applications running on the WILD platform (32 tiles for a total resolution of $20\,480 \times 6\,400$ pixels). (a) Zoomed-in visualization of the North-American part of the world-wide air traffic network (1 200 airports, 5 700 connections) overlaid on NASA's Blue Marble Next Generation images ($86\,400 \times 43\,200$ pixels) augmented with country borders ESRI shapefiles. (b) Panning and zooming in Spitzer's Infrared Milky Way ($396\,032 \times 12\,000$ pixels). (c) Controlled laboratory experiment for the evaluation of mid-air multi-scale navigation techniques.

jBricks (Figure 2) is a Java toolkit that integrates a high-quality 2D graphics rendering engine based on ZVTM [46] and a versatile input configuration module (based on ICon [42] and FlowStates 5.4) into a coherent framework, enabling the exploratory prototyping of interaction techniques and rapid development of post-WIMP applications running on cluster-driven interactive visualization platforms such as wall-sized displays. The goal of this framework is to ease the development, testing and debugging of interactive visualization applications. It also offers an environment for the rapid prototyping of novel interaction techniques and their evaluation through controlled experiments.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See E. Pietriga, S. Huot, M. Nancel, R. Primet, Rapid Development of User Interfaces on Cluster-Driven Wall Displays with jBricks, EICS '11: Proceedings of the 3rd ACM SIGCHI symposium on Engineering interactive computing systems, pages 185-190, June 2011
- OS/Middleware: Java (Linux, Mac OS X, Windows)
- Required library or software: several, managed through Maven
- Programming language: Java

5.3. The SwingStates Toolkit

Participants: Caroline Appert [correspondant], Michel Beaudouin-Lafon.

SwingStates [36] is a library that adds state machines and a graphical canvas to the Java Swing user interface toolkit. It was motivated by the lack of widely disseminated toolkits that support advanced interaction techniques and the observation that HCI research toolkits are little used outside the lab. By extending the popular Java Swing toolkit rather than starting from scratch, the goal is to facilitate the dissemination and adoption of SwingStates by practitioners.

SwingStates uses *state machines* to specify interaction. It provides programmers with a natural syntax to specify state machines and reduces the potential for an explosion of the number of states by allowing multiple state machines to work together or separately. SwingStates can be used to add new interaction techniques to existing Swing widgets, e.g. to select buttons and checkboxes by crossing rather than clicking. It can also be used with the SwingStates canvas (see below) and to control high-level dialogues.

SwingStates also provides a powerful *canvas widget*. The canvas can contain any Java2D shape, including geometric shapes, images, text strings and even Swing widgets. Shapes can be manipulated individually or collectively, through *tags*. An intensive use of polymorphism allows to apply almost any command to a tag: the command is then applied to all objects with this tag. Tags are also used in conjunction with state machines, to specify transitions that occur only on objects with a given tag. For example, pie menus can be implemented by creating a canvas in the overlay layer of any Swing application (Figure 3).

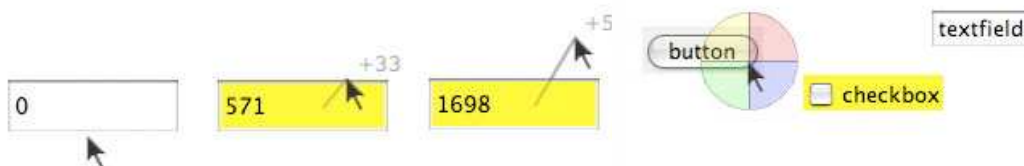


Figure 3. A numeric text field whose value can be set by a joystick-like interaction (left) and a semi-transparent menu to change the background color of Swing widgets (right)

SwingStates tightly integrates state machines, the Java language and the Swing toolkit to provide programmers with a natural and powerful extension to their natural programming environment. SwingStates is available at <http://swingstates.sf.net> under the GNU Lesser General Public License (LGPL).

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See C. Appert and M. Beaudouin-Lafon (2008) SwingStates: Adding State Machines to Java and the Swing Toolkit. *Software: Practice and Experience*, 38(11):1149 - 1182.
- OS/Middleware: Mac OS X, Linux, Windows
- Required library or software: Java virtual machine
- Programming language: Java

5.4. The FlowStates Toolkit

Participants: Caroline Appert [correspondant], Michel Beaudouin-Lafon, Stéphane Huot.

FlowStates [37], is a new toolkit to program advanced interaction techniques which require non standard input (e.g., two different mice that act independently, a joystick, a tablet, etc.). It is built on top of two existing toolkits: SwingStates [36] and ICon [42].

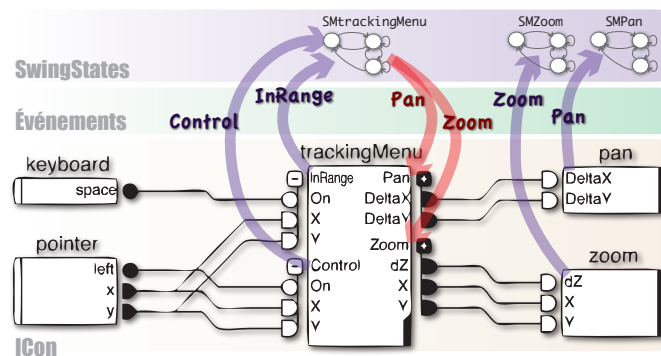


Figure 4. State machines and data flow in FlowStates

With FlowStates the developer can program interaction logic using state machines like SwingStates does but does not restrict the set of possible input channels to Java AWT standard input (a single couple <mouse, keyboard>). The state machines just have to define the virtual input events that are required to trigger their transitions so that FlowStates turns these machines into ICon devices which can be plugged to any physical input channels (Figure 4). An ICon device is a data flow building block that has input and output slots in order to be connected to other devices in the simple graphical environment provided by ICon. State machines can also send out events which appear as output slots in the data flow model.

With FlowStates we showed how two models for programming interaction (state machines and data flow) can be fully integrated to offer a huge power of expression. The explicit decision to not set strict limits between the roles of each model makes this hybrid approach highly flexible, the developer setting himself the limit between the two according to his needs and habits.

FlowStates is available at <http://www.lri.fr/~appert/FlowStates/>.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See C. Appert, S. Huot, P. Dragicevic and M. Beaudouin-Lafon (2009) FlowStates: Prototypage d'applications interactives avec des flots de données et des machines à états. In Proceedings of IHM 2009. ACM, pages 119-128.
- OS/Middleware: Mac OS X, Linux, Windows
- Required library or software: ICon, Java virtual machine
- Programming language: Java

5.5. TouchStone

Participants: Caroline Appert [co-correspondant], Michel Beaudouin-Lafon, Wendy Mackay [co-correspondant].

TouchStone [8] is a platform for designing, running and analyzing the results of controlled experiments (Figure 5). While it focuses on experiments comparing interaction techniques, it can be used in a wide variety of contexts.

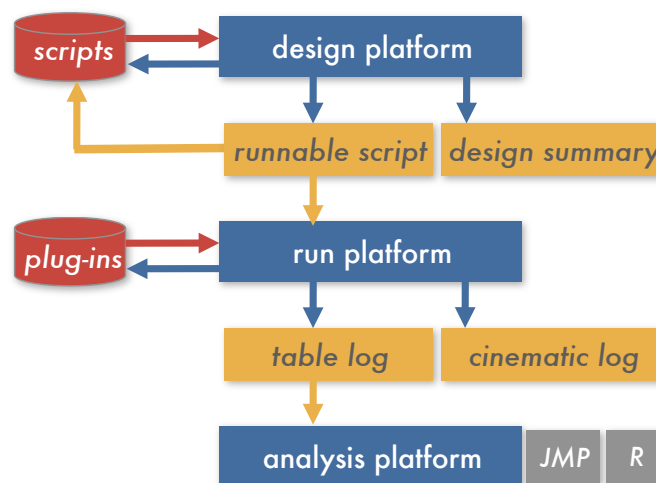


Figure 5. The architecture of the Touchstone platform

The *Touchstone Design platform* allows an experimenter to specify the factors, levels and measures in a controlled experiment, supports blocking and counterbalancing of trials and calculates how long it will take to run the experiment. Experimenters can compare the trade-offs between different experiment designs. The platform produces an XML file that serves as a protocol for the experiment and can be used as input to the Run platform.

The *Touchstone Run platform* provides a framework for implementing and running an experiment and collecting performance data. The flexible plug-in architecture supports various input devices and interaction techniques. The XML script from the Design platform can be run directly or edited to accommodate needs from specific experiments.

Log data from the Run platform can be analyzed by standard statistics tools such as JMP, R or Excel. In future, we hope to create a more elaborate *Touchstone Analysis platform* that will generate analysis scripts based on the output of the Design platform.

