IN PARTNERSHIP WITH:
CNRS

Université Paris-Sud (Paris 11)

Activity Report 2011

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

Project-Team IN-SITU

Keywords: Augmented Reality, Perception, Software Engineering, User Interface, Visualization

Established in 2002, the INSITU project is a collaboration between INRIA Saclay–Île-de-France and the Laboratoire de Recherche en Informatique (Laboratory for Computer Science) of Paris-Sud University and CNRS (Centre National de la Recherche Scientifique), originally established within the framework of the PCRI (Pôle Commun de Recherche en Informatique).

1. Members

Research Scientists

Wendy Mackay [Team Leader, Senior Researcher (DR1), INRIA]
Caroline Appert [Research Scientist (CR2), CNRS]
Olivier Chapuis [Research Scientist (CR1), CNRS]
Emmanuel Pietriga [Team leader, Research Scientist (CR1), INRIA]
Theophanis Tsandilas [Research Scientist (CR2), INRIA]

Faculty Members

Michel Beaudouin-Lafon [Professor, Paris-Sud University & Institut Universitaire de France, HdR]
Anastasia Bezerianos [Associate Professor, Paris-Sud University]
Stéphane Huot [Associate Professor, Paris-Sud University]
Claude Puech [Professor, Paris-Sud University, since September 2010, HdR]

Technical Staff

Romain Primet [Engineer (IR), INRIA]
Arjit Gupta [Engineer, INRIA, CDD March 2011 to February 2012]
Julien Husson [Engineer (Ingénieur Jeune Diplomé), INRIA, CDD October 2009 to September 2011]
Clément Pillias [Engineer, INRIA, CDD Mars 2009 to September 2011]

PhD Students

David Bonnet [Allocataire de recherche MENRT, Paris-Sud University]
Guillaume Faure [Allocataire de recherche MENRT, Paris-Sud University]
Emilien Ghomi [Allocataire de recherche MENRT, Paris-Sud University]
Jérémie Garcia [Allocataire de recherche MENRT, Paris-Sud University]
Mathieu Nancel [Bourse doctorale Région Ile de France/Digiteo, Paris-Sud University]
Cyprien Pindat [Allocataire de recherche MENRT, Paris-Sud University]
Julie Wagner [CORDI-C, INRIA]

Post-Doctoral Fellows

Rodrigo de Almeida [from February 2011 to January 2012]
Ilaria Liccardi [from March 2010 to December 2011]
Daniel Spelmezan [from September 2011 to August 2012]

Administrative Assistant

Alexandra Merlin

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 In Situ 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 In Situ 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 proposed research strategy is to develop case studies and development tools, in parallel. The case studies will 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, will 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 four 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-scale (zoomable) interfaces, interactive information visualization, bimanual 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.

Mediated communication focuses on how to help people to maintain peripheral awareness of each others' activities at a distance (to "stay in touch"), while maintaining privacy and ensuring that users stay in control of their communication channels. Our objective is to generate a design space for alternative forms of communication, developing and testing new communication applications that illustrate different dimensions of the design space. We are currently developing communication appliances for home settings, including support for the elderly, children, remote couples and families.

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 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

- INSITU had 3 papers accepted at the most prestigious conference in our field, ACM CHI 2011, including a Best paper award for *Mid-air Pan-and-Zoom on Wall-sized Displays* authored by Mathieu Nancel, Julie Wagner, Emmanuel Pietriga, Olivier Chapuis and Wendy Mackay.
- James Eagan, Wendy Mackay and Michel Beaudouin-Lafon received a notable mention for *Cracking the Cocoa Nut: User Interface Programming at Runtime* at ACM UIST 2011.
- Michel Beaudouin-Lafon was inducted as senior member of the Institut Universitaire de France.

3. Scientific Foundations

3.1. Fondation 1

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 [35].

4. Application Domains

4.1. Application Domains

INSITU works actively with users from various application domains in order to understand their specific needs. By studying similar problems in different domains, we can generalize our results and develop more general principles. Our current application domains include:

- Scientific discovery, i.e. the use of advanced interactive technologies by scientists of other disciplines, in particular:
  - Biological research, in cooperation with the Institut Pasteur (Paris), INRA (Institut National de la Recherce Agronomique, Evry), INRA Metarisk [1] (Paris), and other laboratories of the University Paris-Sud;
  - Astronomy, in cooperation with the European Southern Observatory on the ALMA project [2] (Atacama Large Millimiter/submillimeter Array), for array operations monitoring and control of radiotelescopes; and with Institut d'Astrophysique Spatiale [3] on the visualization of large astronomy imagery using ultra-high-resolution wall-sized displays;
- Creative industries (music composition), in cooperation with IRCAM (Institut de Recherche et Coordination Acoustique-Musique, Paris);
- Domestic technologies, in cooperation with ENSCI (Ecole Nationale Supérieure de Création Industrielle, Paris).

We have selected these domains to ensure that we explore and address diverse validation criteria, e.g. enhancing productivity versus increasing communication access, diverse user characteristics, e.g. professionals versus non-professionals, and diverse user environments, e.g., desktops at work versus home versus mobile settings.

5. Software

5.1. jBricks

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

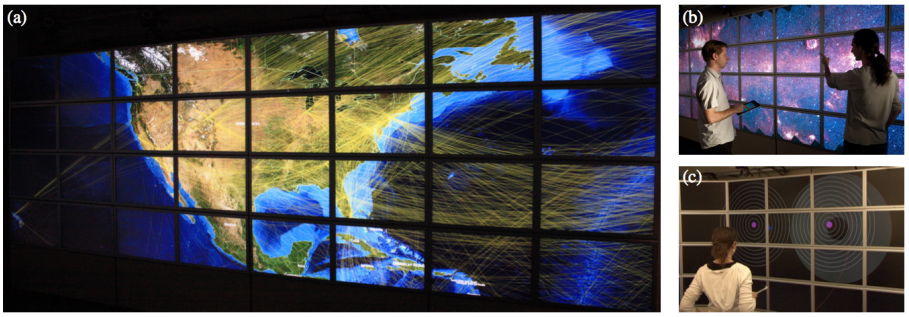

Figure 1. jBricks applications running on the WILD platform (32 tiles for a total resolution of 20 480 × 6 400 pixels). (a) Zoomed-in visualization of the North-American part of the world-wide air traffic network (1 200 airports, 5 700 connections) overlaid on NASA's Blue Marble Next Generation images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

jBricks (Figure 1) is a Java toolkit that integrates a high-quality 2D graphics rendering engine based on ZVTM (section 5.2) and a versatile input configuration module (based on ICon [40] 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

5.2. The Zoomable Visual Transformation Machine

Participants: Caroline Appert, Rodrigo de Almeida, Olivier Chapuis, Arjit Gupta, Julien Husson, Emmanuel Pietriga [correspondant], Mathieu Nancel, Romain Primet.

ZVTM provides application programmers with building blocks for implementing complex multi-scale interface components that cannot be handled by traditional WIMP widgets. Featuring off-the-shelf visualisation and navigation components that are easy to combine, ZVTM provides a simple yet powerful API and handles low-level operations such as multi-threading, clipping, repaint requests and animation management. The toolkit is based on the metaphor of universes that can be observed through smart movable/zoomable cameras. The graphical object model permits management of a large number of complex geometrical shapes. It emphasizes perceptual continuity via an advanced animation module that can animate virtually any on-screen

[1] http://www.paris.inra.fr/metarisk
[2] http://www.almaobservatory.org/
[3] http://www.ias.u-psud.fr

modification. This ranges from camera movements and activation of distortion lenses to modification of the visual variables of graphical objects. Various temporal pacing functions are available to control the execution of these animations. ZVTM is now one of the core components of our jBricks toolkit for wall-sized displays (Section 5.1), and current development activities around the toolkit focus on making applications run transparently on cluster-driven ultra-high-resolution wall-sized displays such as that of the WILD visualization platform. The toolkit is also used to develop advanced visualization components for the ALMA observatory's operations monitoring and control software [29].