Members of InSitu use Touchstone for a variety of experiments and Students in the Research Masters (M2R Interaction) have been using it to design and implement experiments since 2011. Touchstone is available at <http://code.google.com/p/touchstone-platforms/> under a BSD License.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See W. Mackay, C. Appert, M. Beaudouin-Lafon, O. Chapuis, Y. Du, JD. Fekete and Y. Guiard (2007) TouchStone: Exploratory Design of Experiments. In Proceedings of ACM CHI 2007 Conference on Human Factors and Computing Systems. ACM, pages 1425-1434.
- OS/Middleware: Mac OS X, Linux, Windows
- Required library or software: Java virtual machine
- Programming language: Java

5.6. Metisse

Participant: Olivier Chapuis [correspondant].

Metisse [40] is a window system that facilitates the design, implementation and evaluation of innovative window management techniques. The system is based on a compositing approach, making a clear distinction between the rendering and the interactive compositing processes. The Metisse server is a modified X server that supports both input and output redirection. The default compositor is a combination of a slightly modified version of FVWM, a standard window manager, with an interactive viewer application called *FvwmCompositor*.

FvwmCompositor uses OpenGL to display windows, which offers a rich graphics model well adapted to the exploration of new window management techniques. Texture mapping, for example, makes it possible to transform the window shapes in real-time (Figure 6, left). Alpha blending makes it easy to create translucent objects and shadows. Scaling, rotation and translation can also be used to position windows in 2D $\frac{1}{2}$ or 3D (Figure 6, middle and right). Input redirection makes it still possible to interact with applications no matter the visual transformations applied to the windows. It also makes it possible to adapt, reconfigure or re-combine existing graphical interfaces [48]. This year we used again Metisse to implement novel desktop interaction techniques [4].

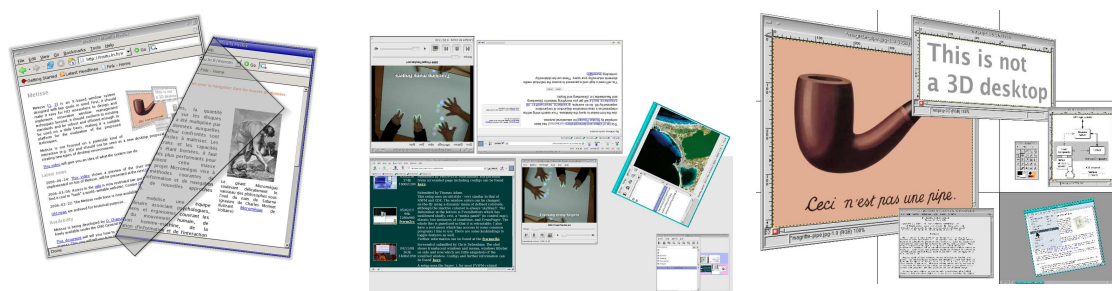


Figure 6. Sample window management techniques implemented with Metisse: extended paper metaphor (left), interactive table configuration that allows to duplicate and rotate windows (middle) and zoomable 3D desktop (right).

- Web: <http://insitu.lri.fr/metisse/>
- ACM: H.5.2 [User Interfaces]: Windowing systems
- Software benefit: see [40], [48], [41], [44] and [4].

- License: GPL
- Type of human computer interaction: Graphique
- OS/Middleware: X Window et Mac OS X
- Required library or software: OpenGL via nucleo ¹ and some usual C/C++ libraries
- Programming language: * C/C++

5.7. The Substance Middleware

Participants: Michel Beaudouin-Lafon [correspondant], Clemens Klokmoose, Tony Gjerlufsen, James Eagan, Clement Pillias.

Substance is a middleware based on a novel programming paradigm called *data-oriented programming* and was designed to facilitate the development of multi-surface interactive applications [45]. Such applications are distributed by nature as they involve a varying number of display and interaction surfaces that are controlled by different computers. For example, our WILD room includes a 32-monitor display wall driven by 16 computers plus a front-end, a multi-touch table, various mobile devices such as iPodTouch and iPads, and the laptops that the users of the room may bring with them. We want to support seamless interaction techniques across these surfaces, such as the pick-and-drop technique pioneered by Rekimoto [47].

Data-oriented programming consists of attaching functionality to a tree data structure through *facets* attached to the individual nodes of the tree. Facets can be added and removed dynamically, and notified of changes in the tree. Substance supports two powerful ways to share nodes and facets: mounting, where access to the shared tree is managed through remotely, and replication, where the shared tree is replicated at each site and synchronized.



Figure 7. *The Canvas* (left) and *SubstanceGrise* (right) applications developed with Substance.
(©CNRS-Phototheque - Cyril FRESILLON for SubstanceGrise).

Substance has been used to create two full-scale applications (Figure 7): a generalized Canvas that can display and manage graphics, PDF files, image files and other content (through an extensible content manager) across surfaces spanning multiple displays and computers; SubstanceGrise, which uses multiple instances of the Anatomist/BrainVISA application to display coordinated 3D imagery of many brains in parallel on the WILD wall and control from a physical model of the brain.

¹<http://interaction.lille.inria.fr/~roussel/projects/nucleo/index.html>

Substance is available at <http://substance-env.sourceforge.net/> under a GNU GPL 3.0 licence.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See T. Gjerlufsen, C. Klokmoose, J. Eagan, C. Pillias and M. Beaudouin-Lafon (2011) Shared Substance: Developing Flexible Multi-Surface Applications. In CHI '11: Proceedings of the 29th international conference on Human factors in computing systems. ACM, pages 3383-3392.
- OS/Middleware: Mac OS X, Linux
- Required library or software: several, managed by Python install
- Programming language: Python

5.8. Scotty

Participants: Michel Beaudouin-Lafon [correspondant], James Eagan, Wendy Mackay.

The goal of Scotty is to support *malleable interfaces*, i.e. interfaces that can be modified at run-time in ways not anticipated by the designers [43]. Scotty is a toolkit that allows a programmer to extend an existing Mac OS X application without access to its source code. Scotty provides the following abstractions: hooks to alter the appearance of windows and widgets, event funnels to alter their behavior, glass sheets to overlay graphics and add new interaction methods, dynamic code loading and object proxies to redefine and extend existing objects. Scotty also provides a higher-level interface based on instrumental interaction [38]. Scotty currently runs on Mac OS X for applications written with the Cocoa user interface framework.

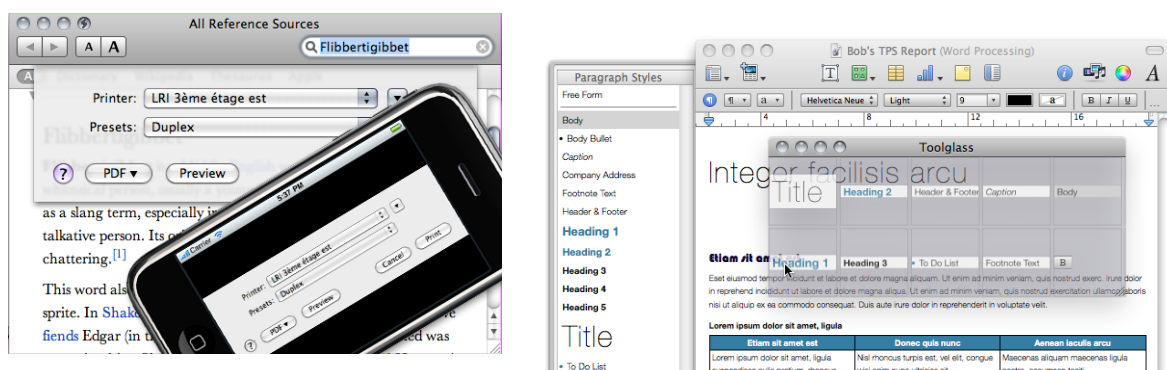


Figure 8. Using Scotty to teleport a window of a Mac OS X application onto an iPhone (left) and to create a toolglass in the Pages word processor (right).

Scotty has been used to create a number of extensions (Figure 8). *Scribbler* is a generic extension that uses glass sheets to allow handwritten annotations of any Cocoa window. *Teleportation* is another generic extension that can teleport and resize the content of any Cocoa window onto another computer, including an iPhone or iPad. The user can interact with the teleported content as if it was on the original computer. It was used to create a content provider for the Substance Canvas (see above), making it possible to display any application running on a laptop onto the WILD wall display and/or table. When vector-based content is available, e.g., for text, Scotty provides smooth rescaling without the typical pixelation apparent when enlarging bitmap images. Finally *Stylesheet* is an extension to the Pages word processor that provides a semi-transparent toolglass for specifying the styles of paragraphs.