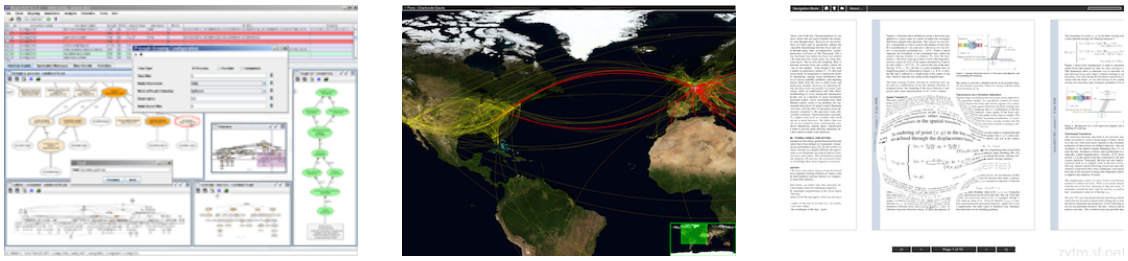

Figure 2. ZVTM used in various applications

Initially developed by Xerox Research Centre Europe and the World Wide Web Consortium (W3C) team at MIT, ZVTM has been available as open-source software under the GNU Lesser General Public License (LGPL) since early 2002. It is used in both academic and industrial projects such as IsaViz (http://www.w3.org/2001/11/IsaViz/), W3C's visual browser/editor for RDF, Blast2GO (Figure 2 - left) (http://www.blast2go.org/), or ZGRViewer (http://zvtm.sourceforge.net/zgrviewer.html) for viewing large graphs generated by AT&T GraphViz [4] (Figure 2 - right). The development of the toolkit is now supported by INRIA. More information can be found at http://zvtm.sourceforge.net and [43] and [24].

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See Pietriga, A Toolkit for Addressing HCI Issues in Visual Language Environments, IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC '05), pages 145-152, September 2005
- License: LGPL
- Type of human computer interaction: Graphique
- 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 [1] 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.

[4] http://www.graphviz.org

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 [33], 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 [1] and ICon [40].

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.

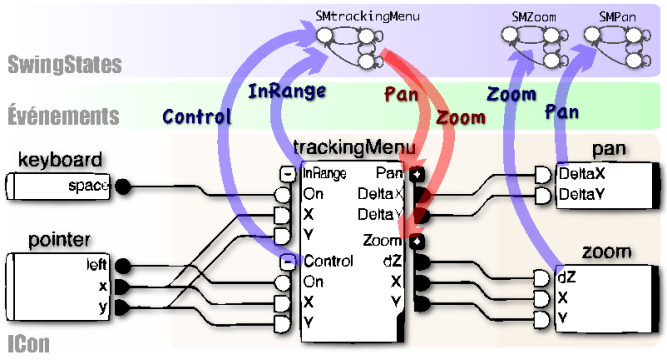

Figure 4. State machines and data flow in FlowStates

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 [correspondant], Michel Beaudouin-Lafon, Wendy Mackay.

TouchStone [5] 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.

With the *Touchstone design platform*, a user specifies the factors and the measures of the experiment, the blocking and counterbalancing of trials, and assess the time it will take to run the experiment. Multiple designs can be explored in parallel to assess the various trade-offs. The output of the design platform is an XML file that can be used as input for the run platform.

The *Touchstone run platform* provides a framework to implement and run an experiment and to collect experimental data. It uses a flexible plug-in architecture to manage a variety of input devices and interaction techniques. The runs of the experiment are controlled by an XML script that can be produced by the design platform.

The analysis platform currently consists of data analysis tools such as JMP, R or Excel. Log data produced by the run platform can be directly loaded into any of these tools. In a future version, analysis sketches will be derived from the experimental design to assist with the analysis.

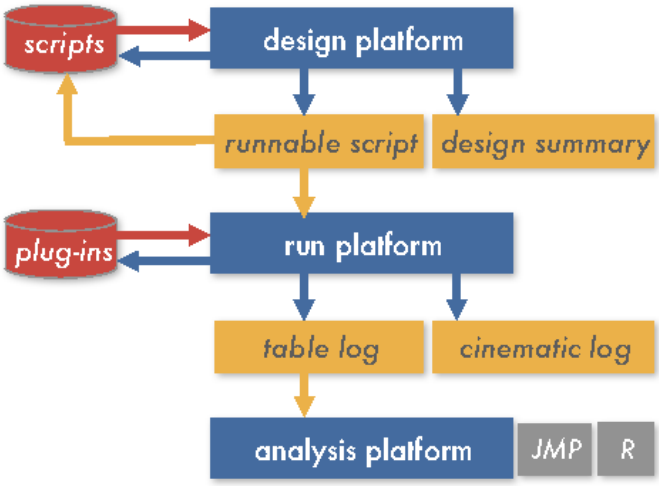

Figure 5. The architecture of the Touchstone platform

Touchstone has been used heavily at INSITU over the past three years for the many experiments that we design and run. It has also been used for teaching for the first time in 2011. Students used it to design various experiments during tutorial classes in Master 2 Interaction ("Introduction to HCI" module).

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 [38] 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 [45]. This year we used again Metisse to implement novel desktop interaction techniques [3].

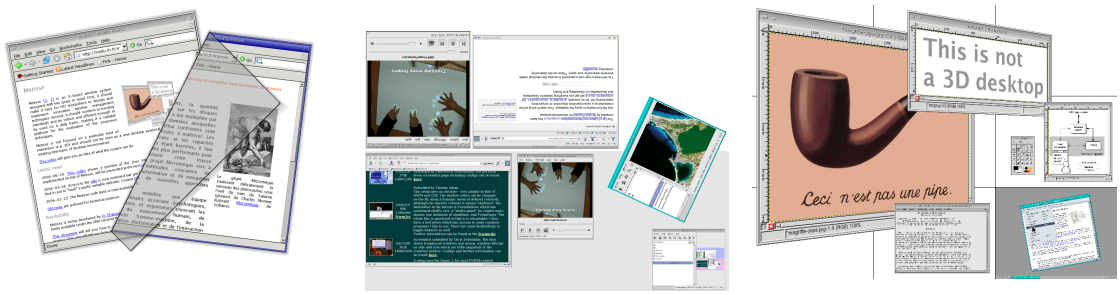

Figure 6. Sample window management techniques implemented with Metisse: extended paper metaphor (left), interactive table configuration that allows to duplicate and rotate windows (middle) and zoomable 3D desktop (right).

- Web: http://insitu.lri.fr/metisse/
- ACM: H.5.2 [User Interfaces]: Windowing systems
- Software benefit: see [38], [45], [39], [41] and [3].
- License: GPL
- Type of human computer interaction: Graphique
- OS/Middleware: X Window et Mac OS X
- Required library or software: OpenGL via nucleo [5] and some usual C/C++ libraries
- Programming language: * C/C++

5.7. Wmtrace

Participant: Olivier Chapuis [correspondant].

Wmtrace [37] includes two tools that help us study an individual user's window management activity. The first tool runs in the background of an X Window session and continuously logs information about windows and how they are being manipulated. The second uses a VCR-like interface (Figure 7) to replay the resulting logs and analyze the entire session. This tool provides several ways to filter the logs and extract high-level information, including interactive move events and mouse speed. Both tools allow HCI researchers to perform qualitative and quantitative statistical analyses of window management activity.

- Web: http://insitu.lri.fr/~chapuis/software/wmtrace/.
- ACM: H.5.2 [User Interfaces]: Windowing systems
- Software benefit: see [37], [41], [36].
- License: GPL
- Type of human computer interaction: Deamon and Graphique
- OS/Middleware: X Window (deamon) and Java (VCR interface)
- Required library or software: all X libraries (daemon) and Java (VCR interface)
- Programming language: * C and Java

[5] http://interaction.lille.inria.fr/~roussel/projects/nucleo/index.html

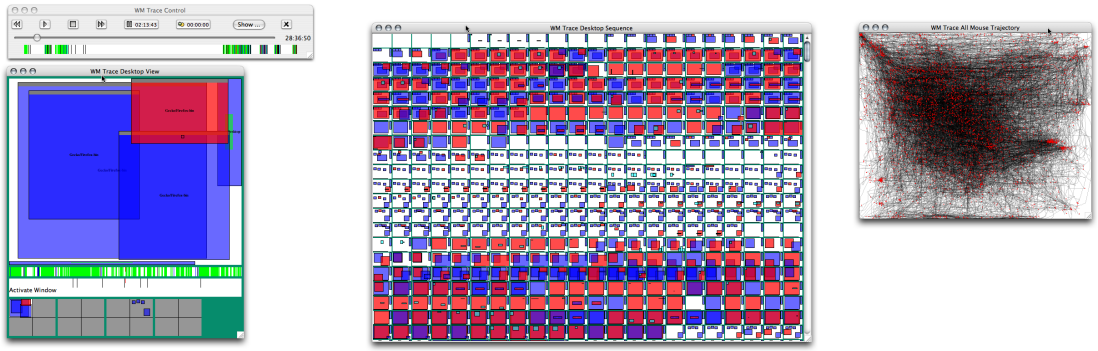

Figure 7. VCR-like interface, session overview and sample plots of mouse trajectories (black) and mouse clicks (red)

5.8. The Substance Middleware

Participants: Michel Beaudouin-Lafon [correspondant], Clemens Klokmose, 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 [20]. 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 [44].

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.

Substance has been used to create two full-scale applications (Figure 8): 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.

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. Klokmose, 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

Figure 8. The Canvas (left) and SubstanceGrise (right) applications developed with Substance. (©CNRS-Phototheque - Cyril FRESILLON for SubstanceGrise).

5.9. Scotty

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

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 [18]. 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 [34]. Scotty currently runs on Mac OS X for applications written with the Cocoa user interface framework.

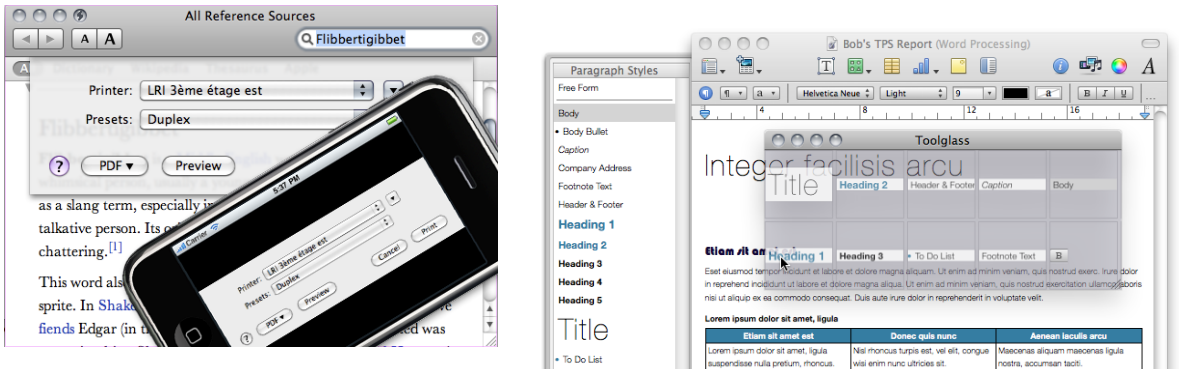

Figure 9. Using Scotty to teleport a window of a Mac OS X application onto an iPhone (left) and to create a toolglass in the Pages word processor (right).

Scotty has been used to create a number of extensions (Figure 9). *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 [correspondant], David Bonnet, Anastasia Bezerianos, Olivier Chapuis, Guillaume Faure, Emilien Ghomi, Stéphane Huot, Mathieu Nancel, Wendy Mackay, Cyprien Pindat, Emmanuel Pietriga, Theophanis Tsandilas, Julie Wagner.

Acquiring a target, such as pointing to an icon, a button or a landmark on a digital map, is the most common action in today's graphical user interfaces. We have continued our work to better understand this seemingly simple action and make it faster and more reliable. This year we have conducted theoretical work on small target [12] and more practical work with TorusDesktop [4].

Targets of only a few pixels are notoriously difficult to acquire. Despite many attempts at facilitating pointing, the reasons for this difficulty are poorly understood. We confirm a strong departure from Fitts' Law for small target acquisition using a mouse and investigate three potential sources of problems: motor accuracy, legibility, and quantization. We find that quantization is not a problem, but both motor and visual sizes are limiting factors. This suggests that small targets should be magnified in both motor and visual space to facilitate pointing. Since performance degrades exponentially as targets get very small, we further advocate the exploration of uniform, target-agnostic magnification strategies. We also confirm Welford's 1969 proposal that motor inaccuracy can be modeled by subtracting a "tremor constant" from target size. We argue for the adoption of this model, rather than Fitts' law, when reflecting on small target acquisition.

With TorusDesktop [4], we revisited a pointing technique that allows to wrap the mouse cursor around screen edges in conventional desktop environments. Allowing the cursor to jump from one edge of the screen to the opposite one (i.e., turning the desktop into a torus) was already explored, but never studied empirically nor designed for everyday desktop usage. We have introduced a dead zone and an off-screen cursor feedback that ease the use of this technique. We also conducted three controlled experiments to refine the design and evaluate its performance. Our results suggest clear benefits in several conditions, but also some potential limitations due to users' over-estimation of cursor wrapping advantages. An implementation of TorusDesktop for the Mac OS X desktop can be downloaded for free at http://insitu.lri.fr/TorusDesktop.

We continued our work on wall-sized displays, focusing on the study of high-level tasks such as pan-zoom navigation (Figure 10), that have received little attention. Indeed, while pointing on this type of display has been studied extensively, it remains unclear which techniques are best suited to perform multiscale navigation in these environments. Building upon empirical data gathered from studies of pan-and-zoom on desktop computers and studies of remote pointing, we identified three key factors for the design of mid-air pan-and-zoom techniques: uni- vs. bimanual interaction, linear vs. circular movements, and level of guidance to accomplish the gestures in mid-air. After an extensive phase of iterative design and pilot testing, we ran a controlled experiment aimed at better understanding the influence of these factors on task performance. This work received a best paper award at CHI 2011 [6].

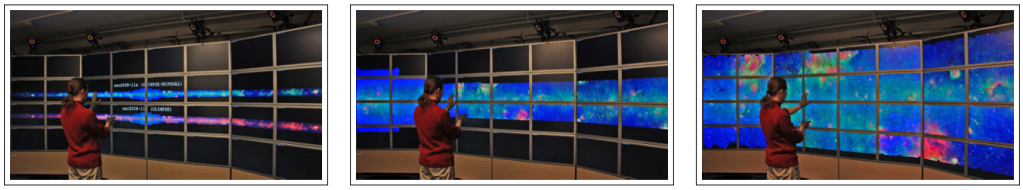

Figure 10. Panning and zooming in Spitzer's 396 032 x 12 000 = 4.7 billion pixels images of the inner part of our galaxy.

On the opposite side, we have studied small displays such as the ones smartphones are equipped with. One major challenge with this type of device is to make the user able to interact in parallel with both the device and other artefacts in his environment (e.g., giving a phone call while holding a paper document). The Swiss Army Menu (SAM) [27] is a radial menu that enables a very large number of functions accessible via small thumb movements. The design of SAM relies on four different kinds of items, support for navigating in hierarchies of items and a control that requires only the thumb of the hand that holds the device. SAM can offer a set of functions so large that it would typically have required a number of widgets that could not have been displayed in a single viewport at the same time.

The different interaction techniques presented above are aimed at improving the control within a given representation. As a complement, we have also worked on improving the user's experience by providing him with two (or more) representations of the data he is interacting with and ways to transition between these representations.