Scotty is available at <http://insitu.lri.fr/Projects/Scotty> under a GNU GPL 3.0 licence.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See J. Eagan, W. Mackay and M. Beaudouin-Lafon (2011) Cracking the Cocoa Nut: User Interface Programming at Runtime. In UIST 2011: Proceedings of the 24th ACM Symposium on User Interface Software and Technology. ACM, pages 225-234.
- OS/Middleware: Mac OS X
- Required library or software: none
- Programming language: Objective-C, Python

6. New Results

6.1. Interaction Techniques

Participants: Caroline Appert, Michel Beaudouin-Lafon, David Bonnet, Anastasia Bezerianos, Olivier Chappuis [correspondant], Cédric Fleury, Stéphane Huot, Can Liu, Wendy Mackay, Halla Olafsdottir, Cyprien Pindat, Theophanis Tsandilas.

We explore interaction techniques in a variety of contexts, including individual interaction techniques on different display surfaces that range from mobile devices to very large wall-sized displays through standard desktop and tabletops. This year, we investigated how people can use different body parts and limbs to convey information to interactive systems. *BodyScape* provides a framework for analysing and designing interaction techniques that involve the entire human body. Both *WristPointing*, which overcomes the limited range of motion of the wrist, and *HeadPad*, which takes the user's head orientation into account, are whole body techniques that facilitate target acquisition. *Arpege* can interpret a wide range of chord gestures, designed according to the range of motion and limitations of the human hand, and includes a dynamic guide with integrated feedforward/feedback to enhance learning by novices, without slowing down experts. On mobile devices, we designed novel interaction techniques that increase the expressivity of gestures by a single finger, including *ThumbRock*, based on movement dynamics, *SidePress*, which senses pressure on the device, and *Powerup*, which detects proximity. We also continued to develop advanced interactive visualization techniques, including *Gimlenses*, which supports focus+context representations for navigating within 3D scenes.

BodyScape – The entire human body plays a central role in interaction. The *BodyScape* design space [34] (honorable mention at CHI 2013) explores the relationship between users and their environment, specifically how different body parts enhance or restrict movement for specific interactions. *BodyScape* can be used to analyze existing techniques or suggest new ones. In particular, we used it to design and compare two free-hand techniques, on-body touch and mid-air pointing, first separately, then combined. We found that touching the torso is faster than touching the lower legs, since it affects the user's balance; and touching targets on the dominant arm is slower than targets on the torso because the user must compensate for the applied force.

HeadPad – Rich interaction with high-resolution wall displays is not limited to remotely pointing at targets. Other relevant types of interaction include virtual navigation, text entry, and direct manipulation of control widgets. However, most techniques for remotely acquiring targets with high precision have studied remote pointing in isolation, focusing on pointing efficiency and ignoring the need to support these other types of interaction. We investigated high-precision pointing techniques capable of acquiring targets as small as 4 millimeters on a 5.5 meters wide display while leaving up to 93% of a typical tablet device's screen space available for task-specific widgets [27]. We compared these techniques to state-of-the-art distant pointing techniques and have shown that two of our techniques, a purely relative one and one that uses head orientation, perform as well or better than the best pointing-only input techniques while using a fraction of the interaction resources.

WristPointing – Wrist movements are physically constrained and take place within a small range around the hand’s rest position. We explored pointing techniques that deal with the physical constraints of the wrist and extend the range of its input without making use of explicit mode-switching mechanisms [33]. Taking into account elastic properties of the human joints, we investigated designs based on rate control. In addition to pure rate control, we examine a hybrid technique that combines position and rate-control and a technique that applies non-uniform position-control mappings. Our experimental results suggest that rate control is particularly effective under low-precision input and long target distances. Hybrid and non-uniform position-control mappings, on the other hand, result in higher precision and become more effective as input precision increases.

Arpege – While multi-touch input has become a standard for interacting with devices equipped with a touchscreen with simple techniques like pinch-to-zoom, the number of gestures systems are able to interpret remains rather small. Arpège [23] is a progressive multitouch input technique for learning chords, as well as a robust recognizer and guidelines for building large chord vocabularies. We conducted two experiments to evaluate our approach. Experiment one validated our design guidelines and suggests implications for designing vocabularies, i.e. users prefer relaxed to tense chords, chords with fewer fingers and chords with fewer tense fingers. Experiment two demonstrated that users can learn and remember a large chord vocabulary with both Arpège and cheat sheets, and Arpège encourages the creation of effective mnemonics.

ThumbRock – Compared with mouse-based interaction on a desktop interface, touch-based interaction on a mobile device is quite limited: most applications only support tapping and dragging to perform simple gestures. Finger rolling provides an alternative to tapping but uses a recognition process that relies on either per-user calibration, explicit delimiters or extra hardware, making it difficult to integrate into current touch-based mobile devices. We introduce ThumbRock [19], a ready-to-use micro gesture that consists in rolling the thumb back and forth on the touchscreen. Our algorithm recognizes ThumbRocks with more than 96% accuracy without calibration nor explicit delimiter by analyzing the data provided by the touch screen with a low computational cost. The full trace of the gesture is analyzed incrementally to ensure compatibility with other events and to support real-time feedback. This also makes it possible to create a continuous control space as we illustrate with our MicroSlider, a 1D slider manipulated with thumb rolling gestures.

SidePress – Virtual navigation on a mobile touchscreen is usually performed using finger gestures: drag and flick to scroll or pan, pinch to zoom. While easy to learn and perform, these gestures cause significant occlusion of the display. They also require users to explicitly switch between navigation mode and edit mode to either change the viewport’s position in the document, or manipulate the actual content displayed in that viewport, respectively. SidePress [31] augments mobile devices with two continuous pressure sensors co-located on one of their sides (Figure 9-(Left)). It provides users with generic bidirectional navigation capabilities at different levels of granularity, all seamlessly integrated to act as an alternative to traditional navigation techniques, including scrollbars, drag-and-flick, or pinch-to-zoom. We built a functional hardware prototype and developed an interaction vocabulary for different applications. We conducted two laboratory studies. The first one showed that users can precisely and efficiently control SidePress; the second, that SidePress can be more efficient than drag-and-flick touch gestures when scrolling large documents.

Powerup – Current technology like Arduino (<http://arduino.cc/>) opens a large space for designing new electronic device. We built the Power-up Button [30] by combining both pressure and proximity sensing to enable gestural interaction with one thumb (Figure 9-(Right)). Combined with a gesture recognizer that takes the hand’s anatomy into account, the Power-up Button can recognize six different mid-air gestures performed on the side of a mobile device. This gives it, for instance, enough expressive power to provide full one-handed control of interface widgets displayed on screen. This technology can complement touch input, and can be particularly useful when interacting eyes-free. It also opens up a larger design space for widget organization on screen: the button enables a more compact layout of interface components than what touch input alone would allow. This can be useful when, e.g., filling the numerous fields of a long Web form, or for very small devices.

Gimlenses – Complex 3D virtual scenes such as CAD models of airplanes and representations of the human body are notoriously hard to visualize. Those models are made of many parts, pieces and layers of varying

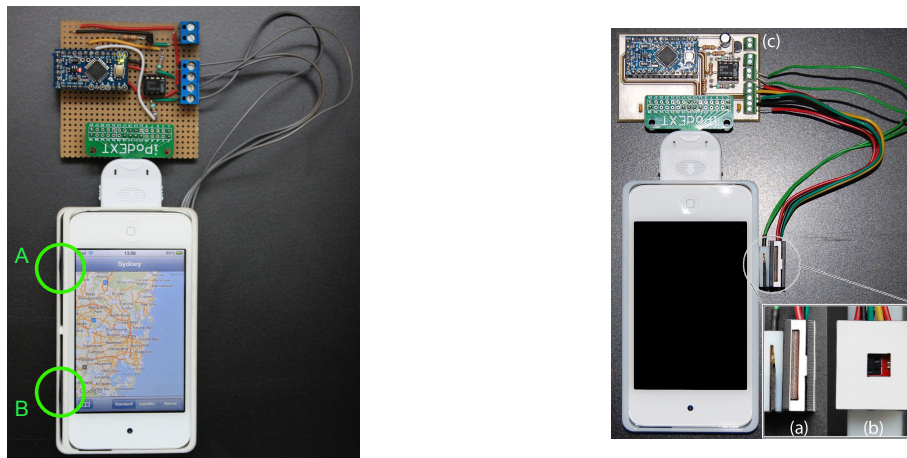


Figure 9. (left) The SidePress prototype has two pressure sensors on one of its sides ; (right) The Power-Up button prototype is equipped with a button for sensing both pressure and proximity.

size, that partially occlude or even fully surround one another. Gimlenses [28] provides a multi-view, detail-in-context visualization technique that enables users to navigate complex 3D models by interactively drilling holes into their outer layers to reveal objects that are buried, possibly deep, into the scene (see Figure 10). These holes are constantly adjusted so as to guarantee the visibility of objects of interest from the parent view. Gimlenses can be cascaded and constrained with respect to one another, providing synchronized, complementary viewpoints on the scene. Gimlenses enable users to quickly identify elements of interest, get detailed views of those elements, relate them, and put them in a broader spatial context.

Dashboard Exploration – Visual stories help us communicate knowledge, share and interpret experiences and have become a focus in visualization research in recent years. In this paper we discuss the use of storytelling in Business Intelligence (BI) analysis [21] (Best Paper Award). We derive the actual practices in creating and sharing BI stories from in-depth interviews with expert BI analysts (both story “creators” and “readers”). These interviews revealed the need to extend current BI visual analysis applications to enable storytelling, as well as new requirements related to BI visual storytelling. Based on these requirements we designed and implemented a storytelling prototype tool with appropriate interaction techniques, that is integrated in an analysis tool used by our experts, and allows easy transition from analysis to story creation and sharing. We report experts’ recommendations and reactions to the use of the prototype to create stories, as well as novices’ reactions to reading these stories.

Hybrid-Image Visualizations – Data analysis scenarios often incorporate one or more displays with sufficiently large size and resolution to be comfortably viewed by different people from various distances. Hybrid-image visualizations [15] blend two different visual representations into a single static view, such that each representation can be perceived at a different viewing distance. They can thus be used to enhance overview tasks from a distance and detail-in-context tasks when standing close to the display. Viewers interact implicitly with these visualizations by walking around the space. By taking advantage of humans’ perceptual capabilities, hybrid-image visualizations show different content to viewers depending on their placement, without requiring tracking of viewers in front of a display. Moreover, because hybrid-images use a perception-based blending approach, visualizations intended for different distances can each utilize the entire display.

Evolutionary Visual Exploration – In a high-dimensionality context, the visual exploration of information is challenging, as viewers are often faced with a large space of alternative views on the data. We present [14], a system that combines visual analytics with stochastic optimization to aid the exploration of multidimensional

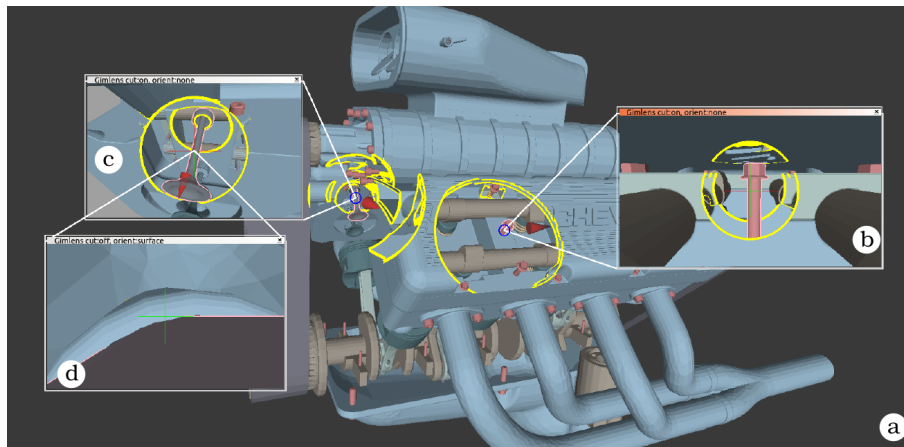


Figure 10. Exploring the CAD drawing of a car engine. The three Gimlenses provide detailed views of different constituent parts of the engine, at different magnification levels and with varying orientation, while revealing their location inside the global 3D model. (a) Context view. (b) Magnified side view of a knot behind, and thus originally hidden by, the cylinder head cover. (c) View fully revealing a poppet valve in-context from a different angle than the main view, with (d) another Gimlens configured so as to provide a low-angled point of view on the valve.

datasets characterized by a large number of possible views or projections. Starting from dimensions whose values are automatically calculated by a PCA, an interactive evolutionary algorithm progressively builds (or evolves) non-trivial viewpoints in the form of linear and non-linear dimension combinations, to help users discover new interesting views and relationships in their data. The system calibrates a fitness function (optimized by the evolutionary algorithm) to take into account the user interactions to calculate and propose new views. Our method leverages automatic tools to detect interesting visual features and human interpretation to derive meaning, validate the findings and guide the exploration without having to grasp advanced statistical concepts. Our prototype was evaluated through an observational study with five domain experts, and helped them quantify qualitative hypotheses, try out different scenarios to dynamically transform their data, and to better formulate their research questions and build new hypotheses for further investigation.

6.2. Research Methods

Participants: Michel Beaudouin-Lafon, Anastasia Bezerianos, Jérémie Garcia, Stéphane Huot, Ilaria Liccardi, Wendy Mackay [correspondant].

Conducting empirical research is a fundamental part of InSitu’s research activities, including observation of users in field and laboratory settings to discover problems faced by users, controlled laboratory experiments to evaluate the effectiveness of the technologies we develop, longitudinal field studies to determine how our technologies work in the real world, and participatory design, to explore design possibilities with users throughout the design process.

However, we not only use research methods, we also investigate and develop them. As organizers of the CHI’13 conference in Paris, which had record-breaking numbers of submissions (over 2000) and participants (3500), we instituted a number of innovations in both the process of creating the program and presenting information to conference participants. In collaboration with researchers at MIT, we introduced an “author-sourcing” process (with an 87% participation rate) for collecting affinity data. We then developed a collaborative, interactive, visualization system on the WILD wall display, combined with the *Cobi* interactive constraint-solving system, that enabled us to resolve all presenter conflicts and successfully place all 500+

papers and events in relevant sessions ([35], [26]). We also replaced the “CHI Madness” series of 25-second presentations with “Video Previews”, in which each research paper, course, panel or other event has a 30-second video preview. These are now available on the CHI’13 website, the ACM/CHI YouTube channel and in the ACM Digital Library, before the paywall. We also developed and field-tested the Interactive Schedule on large, interactive displays, which allowed conference attendees to both view upcoming Video Previews and use their mobile phones to search for particular content and create customized playlists [29]. We also developed two interactive table-top applications that were presented at CHI’13 Interactivity, that allowed attendees to visualize and explore conference events as well as to create customized video playlists.

The RepliCHI workshop at CHI’13, co-organized by Wendy Mackay, examined issues with respect to encouraging replication of controlled experiments, and introduced the RepliCHI award to top research articles that offer strong empirical contributions that include replication. She also organized a session called *Interacting with CHI* in which participants explained the technologies and processes they developed to support the CHI conference design and execution.

In the context of our work with Interactive Paper to support music composition, we developed Paper Tonnetz, a paper-based interface to composing melodies and chords based on musical patterns expressed in Euler’s Tonnetz, and demonstrated it at CHI’13 Interactivity ([22]). We also explored how to create an interactive event for the “Fête de la Science”, called “Design Me a Sound Landscape”, in which participants can create their own ways of expressing a landscape and add natural sounds, such as wind, rain, moving water, that another participant can experience as they move on an interactive floor. Finally, we explored the drawing process, with the *Drawing Assistant* ([25]) in which users receive guidance and feedback as they learn to draw from photographs.

6.3. Engineering of interactive systems

Participants: Caroline Appert, Michel Beaudouin-Lafon [correspondant], Olivier Chapuis, Stéphane Huot, Wendy Mackay.

InSitu has a long tradition of developing software tools and user interface toolkits to facilitate the creation of interactive systems. These tools allow us to better experiment with our ideas and are therefore an integral part of our research methodology. Most of them are freely available and some are used outside InSitu for research or teaching.

Our work has focused on developing middleware for the WILD platform, InSitu’s experimental ultra-high-resolution interactive room for studying collaborative interaction and the visualization of very large datasets [2]. WILD features a wall-sized display with 32 monitors, a multitouch table, a motion-tracking system and various mobile devices. Running applications on WILD requires developing advanced distributed systems that coordinate, in real time, the 16 computers of the cluster driving the wall display with a variety of clients and servers running on other computers, including mobile devices.

We investigated the use of Web standards and protocols to develop and deploy such applications. Hydrascope [24] introduces the concept of *meta-application* that combines, adapts and/or repurposes existing web applications for an environment such as WILD. It uses a web browser (or even a web engine, e.g. WebKit) as a rendering and interaction toolkit and Web protocols (HTTP and WebSockets) for communication. We demonstrated how to control a wall-size presentation tool built on Google Present and a wall-size map built on Google Maps without modifying these applications but by taking advantage of the capability of web applications for introspection.