Gliimpse [17] is a quick preview technique that smoothly transitions between document markup code (HTML, wiki markup or LaTeX) and its visual rendering (see Figure 11). It allows users to regularly check the code they are editing in-place, without leaving the text editor. Gliimpse can complement classical preview windows by offering rapid overviews of code-to-document mappings and leaving more screen real-estate. As the technique smoothly show the links between the code and the rendered result, it can also help to learn how complex markup code will result in the final document (e.g., HTML tables or LaTeXformulae).

Figure 11. Gliimpse smoothly transitions between document markup code and its visual rendering.

In collaboration with University of Toronto and OCAD University, we designed a novel visualization technique called ChronoLenses [14], aimed at supporting users in time-series visual exploration tasks. ChronoLenses perform on-the-fly transformation of the data points in their focus area, tightly integrating visual analysis with user actions, and enabling the progressive construction of advanced visual analysis pipelines, supporting tasks that require visualizing derived values, identifying correlations, or discovering anomalies beyond obvious outliers.

We further explored user understanding of data presented in Dual-Scale data charts, charts that incorporate two different data resolutions into one chart in order to emphasize data in regions of interest (focus) or to enable the comparison of data from distant regions (context) [13]. In collaboration with researchers from inria AVIZ, we presented a unified description of different Dual-Scale data charts, and we compared them in terms of user understanding using elementary graphical perception tasks, such as comparing lengths and distances. Our study suggests that cut-out charts which include collocated full context and focus are the best alternative, and that superimposed charts in which focus and context overlap on top of each other should be avoided.

6.2. Research Methods

Participants: Caroline Appert, Michel Beaudouin-Lafon, Anastasia Bezerianos, Olivier Chapuis, Jérémie Garcia, Stéphane Huot, Ilaria Liccardi, Wendy Mackay [correspondant], Emmanuel Pietriga.

InkSplore [19]. We conducted three studies with contemporary music composers at IRCAM. We found that even highly computer-literate composers use an iterative process that begins with expressing musical ideas on paper, followed by active parallel exploration on paper and in software, prior to final execution of their ideas as an original score. We conducted a participatory design study that focused on the creative exploration phase, to design tools that help composers better integrate their paper-based and electronic activities. We then developed InkSplorer as a technology probe that connects users? hand-written gestures on paper to Max/MSP and OpenMusic. Composers appropriated InkSplorer according to their preferred composition styles, emphasizing its ability to help them quickly explore musical ideas on paper as they interact with the computer. We conclude with recommendations for designing interactive paper tools that support the creative process, letting users explore musical ideas both on paper and electronically.

Wikibook: [22]. With the Wikibook project [22] we investigate how *Wikibooks* authors collaborate to create high-quality books. We combined Information Retrieval and statistical techniques to examine the complete multi-year lifecycle of over 50 high-quality Wikibooks. We found that: 1. The presence of redundant material is negatively correlated with collaboration mechanisms; 2. For most books, over 50% of the content is written by a small core of authors; and 3. Use of collaborative tools (predicted pages and talk pages) is significantly correlated with patterns of redundancy. *Non-redundant* books are well-planned from the beginning and require fewer talk pages to reach high-quality status. *Initially redundant* books begin with high redundancy, which drops as soon as authors use coordination tools to restructure the content. *Suddenly redundant* books display sudden bursts of redundancy that must be resolved, requiring significantly more discussion to reach high-quality status. These findings suggest that providing core authors with effective tools for visualizing and removing redundant material may increase writing speed and improve the book's ultimate quality.

6.3. Engineering of interactive systems

Participants: Caroline Appert, Michel Beaudouin-Lafon, Olivier Chapuis, James Eagan, Tony Gjerlufsen, Stéphane Huot, Wendy Mackay, Clemens Nylandsted Klokmose, Emmanuel Pietriga [correspondant], Clément Pillias, Romain Primet.

We started working on jBricks [24], a Java toolkit enabling the exploratory prototyping of interaction techniques and rapid development of post-WIMP applications running on cluster-driven interactive visualization platforms such as the WILD wall display (Section 7.1). Research on cluster-driven wall displays has mostly focused on techniques for parallel rendering of complex 3D models. There has been comparatively little research effort dedicated to other types of graphics and to the software engineering issues that arise when prototyping novel interaction techniques or developing full-featured applications for such displays. To fill this gap,

jBricks integrates a high-quality 2D graphics rendering engine and a versatile input configuration module into a coherent framework, hiding low-level details from the developer. The goal of this framework is to ease the development, testing and debugging of interactive visualization applications for wall-sized displays. It also offers an environment for the rapid prototyping of novel interaction techniques and their evaluation through controlled experiments, such as the one we recently conducted about mid-air pan-and-zoom techniques for wall-sized displays (see Section 6.1).

We developed the *Shared Substance* framework for multisurface interaction [20]. It is based on Substance, which implements a novel programming model called *data orientation* that separates functionality from data. Shared Substance extends Substance to distributed environments. It makes distribution explicit so that the programmer can dynamically add, reconfigure and remove components at runtime. An application built with Shared Substance is a collection of processes called *environments* that run on different machines. Environments are discovered dynamically and can appear and disappear at any time. Each environment contains a hierarchical data structure that can be shared, in whole or in part, with other environments. Sharing can be done through replication or mounting, which entail different performance trade-offs. Shared Substance also includes the Instrumental Interaction Kit (IIK) to facilitate the development of instruments in a multisurface environment [34], [42]. We have used Shared Substance to develop several applications for our WILD multisurface environment: *Substance Canvas* manages a virtual canvas that can span multiple interactive surfaces managed by different computers, such as the tiled display, interactive table and users' laptops of the WILD room; Content can be added to the canvas from various an extensible set of sources, including live applications using Scotty (see below). *Substance Grise* wraps an existing application for displaying 3D brain scans into a Shared Substance environment; This allows us to run 64 copies of the application, each showing a different brain scan, and synchronize the 3D orientation of the scans using a brain prop that the user turns in his hand.

We explored the notion of user interface programming at run-time to create more malleable software [18]. Rather than creating a new user interface toolkit or supporting the customization of an interactive application from outside, we explored how well-defined hooks and a few high-level constructs could allow a programmer to modify an application "from inside", i.e. using code that is dynamically loaded by the application at run-time. Compared with existing approaches, this supports deep customization that involve the behavior of the application, not just the surface of its user interface. The Scotty prototype implements run-time interface programming in the Mac OS X environment for any application written with the native Cocoa framework. We have used Scotty to distribute the user interface of an application over multiple devices, e.g. to move the Print button of an application onto an iPhone so the user can safely print while physically close to the printer; to replace a tool palette in an application with a toolglass; to check for the presence of attachments in an email application before sending an email; to add subtitles to a video viewer that does not have this functionality. We have also used Scotty in connection with the work on Shared Substance (see above) to teleport a live vector-based representation of a running applications to the WILD wall display. The advantage of this approach over, e.g., VNC, is that the content is properly scaled, taking advantage of the full resolution of the wall.

7. Partnerships and Cooperations

7.1. Regional Initiatives

+ WILD - Wall-sized Interaction with Large Datasets (2008-2011). 3 academic partners: LRI, INRIA and LIMSI-CNRS. Funded by RTRA Digiteo and Région Île-de-France, Domaine d'Intérêt Majeur "Logiciels et systèmes complexes": 429 Keuros. Emmanuel Pietriga & Michel Beaudouin-Lafon: coordinators and principal investigators. WILD is an experimental high-resolution, interactive platform for conducting research on collaborative human-computer interaction and the visualization of large datasets. The platform is now being made available to scientists from other disciplines, including astrophysicists, biologists, chemists, as well as computer scientists, to visualize, explore and analyze their data.

+ WILD-PCRI (2010-2011). Extension of the WILD project (same partners) to extend the WILD platform with multi-channel audio capabilities and a flat-panel multitouch surface, and move it to the new PCRI building.
+ Design and evaluation of novel paper-based interfaces for large interactive surfaces (2010-2011). 24 Keuros. Funded by Univ. Paris-Sud ("Bonus attractivité"). Theophanis Tsandilas: principal investigator. This equipment grant will allow us to explore the use of paper-based interfaces by scientists in the context of the multi-surface interaction paradigm that we develop for the WILD platform.

7.2. National Initiatives

+ Digiscope - Collaborative Interaction with Complex Data and Computation (2011-2020) - http://digiscope.fr. "Equipment of Excellence" project funded by the "Invesissements 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). In Situ 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.
+ HolyRisk - Scientific Uncertainty and Food Risk Regulation (2009-2013). 5 academic partners. Funded by the French National Research Agency (ANR), Programme BLANC: 61 Keuros/702 Keuros. Emmanuel Pietriga: principal investigator for In Situ. This project is conducting a US/EU comparative empirical study that investigates the ways uncertainties are perceived, handled and expressed by experts throughout the food risk analysis process. In Situ is contributing a visual interface that allows efficient multi-scale navigation in a large corpus of annotated documents.
+ MLSN - Multi-Level Social Networks (2009-2012). 4 academic and industrial partners. Funded by the French National Research Agency (ANR), Programme VERSO: 177 Keuros/738 Keuros. Emmanuel Pietriga: principal investigator for In Situ. Real-time social network visualisation of multiplex social interactions. MLSN is based on recent findings in academic research on graph drawing/navigation techniques and on network analysis

7.3. International Initiatives

7.3.1. INRIA Associate Teams

- Equipe Associée Sirius (Principal Investigators: Michel Beaudouin-Lafon, Wendy Mackay): Joint lab between In Situ, the HCI Group at Stanford University and the Distributed Cognition and HCI Lab at University of California, San Diego. Wendy Mackay and Michel Beaudouin-Lafon are spending a sabbatical year, that began in September 2010, at Stanford University, with visits to UC San Diego. SIRIUS will continue this collaboration when they are back in France.

7.3.2. INRIA International Partners

- ALMA (Atacama Large Millimeter/submillimeter Array, http://www.almaobservatory.org/) (Principal Investigator: Emmanuel Pietriga): Collaboration over 4 years with the European Southern Observatory (ESO), the National Astronomical Observatory of Japan (NAOJ), and the National Radio Astronomy Observatory (NRAO)/NSF to redesign graphical user interfaces of the observatory's operations monitoring and control software, based on state-of-the-art visualisation and interaction techniques. The project is partly be implemented using In Situ's ZVTM toolkit (see Section 5.2).

8. Dissemination

8.1. Keynote addresses and Invited Lectures

Michel Beaudouin-Lafon: "WILD, Wall-Sized Interaction with Large Datasets", MIT European Career Fair, Cambridge, MA, USA, January 2011

Michel Beaudouin-Lafon and Wendy Mackay: "Experimental design with Touchstone", Stanford HCI Group, Palo Alto, CA, USA, March 2011

Michel Beaudouin-Lafon: "Interaction Beyond Computation", UCSD Distinguished Lecture, La Jolla, CA, USA, April 2011

Michel Beaudouin-Lafon: "Lessons from the WILD room", Berkeley RESS Seminar, Berkeley, CA, USA, April 2011

Michel Beaudouin-Lafon: "Lessons from the WILD room", FXPal, Palo Alto, CA, USA, April 2011

Michel Beaudouin-Lafon: "Lessons from the WILD room", Google Research, Mountain View, CA, USA, May 2011

Michel Beaudouin-Lafon: "Information Visualization, Virtual & Mixed Reality", Digiteo Scientific Committee, Orsay, France, June 2011

Michel Beaudouin-Lafon: Panel "Expérience tracée, une inscription de connaissance d'un nouveau type ?", LIRIS, Lyon, France, November 2011

Jérémie Garcia: "Composing with Interactive paper", Music Department and Computer Science Department of Maynooth University, Dublin, Ireland, November 2011

Stéphane Huot: "Novel Interaction Techniques and Engineering of Interactive Systems", Media Computing Group - RWTH Aachen, Aachen, Germany, October 2011

Wendy Mackay: "Mediated Communication", MIT European Career Fair, Cambridge, MA, USA, January 2011

Wendy Mackay: "Interactive Paper: From creative expression to computational power", U.C. Berkeley CNMAT Seminar Series, Berkeley, CA, USA, February 2011

Wendy Mackay: "Designing co-adaptive human-computer partnerships or When HCI meets AI", UCSD Distinguished Lecture, La Jolla, CA, USA, April 2011

Wendy Mackay: “Comm Apps: An alternative to Facebook for helping people stay in touch with close family and friends”, CMU Silicon Valley Seminar Series, Mountain View, CA, USA, April 2011

Wendy Mackay: “Interactive Paper: From creative expression to computational power”, FXPal, Palo Alto, CA, USA, April 2011

Wendy Mackay: “Global Work”, Center for Work, Technology, and Organization, Stanford University, Stanford, CA, May 2011

Wendy Mackay: “Replication: Perspectives across disciplines”, RepliCHI panel, CHI’11 conference, Vancouver, BC, Canada, May 2011

Wendy Mackay: “Reinventing Interactive Systems”, INRIA Silicon Valley Workshop, Berkeley, CA, USA, May 2011

Wendy Mackay: “FamilyNet and Comm Apps: An Alternative to Facebook for Staying in Touch”, MobiSocial Seminar, Stanford University, Stanford, CA, USA, November 2011

Wendy Mackay: “Enhancing Creativity with Interactive Paper”, CS-547 HCI Seminar, Stanford University, Stanford, CA, USA, November 2011

Wendy Mackay: “Communication App: Dedicated communication channels for staying in touch”, Invited Address, Nokia, Mountain View, CA, USA, December 2011

Emmanuel Pietriga: “Mid-air Interaction with Wall-sized Displays”, Workshop Ubimedia, Joint lab Institut Telecom / Alcatel Lucent, December 2011, Paris

Emmanuel Pietriga: “Interacting with Wall-sized Displays”, New York University, September 2011, NYC, USA

Emmanuel Pietriga: “Making ALMA’s Operations Monitoring & Control Graphical User Interfaces Scalable”, Universidad de Chile, June 2011, Santiago de Chile

Emmanuel Pietriga: “Interacting with Wall-sized Displays”, IT University of Copenhagen, June 2011, Copenhagen, Denmark

Emmanuel Pietriga: “HCI and Information Visualization Research Overview and its application to ALMA”, National Radio Astronomy Observatory, March 2011, Socorro, NM, USA

8.2. Journal editorial board

Transactions on Computer-Human Interaction (TOCHI), ACM: Michel Beaudouin-Lafon (Associate Editor)

International Journal of Human-Computer Studies (IJHCS), Elsevier: Michel Beaudouin-Lafon (Member of the Advisory Board)

Journal of Computer-Supported Cooperative Work (JCSCW), Springer: Michel Beaudouin-Lafon (Member of the Advisory Board)

Journal of Visual Languages and Computing (JVLC), Elsevier: Emmanuel Pietriga (Guest Editor)

8.3. Journal reviewing

Transactions on Computer-Human Interaction (TOCHI), ACM: Olivier Chapuis, Wendy Mackay

International Journal of Human-Computer Studies (IJHCS), Elsevier: Caroline Appert, Anastasia Bezerianos, Theophanis Tsandilas

Human-Computer Interaction (HCI), Taylor & Francis: Olivier Chapuis

Software: Practice and Experience, Wiley: Emmanuel Pietriga

Transactions on Visualization and Computer Graphics (TVCG), IEEE: Emmanuel Pietriga

8.4. Conference organization

ACM CHI 2011 - ACM Conference on Human Factors in Computing Systems: Emmanuel Pietriga (Program Committee member)

ACM UIST 2011 - ACM Symposium on User Interface Software and Technology: Caroline Appert (Program Committee member), Michel Beaudouin-Lafon (Program Committee member)

ACM CSCW 2011 - ACM Conference on Computer Supported Cooperative Work: Michel Beaudouin-Lafon (Program Committee member)