This approach was used to develop CHIWall, an application designed to help us schedule the CHI 2013 conference that InSitu chaired this year in Paris. The resulting tool combines a wall-size display of the full program with a constraint-detection and constraint-solving assistant called Cobi [26], which itself uses crowd-sourced information from the authors. The resulting application supports collaborative work to fine-tune the program (Figure 11) and features a flexible architecture that has been reused for other prototype applications.

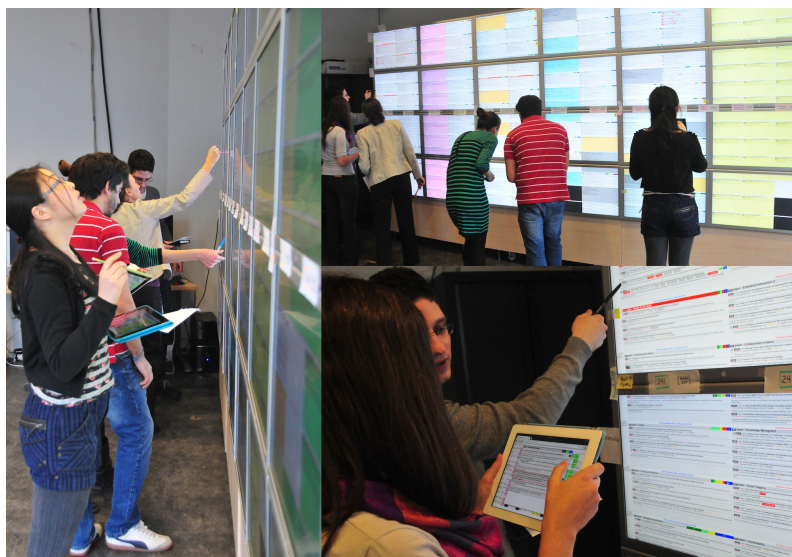


Figure 11. A group of users interacting with the CHIwall application to fine tune the schedule of the CHI 2013 conference (500 events (400 research articles) in 200 sessions, in 16 parallel tracks over four days). The tablet interface provides additional detail about the content of a session, such as the abstract and the details of the affinity data crowd-sourced from the authors.

In summary, InSitu has continued to make significant progress towards mature toolkits that support post-WIMP and distributed user interfaces. These toolkits, in turn, have enabled us to experiment with novel interaction techniques using rapid prototyping. Conversely, our work on novel interaction techniques has driven the development of software toolkits that embody their underlying principles, facilitating further exploration. This back-and-forth between techniques, methods and tools is a defining feature of InSitu, captured by the *Designing Interaction* [11] framework. As the focus of our research on interaction techniques has shifted from on-the-desktop to off-the-desktop, this approach has proven more valid than ever: improving interaction in such environments requires more complex software architectures and tools; in turn, these tools and architectures are a key step to getting these technologies outside the lab.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Mix3D - CIFRE Funding for Justin Mathew PhD thesis “New visualization and interaction techniques in spatial composition for mixing audio interfaces in the context of 3D spatial audio.”, Coordinator: Stéphane Huot. Partners: Univ. Paris-Sud, ENS Louis-Lumière & DMS-Cinema. The project involves studying and designing new ‘physical’ and software interfaces for mixing spatial audio.

8. Partnerships and Cooperations

8.1. Regional Initiatives

DigiPods - Remote Collaborative Interaction among Heterogeneous Visualization Platforms, Région Île-de-France (2012-2015), Coordinator: Stéphane Huot. Partners: Digiteo/FCS Campus Paris-Saclay, Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech. The goal of DIGIPODS is to design new interactive equipments and devices for collaborative interaction in immersive and high-resolution visualization platforms, connected through a high-end telepresence infrastructure. Beyond the usual interactive devices of such platforms (motion capture, interactive surfaces, haptic devices, audio and video systems), all the platforms will be augmented with new devices to facilitate co-located or remote interaction and collaboration: telepresence robots and the DigiCarts, a new kind of interaction devices specifically designed for these needs. These equipments will be used by researchers in Human-Computer Interaction to explore the visualization and manipulation of large datasets, interaction in virtual reality, remote collaboration among heterogeneous platforms; but also by researchers from other fields and by professionals in order to explore and manipulate their complex data.

DigiCarts - Post-doctoral fellow position funded by Digiteo, Coordinator: Stéphane Huot. Partners: Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech. Complements the DigiPods project with funding for a 18 months post-doctoral position focused on the design, implementation and evaluation of the DigiCart devices.

DigiZoom - Funding by DIGICOSME Labex, Coordinator: Olivier Chapuis. Partners: U. Paris-Sud, Inria, Institut Mines-Telecom. Design, modeling and empirical evaluation of multi-scale navigation techniques depending on the input channels and output characteristics of the devices, in particular the size, in single-user and collaborative contexts.

8.2. National Initiatives

Digiscope - Collaborative Interaction with Complex Data and Computation (2011-2020) <http://digiscope.fr>. “Equipment of Excellence” project funded by the “Investissements d’Avenir” program of the French government. 10 academic partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, CNRS, CEA, Inria, Institut Telecom ParisTech, Ecole Centrale Paris, Université Versailles - Saint-Quentin, ENS Cachan, Maison de la Simulation. Overall budget: 22.5 Meuros, including 6.7 Meuros public funding from ANR. Michel Beaudouin-Lafon: coordinator and principal investigator for the whole project. The goal of the project is to create nine high-end interactive rooms interconnected by high-speed networks and audio-video facilities to study remote collaboration across interactive visualization environments. The equipment will be open to outside users and targets four main application areas: scientific discovery, product lifetime management, decision support for crisis management, and education and training. In Situ will contribute the existing WILD room, a second room called WILDER funded by the project, and its expertise in the design and evaluation of advanced interaction techniques and the development of distributed software architectures for interactive systems.

MDGest - Interacting with Multi-Dimensional Gestures (2011-2014). InSitu is the only academic partner. Funded by the French National Research Agency (ANR), Programme JCJC (Junior researchers): 88 Keuros. Caroline Appert (coordinator) and Theophanis Tsandilas. This project investigates new interactions for small devices equipped with a touchscreen. Complementing the standard point-and-click interaction paradigm, the MDGest project explores an alternative way of interacting with a user interface: tracing gestures with the finger. According to previous work, this form of interaction has several benefits, as it is faster and more natural for certain contexts of use. The originality of the approach lies in considering new gesture characteristics (dimensions) to avoid complex shapes that can be hard for users to memorize and activate. Dimensions of interest include drawing speed (local or global), movement direction, device orientation or inclination, and distinctive drawing patterns in a movement.

DRAO – Adrien Bousseau (Inria, Sophia Antipolis) submitted a successful ANR grant with members from InSitu Theophanis Tsandilas (Inria) and Wendy Mackay, and Prof. Maneesh Agrawala (Berkeley), called DRAO, to create interactive graphics tools to support sketching. The kickoff meeting was held in Nov. 2012 and included interviews with designers from Toyota.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. CREATIV

Type: IDEAS

Instrument: ERC Advanced Grant

Duration: June 2013 - May 2018

Coordinator: Wendy Mackay

Partner: Inria (France)

Inria contact: Wendy Mackay

Abstract: CREATIV explores how the concept of co-adaptation can revolutionize the design and use of interactive software. Co-adaptation is the parallel phenomenon in which users both adapt their behavior to the system's constraints, learning its power and idiosyncrasies, and appropriate the system for their own needs, often using it in ways unintended by the system designer. The initial goal of the CREATIV project is to fundamentally improve the learning and expressive capabilities of advanced users of creative software, offering significantly enhanced methods for expressing and exploring their ideas. The ultimate goal is to radically transform interactive systems for everyone by creating a powerful and flexible partnership between human users and interactive technology.

8.3.1.2. Social Privacy

Type: PEOPLE

Instrument: Marie Curie International Outgoing Fellowships for Career Development

Duration: September 2012 - August 2015

Coordinator: Wendy Mackay

Partner: Inria (France) and Massachusetts Institute of Technology (USA)

Inria contact: Ilaria Liccardi

Abstract: Although users' right to privacy has long been protected, the rapid adoption of social media has surpassed society's ability to effectively regulate it. Today's users lack informed consent: they must make all-or-nothing decisions about on-line privacy regardless of context. The Social Privacy project will first diagnose the problem, exploring privacy issues associated with social media at the level of the individual, the enterprise and society, and then generate effective solutions, from providing users with technical safeguards and informed consent, to establishing corporate guidelines for protecting privacy, to developing and testing recommendations for public policy.