IEEE VL/HCC 2011 - IEEE Symposium on Visual Languages and Human Centric Computing: Emmanuel Pietriga (Program Committee member)

IEEE Symposium on Visual Languages and Human Centric Computing: Emmanuel Pietriga (Steering Committee member, and chair since September 2011)

IEEE PacificVis 2011 - IEEE Pacific Visualization Symposium: Anastasia Bezerianos (Program Committee member)

IHM 2011 - Conférence Francophone d'Interaction Homme-Machine: Stéphane Huot (Program Committee member, Demonstrations Co-Chair)

ACM CHI 2011 Workshop "Ethics, Logs and Videotape": Wendy Mackay (Co-Organizer)

ACM CHI 2011 Panel "RepliCHI": Wendy Mackay (Panelist and Co-Organizer)

Graduate Consortium: Expanding end user control in socio-technical systems (in conjunction with VL/HCC '11, funded by NSF): Emmanuel Pietriga (Panelist and Submission Coordinator)

Mensch & Computer 2011 - Workshop "Interaktive Displays in der Kooperation: Herausforderung an Gestaltung und Praxis": Julie Wagner (Workshop Co-Chair)

8.5. Conference reviewing

ACM CHI 2011: Caroline Appert, Michel Beaudouin-Lafon, Anastasia Bezerianos, Olivier Chapuis, Stéphane Huot, Wendy Mackay, Theophanis Tsandilas, Julie Wagner

ACM UIST 2011: Olivier Chapuis, Stéphane Huot, Wendy Mackay, Emmanuel Pietriga, Theophanis Tsandilas

ACM CSCW 2011 - ACM Conference on Computer Supported Cooperative Work: Anastasia Bezerianos

ACM EICS 2011 - ACM Symposium on Engineering Interactive Computing Systems: Emmanuel Pietriga

ACM ITS 2011 - ACM Conference on Interactive Tabletop and Surfaces: Anastasia Bezerianos, Emmanuel Pietriga, Theophanis Tsandilas

INTERACT 2011 - 13th IFIP TC13 Conference on Human-Computer Interaction: Caroline Appert, Michel Beaudouin-Lafon, Emmanuel Pietriga

IEEE ISMAR 2011 - IEEE International Symposium on Mixed and Augmented Reality: Wendy Mackay

IEEE 3DUI 2011 - IEEE Symposium on 3D User Interfaces: Stéphane Huot

IEEE EuroVis 2011 - Eurographics/IEEE Symposium on Visualization: Anastasia Bezerianos

IEEE InfoVis 2011 - IEEE Information Visualization Conference: Anastasia Bezerianos, Emmanuel Pietriga

IEEE PacificVis 2011 - IEEE Pacific Visualization Symposium: Anastasia Bezerianos

IEEE VAST 2011 - Visual Analytics Software and Technology: Emmanuel Pietriga

Graphics Interface 2011: Emmanuel Pietriga

IHM 2011: Olivier Chapuis, Stéphane Huot, Mathieu Nancel

EGC 2011 - Atelier Fouille Visuelle de Données. Avancées récentes et perspectives: Stéphane Huot

8.6. Scientific associations

ACM: Michel Beaudouin-Lafon member of the ACM Europe Council (since 2009)

ACM SIGCHI Paris Local Chapter: Emmanuel Pietriga (Chair), Anastasia Bezerianos (Treasurer), Julie Wagner (Seminars Co-Organizer, Webmaster)

AFIHM (French speaking HCI asssociation): Michel Beaudouin-Lafon member of the Scientific Board (CPPMS)

8.7. Evaluation committees and invited expertise

Steering Committee for ANR CONTINT, National Research Agency, member: Michel Beaudouin-Lafon

Area committee for Information and Communication Science and Technology, National Research Agency (Comité Sectoriel STIC de l'ANR), member: Michel Beaudouin-Lafon

ALLISTENE (Alliance des Sciences et Technologies du Numérique) working group on Knowledge, Content and Interaction, members: Wendy Mackay, Michel Beaudouin-Lafon

IRCAM (Paris) Scientific Committee, member: Michel Beaudouin-Lafon

TELECOM ParisTech Research Committee, member: Michel Beaudouin-Lafon

CIGREF Scientific Council, member: Michel Beaudouin-Lafon

Expert reviewer for NSERC (Canada): Michel Beaudouin-Lafon

Expert reviewer for ANR: Caroline Appert, Olivier Chapuis, Emmanuel Pietriga

Expert reviewer for the New Eurasia Foundation: Emmanuel Pietriga

Expert reviewer for FP7 Strategic Objective 4.2: Intelligent Content and Semantics: Emmanuel Pietriga

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: Stéphane Huot

Univ. Lille hiring committee, Comité de Sélection 27ème section (computer science), members: Caroline Appert

8.8. PhD and Habilitation defenses

Yannick Prié (Univ. Claude Bernard Lyon 1, Lyon): Michel Beaudouin-Lafon, President of the jury (Habilitation), November 2011

Anonymous (University of Melbourne, Australia): Emmanuel Pietriga (reviewer), Summer 2011

Guillaume Faure (Ph.D., Université Paris-Sud, December 15th, 2011), Michel Beaudouin-Lafon director and Olivier Chapuis advisor.

8.9. Teaching

"Graphical Interfaces Programming", 92h, DUT Informatique (L1), IUT Orsay - Université Paris-Sud, France: Stéphane Huot (Lecturer)

"Java Programming", 49h, DUT Informatique (L2), IUT Orsay - Université Paris-Sud, France: Stéphane Huot (Lecturer)

Projects and Internships Advisor, 59h, DUT Informatique (L2) and Licence Pro. (L3), IUT Orsay - Université Paris-Sud, France: Stéphane Huot

"Internet Programming", 20h, L2, Université Paris-Sud, France: David Bonnet (Teaching Assistant)

"Artificial Life", 32h, L2, Université Paris-Sud, France: Jérémie Garcia (Teaching Assistant)

"Internet Programming", 25h, L1, Université Paris-Sud, France: Mathieu Nancel (Teaching Assistant)

"Human-Computer Interaction", 12h, L3, Polytech Paris-Sud, France: Olivier Chapuis (Lecturer)

"Human-Computer Interaction", 24h, L3, Polytech Paris-Sud, France: Mathieu Nancel (Teaching Assistant)

"Databases", 20h, L3, Polytech Paris-Sud, France: Mathieu Nancel (Teaching Assistant)

"Introduction to Computer Science", 40h, L1, Université Paris-Sud, France: Cyprien Pindat (Teaching Assistant)

"Interfaces and Interactive Systems", 12h, Masters Informatique (M1), Université Paris-Sud, France: Theophanis Tsandilas (Lecturer)

"Interfaces and Interactive Systems", 20h, Masters Informatique (M1), Université Paris-Sud, France: Cyprien Pindat (Teaching Assistant)

"Human-Computer Interaction", 3h, Research Masters IAC (M2), Université Paris-Sud, France: Theophanis Tsandilas (Guest Lecturer)

"Human-Computer Interaction", 3h, Research Masters IAC (M2), Université Paris-Sud, France: Olivier Chapuis (Guest Lecturer)

"Fundamentals of Human-Computer Interaction", 50h, Research Masters in Computer Science - HCI Specialty (M2), Université Paris-Sud, France: Michel Beaudouin-Lafon (Lecturer), Anastasia Bezerianos (Teaching Assistant), Caroline Appert (Teaching Assistant)

"Mixed-Reality and Tangible Interaction", 12h, Research Masters in Computer Science - HCI Specialty (M2), Université Paris-Sud, France: Anastasia Bezerianos (co-Lecturer)

"Design and Evaluation of Interactive Systems", 18h, Research Masters in Computer Science - HCI Specialty (M2), Université Paris-Sud, France: Anastasia Bezerianos (co-Lecturer)

"Internships coordination", 5h, Research Masters in Computer Science - HCI Specialty (M2), Université Paris-Sud, France: Caroline Appert (Teaching Assistant)