8.3.2. Collaborations in European Programs, except FP7

EIT ICT Labs Master School, European Institute of Technology. Coordinator: M. Beaudouin-Lafon. Partners: KTH (Sweden), U. Paris-Sud (France), U. Aalto (Finland), Technical University Berlin (Germany), Technical University Delft (Netherlands), U. College London (UK), U. Trento (Italy). InSitu participates in the Human-Computer Interaction and Design (HCID) major of the EIT ICT Labs European Master School. Paris-Sud is of the two sites for the first year of this Master Program, and host one of the specialties for second-year students. Students in this program receive a double degree after studying in two countries. https://www.dep-informatique.u-psud.fr/en/formation/lmd/M1_HCID.

8.3.3. Collaborations with Major European Organizations

VCoRE - Next-Generation Visual Computing Platform (ADT Inria, 2011-2014), Coordinator for InSitu: Stéphane Huot. Partners: Inria (Grenoble, Lille, Rennes, Saclay, Sophia Antipolis), IGD Fraunhofer Institute. Collaboration between Inria and IGD Fraunhofer Institute for the specification and development of a software framework dedicated to mixed/augmented/virtual reality and advanced visualization platforms (distributed computer graphics, simulation and interaction).

8.4. International Initiatives

8.4.1. Inria Associate Teams

SIRIUS, Situated Interaction Research, Associate Team between Inria, Stanford Univ. and UC San Diego. Scott Klemmer, Stanford Univ. and Jim Hollan, UC San Diego

Inria Silicon Valley allowed us to expand the scope of our work with Stanford and U.C. San Diego to include U.C. Berkeley (see below). Daniel Strazzula, a Master's student, was accepted as a Ph.D. student (Cordi grant), and Lora Oehlberg, a Ph.D. student, was accepted as a Post-Doc (Cordi Inria Silicon Valley) at InSitu. Members of InSitu went to Stanford and Berkeley for several week-long visits during the year. Volunteers from Berkeley, Stanford and U.C. San Diego were actively involved in the creation technology to support the CHI'13 conference in Paris, including the Interactive Schedule ([29]), author-sourcing [35]; the Video Previews, and the use of HydraScope to create CHIWall, for collaborative scheduling of the CHI'13 conference.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

BayScope - Architectures and Interaction Paradigms for Multi-surface Environments, NSF CNIC (Catalyzing New International Organizations) grant (2012-2013), Coordinator: Wendy Mackay. Partners: InSitu, Berkeley Institute of Design (BiD).

In the context of the 22m€ Digiscope project in France and corresponding projects at UCSD and Berkeley, we continued to work on BayScope, a strategy for creating novel applications for wall-size display and multisurface environments, by aggregating existing or new web-based applications. Prof. Bjoern Hartmann obtained support for this collaboration (NSF grant) that he secured for our collaboration. We developed HydraScope ([24]), a framework for transforming existing web applications into meta-applications that execute and synchronize multiple copies of applications in parallel, with a multi-user input layer for interacting with it, which was validated with five meta-applications.

8.4.3. Inria International Labs

CIRIC Chili (Emmanuel Pietriga & Claude Puech) – Publications on wall displays [27], mobile devices [31], [30] and focus+context navigation [28]. Thesis of C. Pindat.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Maria Jesus Lobo, Pontificia Universidad Católica de Chile. *Graphical interaction techniques for undo and redo*, January - March 2013, Caroline Appert & Olivier Chapuis.
- Iuliia Vlasenko, University of Alberta, Canada. *Interactive visualization of temporal data on wall-size display*, June - November 2013, Wendy Mackay.

9. Dissemination

9.1. Scientific Animation

Conference Organization

- CHI 2013, *ACM Conference on Human Factors in Computing Systems*, Paris, 2013: Wendy Mackay (General Chair), Michel Beaudouin-Lafon (Technical Program Co-Chair)
- ECRC 2013, *First ACM European Computer Research Congress*, Paris, 2013: Michel Beaudouin-Lafon (Organizing Committee member)
- IHM 2013, *Conférence Francophone d'Interaction Homme-Machine*: Stéphane Huot (Program Co-Chair)

Program Committees

- CHI, *ACM Conference on Human Factors in Computing*: Caroline Appert, Stéphane Huot
- UIST, *ACM Symposium on User Interface Software and Technology*: Caroline Appert
- INTERACT *14th IFIP TC13 Conference in Human-Computer Interaction*: Caroline Appert, Olivier Chapuis, Stéphane Huot
- Eurographics, *34th Annual Conference of the European Association for Computer Graphics*: Theophanis Tsandilas
- PacificVis, *IEEE Pacific Visualization Symposium 2013*: Anastasia Bezerianos
- IHM, *Conférence Francophone d'Interaction Homme-Machine*: Olivier Chapuis

Editorial Boards

- CACM, *Communications of the ACM*, ACM: Wendy Mackay (2008-)
- TOCHI, *Transactions on Computer Human Interaction*, ACM: Michel Beaudouin-Lafon (2009-)
- IJHCS, *International Journal of Human-Computer Study*, Elsevier: Michel Beaudouin-Lafon (Member of the Advisory Board, 2009-)
- JCSCW, *Journal of Computer Supported Cooperative Work*, Springer: Michel Beaudouin-Lafon (Member of the Advisory Board, 2010-)

Journal and Conference Reviewing

- Transactions on Computer-Human Interaction (TOCHI), ACM: Anastasia Bezerianos, Olivier Chapuis, Lora Oehlberg, Theophanis Tsandilas
- International Journal of Human-Computer Studies (IJHCS), Elsevier: Olivier Chapuis
- Journal on Computing and Cultural Heritage (JOCCH), ACM: Theophanis Tsandilas
- ACM CHI 2013: Anastasia Bezerianos, David Bonnet, Jérémie Garcia (Work In Progress), Theophanis Tsandilas
- ACM UIST 2013: Michel Beaudouin-Lafon, Anastasia Bezerianos, David Bonnet, Olivier Chapuis, Stéphane Huot, Theophanis Tsandilas
- ACM EICS 2013 - ACM Symposium on Engineering Interactive Computing Systems: Stéphane Huot
- ACM ITS 2013 - ACM Conference on Interactive Tabletop and Surfaces: Anastasia Bezerianos, Olivier Chapuis, Stéphane Huot
- ACM MobileHCI 2013 - ACM Conference on Human-Computer Interaction with Mobile Devices and Services: Olivier Chapuis
- TEI 2013 - Conference on Tangible Embedded and Embodied Interaction: Stéphane Huot
- IEEE InfoVis 2013 - IEEE Information Visualization Conference: Anastasia Bezerianos
- IHM 2013 - Conférence Francophone d'Interaction Homme-Machine: Michel Beaudouin-Lafon, Theophanis Tsandilas

Research Organizations

- Agence Nationale de la Recherche (ANR), “Contenus et Interactions” program: Michel Beaudouin-Lafon (Steering Committee member)
- Agence Nationale de la Recherche (ANR), “Blanc” program: Caroline Appert and Theophanis Tsandilas (Reviewers)
- Agence Nationale de la Recherche (ANR), “Blanc International” and “Jeunes Chercheuses Jeunes Chercheurs” programs: Caroline Appert (Reviewer)
- Steering Committee of the Campus Paris-Saclay “Institute for Digital Society” (“Institut de la Société Numérique”): Michel Beaudouin-Lafon (Member)
- Alliance des Sciences et Technologies du Numérique (ALLISTENE), Working group “Knowledge, Content and Interaction”: Wendy Mackay and Michel Beaudouin-Lafon (Members)
- Alliance des Sciences et Technologies du Numérique (ALLISTENE), Working group “Interactions des mondes physiques, de l’humain et du monde numérique” for the National Research Strategy agenda: Michel Beaudouin-Lafon (Co-chair)

Learned Societies

- Association Francophone d'Interaction Homme-Machine (AFIHM): Olivier Chapuis (member of the board, vice-president), Stéphane Huot (members of the board and of the scientific council – CPPMS)
- Paris SIGCHI Local Chapter: Anastasia Bezerianos (vice-president)
- ACM Europe Council: Michel Beaudouin-Lafon (member)
- ACM SIGCHI: Wendy Mackay (member of conference management committee)

Hiring committees

- Univ. Paris-Sud hiring committee, Commission Consultative des Spécialistes de l'Université 27ème section (computer science), members: Michel Beaudouin-Lafon, Stéphane Huot, Wendy Mackay
- Univ. Paris-Sud hiring committee, Comité de Sélection 27ème section (computer science), members: Michel Beaudouin-Lafon, Wendy Mackay
- Univ. Bordeaux I (Bordeaux) hiring committee, Comité de Sélection 27ème section (computer science), members: Stéphane Huot