CS477 "Reinventing Interactive Systems", 20h, CS bachelors and masters degrees, Stanford University, USA: Michel Beaudouin-Lafon and Wendy Mackay (Lecturers)

"The Future of Educational Interfaces", Stanford University, USA: Michel Beaudouin-Lafon and Wendy Mackay (Jury members)

Master - Internship supervision: Caroline Appert (student: David Bonnet, Univ. Paris-Sud, France), Stéphane Huot (student: Can Liu, RWTH Aachen, Germany), Theophanis Tsandilas (student: Pierre Rossinés, Univ. Paris-Sud, France), Olivier Chapuis (student: Julien Altieri, Ecole Polytechnique)

PhD: Guillaume Faure, "Sur le Contexte Spatial en gestion des fenêtres et interaction homme-machine", Université Paris-Sud, December 15th, 2011, Michel Beaudouin-Lafon and Olivier Chapuis

PhD in progress: David Bonnet, "Gesture-based interactions and instrumental interaction", started in September 2011, Michel Beaudouin-Lafon and Caroline Appert

PhD in progress: Jérémie Garcia, "Supporting creative activities with interactive paper", started in September 2010, Wendy mackay and Theophanis Tsandilas

PhD in progress: Émilien Ghomi, “Studying expert practices as a basis for designing expressive interaction techniques”, started in September 2008, Michel Beaudouin-Lafon and Stéphane Huot

PhD in progress: Mathieu Nancel, “Interaction with Wall-sized Displays”, started in September 2008, Michel Beaudouin-Lafon and Emmanuel Pietriga

PhD in progress: Cyprien Pindat, “Multi-dimensional exploration of complex multi-scale data”, started in September 2010, Claude Puech, Olivier Chapuis and Emmanuel Pietriga

PhD in progress: Julie Wagner, “A theoretical extension to the kinematic chain for whole-body interaction”, started in October 2009, Wendy Mackay and Stéphane Huot

PhD in progress: Micheline Elias, “Semantic Information Retrieval and Visualization in Business Intelligence Dashboards”, École Centrale de Paris, started in October 2009, Anastasia Bezerianos and Marie-Aude Aufaure (École Centrale de Paris)

8.10. Dissemination

- “Fête de la science” 2011 at LRI, Coordinator: Theophanis Tsandilas
- “ACM SigCHI Paris VideoShowcase” 2011, Espace Pompidou, Paris, France, Coordinator: Caroline Appert

9. Bibliography

Major publications by the team in recent years

[1] C. APPERT, M. BEAUDOUIN-LAFON. *SwingStates: Adding State Machines to Java and the Swing Toolkit*, in "Software: Practice and Experience", 2008, vol. 38, n^{o} 11, p. 1149 - 1182, http://dx.doi.org/10.1002/spe.867.

[2] 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, p. 1391–1400, http://doi.acm.org/10.1145/1518701.1518911, http://hal.archives-ouvertes.fr/inria-00373678.

[3] O. CHAPUIS, N. ROUSSEL. *UIMarks: Quick Graphical Interaction with Specific Targets*, in "UIST '10: Proceedings of the 23rd annual ACM symposium on User interface software and technology", ACM, October 2010, p. 173–182, http://doi.acm.org/10.1145/1866029.1866057, http://hal.archives-ouvertes.fr/inria-00533398.

[4] S. HUOT, O. CHAPUIS, P. DRAGICEVIC. *TorusDesktop: pointing via the backdoor is sometimes shorter*, in "Proceedings of the 2011 annual conference on Human factors in computing systems", New York, NY, USA, CHI '11, ACM, 2011, p. 829–838, http://doi.acm.org/10.1145/1978942.1979064.

[5] W. 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, p. 1425-1434, http://doi.acm.org/10.1145/1240624.1240840, http://hal.archives-ouvertes.fr/inria-00538384.

[6] M. NANCEL, J. WAGNER, E. PIETRIGA, O. CHAPUIS, W. MACKAY. *Mid-air pan-and-zoom on wall-sized displays*, in "Proceedings of the 2011 annual conference on Human factors in computing systems", New York, NY, USA, CHI '11, ACM, 2011, p. 177–186, http://doi.acm.org/10.1145/1978942.1978969.

[7] E. PIETRIGA, O. BAU, C. APPERT. *Representation-Independent In-Place Magnification with Sigma Lenses*, in "IEEE Transactions on Visualization and Computer Graphics", 2010, vol. 16, n° 1, p. 455-467, http://hal.inria.fr/inria-00467658, http://hal.inria.fr/inria-00467658.

[8] E. PIETRIGA, C. BIZER, D. KARGER, R. LEE. *Fresnel - A Browser-Independent Presentation Vocabulary for RDF*, in "Lecture Notes in Computer Science (LNCS 4273), Proceedings of the 5th International Semantic Web Conference (ISWC 2006)", Springer, November 2006, p. 158-171, http://dx.doi.org/10.1007/11926078_12.

[9] A. TABARD, W. MACKAY, N. ROUSSEL, C. LETONDAL. *PageLinker: Integrating Contextual Bookmarks into a Browser*, in "Proceedings of ACM CHI 2007 Conference on Human Factors and Computing Systems", ACM Press, April 2007, p. 337–346, http://doi.acm.org/10.1145/1240624.1240680.

[10] T. TSANDILAS, C. LETONDAL, W. MACKAY. *Musink: Composing Music through Augmented Drawing*, in "CHI '09: Proceedings of the SIGCHI conference on Human factors in computing systems", ACM, 2009, p. 819–828, http://doi.acm.org/10.1145/1518701.1518827.

Publications of the year

Doctoral Dissertations and Habilitation Theses

[11] G. FAURE. *Sur le Contexte Spatial en gestion des fenêtres et interaction homme-machine*, Univ Paris-Sud, Orsay, France, Décembre 2011.

Articles in International Peer-Reviewed Journal

[12] O. CHAPUIS, P. DRAGICEVIC. *Effects of Motor Scale, Visual Scale and Quantization on Small Target Acquisition Difficulty*, in "ACM Transactions on Computer-Human Interaction", July 2011, vol. 18, n° 3, p. 13:1–13:32 [*DOI :* 10.1145/1993060.1993063], http://hal.inria.fr/hal-00614061/en.

[13] P. ISENBERG, A. BEZERIANOS, P. DRAGICEVIC, J.-D. FEKETE. *A Study on Dual-Scale Data Charts*, in "Transactions on Visualization and Computer Graphics", 2011, vol. 17, n° 12, p. 2469-2487, http://dx.doi.org/10.1109/TVCG.2011.238.

[14] J. ZHAO, F. CHEVALIER, E. PIETRIGA, R. BALAKRISHNAN. *Exploratory Analysis of Time-series with ChronoLenses*, in "IEEE Transactions on Visualization and Computer Graphics", October 2011, vol. 17, n° 12, p. 2422-2431 [*DOI :* 10.1109/TVCG.2011.195], http://hal.inria.fr/inria-00637082/en.

International Conferences with Proceedings

[15] B. BACH, E. PIETRIGA, I. LICCARDI, G. LEGOSTAEV. *OntoTrix: A Hybrid Visualization for Populated Ontologies*, in "WWW '11: 19th international conference on World wide web", Hyderabad, India, ACM, March 2011, http://hal.inria.fr/inria-00560548/en.

[16] M. CHALMERS, D. MCMILLAN, A. MORRISON, H. CRAMER, M. ROST, W. MACKAY. *Ethics, logs and videotape: ethics in large scale user trials and user generated content*, in "CHI EA '11: Proceedings of the 2011 annual conference extended abstracts on Human factors in computing systems", ACM, 2011, p. 2421–2424, Workshop, http://doi.acm.org/10.1145/1979742.1979574.

[17] P. DRAGICEVIC, S. HUOT, F. CHEVALIER. *Gliimpse: Animating from Markup Code to Rendered Documents and Vice-Versa*, in "UIST 2011: Proceedings of the 24th ACM Symposium on User Interface Software and Technology", ACM, 2011, p. 257–262, http://doi.acm.org/10.1145/2047196.2047229.