9.2. Teaching - Supervision - Juries**9.2.1. Teaching**

Interaction Masters (Research Master in Computer Science, Interaction Specialty): Anastasia Bezerianos & Michel Beaudouin-Lafon, Chairs, Caroline Appert, Cédric Fleury, & Wendy Mackay, Internships organization, M2, Univ. Paris-Sud

HCID Masters (EIT ICT Labs European Master in Human-Computer Interaction and Design): Michel Beaudouin-Lafon & Anastasia Bezerianos, Chairs, Wendy Mackay, M1 & M2, Univ. Paris-Sud

DUT Informatique: Stéphane Huot, Director of studies for the 1st year, IUT Orsay – Univ. Paris-Sud
Masters in Computer Science & HCID Masters: Anastasia Bezerianos & Cédric Fleury *Programming of Interactive Systems*, 63 hrs, M1, Univ. Paris-Sud

Research Masters in Computer Science: Wendy Mackay & Anastasia Bezerianos *Formation à la Recherche* 45 hrs, M2 (all research specialties), Univ. Paris-Sud

Interaction Masters & HCID Masters: Michel Beaudouin-Lafon, *Fundamentals of Human-Computer Interaction*, 38 hrs, M1/M2, Univ. Paris-Sud

Interaction Masters & HCID Masters: Wendy Mackay *Design and Evaluation of Interactive Systems*, 63 hrs, M1/M2, Univ. Paris-Sud

HCID Masters: Wendy Mackay *Business Design Labs*, 8 hrs, M1, Univ. Paris-Sud

Master 2 Professional: Anastasia Bezerianos *Design and Evaluation of Interactive Systems*, 38 hrs, M2Pro, Univ. Paris-Sud

Interaction Masters: Anastasia Bezerianos, *Mixed Reality and Tangible Interaction*, 18 hrs, M2, Univ. Paris-Sud

Interaction Masters: Michel Beaudouin-Lafon & Cédric Fleury, *Groupware and Collaborative Interaction*, 38 hrs, M2, Univ. Paris-Sud

HCID Masters: Caroline Appert, *Evaluation of interactive systems*, 63 hrs, M1, Univ. Paris-Sud

HCID Masters: Anastasia Bezerianos, Wendy Mackay, Michel Beaudouin-Lafon, *Human-Computer Interaction project*, 50 hrs, M1, Univ. Paris-Sud

Polytech 3ème année: Anastasia Bezerianos *Interaction Homme-Machine*, 18 hrs, M1, Univ. Paris-Sud

License 2: Anastasia Bezerianos *Developpement Logiciel*, 15 hrs, L2, Univ. Paris-Sud

DUT Informatique: Stéphane Huot, *Programmation Orientée Objet*, 21 hrs, L2, IUT Orsay – Univ. Paris-Sud

9.2.2. Supervision

Habilitations

HdR : Stéphane Huot, “*Designing Interaction*”: *A Missing Link in the Evolution of Human-Computer Interaction*, Université Paris-Sud, 7 May 2013

PhD Students

PhD : Cyprien Pindat, *A Content-Aware Design Approach to Multiscale Navigation*, Université Paris-Sud, defended on 20 December 2013, Claude Puech, Emmanuel Pietriga & Olivier Chapuis

PhD in progress : David Bonnet, *Gesture-based interactions and instrumental interaction*, October 2011, Michel Beaudouin-Lafon & Caroline Appert

PhD in progress : Jérémie Garcia, *Supporting creative activities with interactive paper*, October 2010, Wendy Mackay & Theophanis Tsandilas

PhD in progress : Ghita Jalal, *Co-Adaptive Systems*, September 2013, Wendy Mackay

PhD in progress : Alexandre Kouyoumdjian, *Multimodal Selection of Numerous Moving Targets in Large Visualization Platforms: Application to Interactive Molecular Simulation.*, October 2013, Stéphane Huot, Patrick Bourdot & Nicolas Ferey (LIMSI-CNRS)

PhD in progress : Can Liu, *Collaborative Multiscale Navigation and Interaction*, October 2012, Michel Beaudouin-Lafon, Olivier Chapuis & Eric Lecolinet (Telecom ParisTech)

PhD in progress : Justin Mathew, *New visualization and interaction techniques for 3D spatial audio*, June 2013, Stéphane Huot & Alan Blum (ENS Louis-Lumière)

PhD in progress : Daniel Strazzulla, *Multimedia Communication*, October 2012, Wendy Mackay

PhD in progress : Oleksandr Zinenko, *Interactive Code Restructuring*, September 2013, Stéphane Huot & Cédric Bastoul (Université de Strasbourg)

Masters students

Jessalyn Alvina. *RouteLens: efficient route following for map applications*, April - September 2013, Caroline Appert & Olivier Chapuis

Stephan Delarue. *Performance gestuelle et physiologie*, April – August 2013, Caroline Appert & Halla Olafsdottir

Evanthia Dimara. *Linking AI and HCI through Co-Adaptive Instruments*. April - September 2013, Wendy Mackay.

Magdalini Grammatikou. *BricoSketch: Replicating and reusing electronic and physical material in professional illustrations*, April - September 2013, Stéphane Huot & Theophanis Tsandilas

Thibaut Jacob. *Sketching Interactions for Data Exploration*, April - September 2013, Anastasia Bezerianos & Theophanis Tsandilas

Ghita Jalal. *Co-Adaptive Instruments*. May - September 2013, Wendy Mackay

Antoine Ponsard. *Interactive Visualisation with Temporal Data*. April - June 2013, Michel Beaudouin-Lafon, September 2013, Anastasia Bezerianos & Theophanis Tsandilas

Julia Vlasenko. *Interactive Visualization of Ubiquitous Dat*. May - November 2013, Wendy Mackay

Summer Schools

Reviewing process workshop, Rencontres Jeunes Chercheurs en Interaction Homme-Machine. June 17-20, 2013. RJC-IHM’13, Lyon, France. Caroline Appert.

Les thèmes émergents de l’IHM, Rencontres Jeunes Chercheurs en Interaction Homme-Machine. June 17-20, 2013. RJC-IHM’13, Lyon, France. Olivier Chapuis.

Tangible Interfaces and Instrumental Interaction, French-German Tangible Interaction Studio. August 26-28, 2013, Biarritz, France. Michel Beaudouin-Lafon.

Participatory Information Technology, Generative Walkthroughs Summer School. August 26-28, 2013, Aarhus, Denmark. Michel Beaudouin-Lafon & Wendy Mackay.

UXdesign : l’expérience au service des apprentissages ?, Keynote at the Campus Européen d’Eté 2013 de l’Université de Poitiers. September 16-20, 2013, Poitiers, France. Wendy Mackay.

9.2.3. Juries

Simon Perrault (Télécom ParisTech, Paris): Olivier Chapuis, reviewer
 Sebastien Rufiange (École de Technology Supérieure, Canada): Anastasia Bezerianos, reviewer
 Raphaël Hoarau (ENAC, Toulouse): Michel Beaudouin-Lafon, reviewer and president
 Joseph Malloch (McGill University, Canada): Michel Beaudouin-Lafon, reviewer
 Eakachai Charoenchaimonkon (AIT, Bangkok): Michel Beaudouin-Lafon, reviewer
 Dong-Bach Vo (Télécom ParisTech, Paris): Stéphane Huot, jury member

9.3. Popularization

Wendy Mackay was interviewed for Inria/Technoscope: "L'interaction homme-machine en ligne de mire", February, 2013, and for an article in "Science & Vie" on the topic of Google Glass, November 12, 2013.

Wendy Mackay was interviewed on two *France Culture* radio shows: "Place de la Toile" on the topic of tomorrow's computers ("l'ordinateur de demain") on September 7, 2013 and on "Science Publique" on the topic of whether augmented reality will change our vision of the world ("La réalité augmentée va-t-elle changer notre vision du monde?") on November 1, 2013.

Wendy Mackay and Michel Beaudouin-Lafon were each interviewed as the scientist of the day ("savant du jour") on the *France Inter* radio show "On va tous y passer", on October 30 and November 20, 2013 respectively.

10. Bibliography

Major publications by the team in recent years

- [1] C. APPERT, S. HUOT, P. DRAGICEVIC, M. BEAUDOUIN-LAFON. *FlowStates: Prototypage d'applications interactives avec des flots de données et des machines à états*, in "Proceedings of IHM 2009", ACM, Octobre 2009, pp. 119-128, Best Paper Award, <http://doi.acm.org/10.1145/1629826.1629845>
- [2] M. BEAUDOUIN-LAFON, O. CHAPUIS, J. EAGAN, T. GJERLUFSEN, S. HUOT, C. KLOKMOSE, W. E. MACKAY, M. NANCEL, E. PIETRIGA, C. PILLIAS, R. PRIMET, J. WAGNER. *Multi-surface Interaction in the WILD Room*, in "IEEE Computer", 2012, vol. 45, n^o 4, pp. 48-56, <http://dx.doi.org/10.1109/MC.2012.110>
- [3] O. CHAPUIS, J.-B. LABRUNE, E. PIETRIGA. *DynaSpot: speed-dependent area cursor*, in "CHI '09: Proceedings of the 27th international conference on Human factors in computing systems", ACM, 2009, pp. 1391-1400, Notable Mention Award, <http://doi.acm.org/10.1145/1518701.1518911>, <http://hal.archives-ouvertes.fr/inria-00373678>
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- [6] E. GHOMI, G. FAURE, S. HUOT, O. CHAPUIS, M. BEAUDOUIN-LAFON. *Using Rhythmic Patterns as an Input Method*, in "CHI '12: Proceedings of the 30th international conference on Human factors in computing systems", ACM, 2012, pp. 1253–1262, Best Paper Award, <http://doi.acm.org/10.1145/2207676.2208579>
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- [8] W. E. MACKAY, C. APPERT, M. BEAUDOUIN-LAFON, O. CHAPUIS, Y. DU, J.-D. FEKETE, Y. GUIARD. *TouchStone: Exploratory Design of Experiments*, in "Proceedings of ACM CHI 2007 Conference on Human Factors and Computing Systems", ACM Press, April 2007, pp. 1425-1434, <http://doi.acm.org/10.1145/1240624.1240840>, <http://hal.archives-ouvertes.fr/inria-00538384>
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- [10] T. TSANDILAS, C. LETONDAL, W. E. MACKAY. *Musink: Composing Music through Augmented Drawing*, in "CHI '09: Proceedings of the SIGCHI conference on Human factors in computing systems", ACM, 2009, pp. 819–828, Best Paper Award, <http://doi.acm.org/10.1145/1518701.1518827>

Publications of the year

Doctoral Dissertations and Habilitation Theses

- [11] S. HUOT. , *'Designing Interaction': un chaînon manquant dans l'évolution de l'Interaction Homme-Machine*, Université Paris Sud - Paris XI, May 2013, Habilitation à Diriger des Recherches, <http://hal.inria.fr/tel-00823763>

Articles in International Peer-Reviewed Journals

- [12] B. BACH, E. PIETRIGA, J.-D. FEKETE. *GraphDiaries: Animated Transitions and Temporal Navigation for Dynamic Networks*, in "Transactions on Visualization and Computer Graphics (TVCG)", November 2013 [DOI : 10.1109/TVCG.2013.254], <http://hal.inria.fr/hal-00906597>
- [13] B. BACH, E. PIETRIGA, I. LICCARDI. *Visualizing Populated Ontologies with Ontrotrix*, in "International Journal On Semantic Web and Information Systems (IJSWIS)", 2014, <http://hal.inria.fr/hal-00931052>
- [14] N. BOUKHELIFA, W. G. CANCINO TICONA, A. BEZERIANOS, E. LUTTON. *Evolutionary Visual Exploration: Evaluation With Expert Users*, in "Computer Graphics Forum (EuroVis 2013, June 17–21, 2013, Leipzig, Germany)", June 2013, vol. 32, n^o 3, pp. 31-40 [DOI : 10.1111/CGF.12090], <http://hal.inria.fr/hal-00805234>
- [15] P. ISENBERG, P. DRAGICEVIC, W. WILLETT, A. BEZERIANOS, J.-D. FEKETE. *Hybrid-Image Visualization for Large Viewing Environments*, in "IEEE Transactions on Visualization and Computer Graphics", 2013, vol. 19, n^o 12, pp. 2346–2355 [DOI : 10.1109/TVCG.2013.163], <http://hal.inria.fr/hal-00844878>

International Conferences with Proceedings

- [16] B. BACH, E. PIETRIGA, J.-D. FEKETE. *Visualizing Dense Dynamic Networks with Matrix Cubes*, in "IEEE VisWeek 2013 Electronic Conference Proceedings", Atlanta, GA, United States, October 2013, Best Poster, <http://hal.inria.fr/hal-00850662>
- [17] B. BACH, E. PIETRIGA, J.-D. FEKETE. *Visualizing Dynamic Networks with Matrix Cubes*, in "SIC-CHI Conference on Human Factors in Computing Systems (CHI)", Toronto, Canada, ACM, April 2014 [DOI : 10.1145/2556288.2557010], <http://hal.inria.fr/hal-00931911>
- [18] A. BEZERIANOS, P. ISENBERG, O. CHAPUIS, W. WILLETT. *Perceptual Affordances of Wall-Sized Displays for Visualization Applications: Color*, in "Proceedings of the CHI Workshop on Interactive, Ultra-High-Resolution Displays (PowerWall)", Paris, France, April 2013, <http://hal.inria.fr/hal-00799486>
- [19] D. BONNET, C. APPERT, M. BEAUDOUIN-LAFON. *Extending the Vocabulary of Touch Events with ThumbRock*, in "GI - Graphics Interface - 2013", Regina (Saskatchewan), Canada, May 2013, <http://hal.inria.fr/hal-00839414>
- [20] W. G. CANCINO TICONA, N. BOUKHELIFA, A. BEZERIANOS, E. LUTTON. *Evolutionary Visual Exploration: Experimental Analysis of Algorithm Behaviour*, in "GECCO workshop on Genetic and Evolutionary Computation (VizGEC 2013)", Amsterdam, Netherlands, July 2013, pp. 1373-1380 [DOI : 10.1145/2464576.2482717], <http://hal.inria.fr/hal-00818641>
- [21] *Best Paper*
M. ELIAS, M.-A. AUFURE, A. BEZERIANOS. *Storytelling in Visual Analytics tools for Business Intelligence*, in "INTERACT 2013 - 14th IFIP TC13 Conference on Human-Computer Interaction", Cape Town, South Africa, Springer, September 2013, vol. 8119, pp. 280-297, Brian Shackel Award, <http://hal.inria.fr/hal-00817732>.
- [22] J. GARCIA, L. BIGO, A. SPICHER, W. E. MACKAY. *PaperTonnetz: Supporting Music Composition with Interactive Paper*, in "Extend Abstract on Human Factors in Computing Systems", Paris, France, April 2013, <http://hal.inria.fr/hal-00837640>
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- [24] B. HARTMANN, M. BEAUDOUIN-LAFON, W. E. MACKAY. *Hydrascope: Creating Multi-Surface Meta-Applications Through View Synchronization and Input Multiplexing*, in "2nd ACM International Symposium on Pervasive Displays", Mountain View, United States, ACM (editor), June 2013, pp. 43-48 [DOI : 10.1145/2491568.2491578], <http://hal.inria.fr/hal-00931142>
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- [27] M. NANCEL, O. CHAPUIS, E. PIETRIGA, X.-D. YANG, I. POURANG, M. BEAUDOUIN-LAFON. *High-Precision Pointing on Large Wall Displays using Small Handheld Devices*, in "CHI '13: SIGCHI Conference on Human Factors and Computing Systems", Paris, France, ACM, April 2013, pp. 831-840 [DOI : 10.1145/2470654.2470773], <http://hal.inria.fr/hal-00786532>
- [28] *Best Paper*
C. PINDAT, E. PIETRIGA, O. CHAPUIS, C. PUECH. *Drilling into Complex 3D Models with Gimlenses*, in "VRST '13: 19th ACM Symposium on Virtual Reality Software and Technology", Singapore, Singapore, ACM, October 2013, pp. 223-230 [DOI : 10.1145/2503713.2503714], <http://hal.inria.fr/hal-00870304>.
- [29] A. SATYANARAYAN, D. STRAZZULLA, C. KLOKMOSE, M. BEAUDOUIN-LAFON, W. E. MACKAY. *The CHI 2013 Interactive Schedule*, in "CHI '13 International Conference on Human Factors in Computing Systems", Paris, France, April 2013, pp. 2987-2990 [DOI : 10.1145/2468356.2479591], <http://hal.inria.fr/hal-00931149>
- [30] D. SPELMEZAN, C. APPERT, O. CHAPUIS, E. PIETRIGA. *Controlling Widgets with One Power-up Button*, in "UIST '13", Saint Andrews, United Kingdom, UIST '13, October 2013, pp. 71-74 [DOI : 10.1145/2501988.2502025], <http://hal.inria.fr/hal-00864209>
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J. WAGNER, M. NANCEL, S. GUSTAFSON, S. HUOT, W. E. MACKAY. *A Body-centric Design Space for Multi-surface Interaction*, in "CHI'13 - 31st International Conference on Human Factors in Computing Systems", Paris, France, ACM, April 2013, <http://hal.inria.fr/hal-00789169>.
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