[18] J. EAGAN, W. MACKAY, M. BEAUDOUIN-LAFON. *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, 2011, p. 225–234, http://doi.acm.org/10.1145/2047196.2047226.

[19] J. GARCIA, T. TSANDILAS, C. AGON, W. MACKAY. *InkSplorer: Exploring Musical Ideas on Paper and Computer*, in "New Interfaces for Musical Expression (NIME 2011)", Oslo, Norway, May 2011, http://hal.inria.fr/inria-00600083/en.

[20] T. GJERLUFSEN, C. N. KLOKMOSE, J. EAGAN, C. PILLIAS, M. BEAUDOUIN-LAFON. *Shared Substance: Developing Flexible Multi-Surface Applications*, in "CHI '11: Proceedings of the 29th international conference on Human factors in computing systems", ACM, 2011, p. 3383–3392, http://doi.acm.org/10.1145/1978942.1979446.

[21] S. HUOT, O. CHAPUIS, P. DRAGICEVIC. *TorusDesktop: Pointing via the Backdoor is Sometimes Shorter*, in "CHI '11: Proceedings of the SIGCHI Conference on Human Factors and Computing Systems", Vancouver, Canada, May 2011, p. 829–838 [*DOI :* 10.1145/1978942.1979064], http://hal.inria.fr/hal-00559194/en.

[22] I. LICCARDI, O. CHAPUIS, C.-M. AU YEUNG, W. MACKAY. *Redundancy and Collaboration in Wikibooks*, in "INTERACT '11: 13th IFIP TC13 Conference in Human-Computer Interaction", Lisbon, Portugal, September 2011, p. 215-232 [*DOI :* 10.1007/978-3-642-23774-4_20], http://hal.inria.fr/inria-00595516/en.

[23] M. NANCEL, J. WAGNER, E. PIETRIGA, O. CHAPUIS, W. MACKAY. *Mid-air Pan-and-Zoom on Wall-sized Displays*, in "CHI '11: Proceedings of the SIGCHI Conference on Human Factors and Computing Systems", Vancouver, Canada, May 2011, p. 177–186 [*DOI :* 10.1145/1978942.1978969], http://hal.inria.fr/hal-00559171/en.

[24] E. PIETRIGA, S. HUOT, M. NANCEL, R. PRIMET. *Rapid Development of User Interfaces on Cluster-Driven Wall Displays with jBricks*, in "EICS '11: 2nd ACM SIGCHI symposium on Engineering interactive computing systems", Pisa, Italy, ACM, June 2011, http://hal.inria.fr/inria-00582640/en.

[25] M. WILSON, W. MACKAY, E. CHI, M. BERNSTEIN, D. RUSSELL, H. THIMBLEBY. *RepliCHI - CHI should be replicating and validating results more: discuss*, in "CHI EA '11: Proceedings of the 2011 annual conference extended abstracts on Human factors in computing systems", ACM, 2011, p. 463–466, Panel, http://doi.acm.org./10.1145/1979742.1979491.

National Conferences with Proceeding

[26] M. BEAUDOUIN-LAFON. *Lessons Learned from the WILD Room, a Multisurface Interactive Environment*, in "IHM '11: Proceedings of the 23rd French Speaking Conference on Human-Computer Interaction", ACM, 2011, p. 18:1–18:8, http://doi.acm.org/10.1145/2044354.2044376.

[27] D. BONNET, C. APPERT. *SAM: the Swiss Army Menu*, in "IHM '11: Proceedings of the 23rd French Speaking Conference on Human-Computer Interaction", IHM '11, ACM, 2011, p. 5:1–5:4, http://doi.acm.org/10.1145/2044354.2044361.

Conferences without Proceedings

[28] K. BARRETT, K. CHEN, L. WU, J. CIRIMELE, S. CARD, W. MACKAY, S. KLEMMER. *Reducing medical errors through operating room cognitive aids*, in "CURIS poster", 2011.

[29] M. SCHILLING, R. PRIMET, E. PIETRIGA, J. SCHWARZ. *Human Computer Interaction in the ALMA Control Room*, in "Astronomical Data Analysis Software and Systems (ADASS)", 2011, Poster, http://www.eso.org/sci/php/meetings/adass2011/html/display.php?topic=Poster_Schilling_1316081987.html.

Scientific Books (or Scientific Book chapters)

[30] M. BEAUDOUIN-LAFON. *Tables de travail informatiques : de l'écran graphique au papier interactif*, in "Lieux de savoir 2: Les mains de l'intellect", C. JACOB (editor), Albin Michel, 2011, p. 172-191.

[31] A. TANAKA, O. BAU, W. MACKAY. *The A20: Interactive Instrument Techniques for Sonic Design Exploration*, in "Sonic Interaction Design", K. FRANINOVIC, S. SERAFIN (editors), MIT Press, 2011, In Press.

Other Publications

[32] C. LIU, J. DIEHL, S. HUOT, J. BORCHERS. *Mobile Augmented Note-taking to Support Operating Physical Devices*, August 2011, Mobile Augmented Reality: Design Issues and Opportunities - 1st Workshop on Mobile Augmented Reality, MobileHCI 2011, http://hal.inria.fr/inria-00626260/en.

References in notes

[33] 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, 21ème conférence francophone sur l'Interaction Homme-Machine", ACM, Octobre 2009, p. 119-128, Best paper award, http://doi.acm.org/10.1145/1629826.1629845.

[34] M. BEAUDOUIN-LAFON. *Instrumental interaction: an interaction model for designing post-WIMP user interfaces*, in "Proc. ACM Conference on Human Factors in Computing Systems (CHI 2000)", CHI Letters, ACM, 2000, vol. 2(1), p. 446–453, http://doi.acm.org/10.1145/332040.332473.

[35] M. BEAUDOUIN-LAFON. *Designing interaction, not interfaces*, in "Proc. Conference on Advanced Visual Interfaces, AVI 2004", Gallipoli (Italy), ACM Press, May 2004, p. 15–22, Invited keynote address, http://doi.acm.org/10.1145/989863.989865.

[36] O. CHAPUIS, R. BLANCH, M. BEAUDOUIN-LAFON. *Fitts' Law in the Wild: A Field Study of Aimed Movements*, LRI, Univ Paris-Sud, France, 2007, n^{o} 1480, 11 pages, http://insitu.lri.fr/~chapuis/publications/RR1480.pdf.

[37] O. CHAPUIS. *Gestion des fenêtres : enregistrement et visualisation de l'interaction*, in "Proceedings of IHM 2005, 17ème conférence francophone sur l'Interaction Homme-Machine", ACM, Septembre 2005, p. 255-258, http://doi.acm.org/10.1145/1148550.1148590.

[38] O. CHAPUIS, N. ROUSSEL. *Metisse is not a 3D desktop!*, in "Proceedings of UIST'05, the 18th ACM Symposium on User Interface Software and Technology", ACM, 2005, p. 13-22, http://doi.acm.org/10.1145/1095034.1095038.

[39] O. CHAPUIS, N. ROUSSEL. *Copy-and-Paste Between Overlapping Windows*, in "Proceedings of ACM CHI 2007 Conference on Human Factors and Computing Systems", ACM, 2007, p. 201–210, http://doi.acm.org/10.1145/1240624.1240657.

[40] P. DRAGICEVIC, J.-D. FEKETE. *Support for input adaptability in the ICON toolkit*, in "Proc. ICMI'04", ACM, 2004, p. 212–219, http://doi.acm.org/10.1145/1027933.1027969.

[41] G. FAURE, O. CHAPUIS, N. ROUSSEL. *Power tools for copying and moving: useful stuff for your desktop*, in "CHI '09: Proceedings of the SIGCHI conference on Human factors in computing systems", ACM, 2009, p. 1675–1678, http://doi.acm.org/10.1145/1518701.1518958.

[42] C. N. KLOKMOSE, M. BEAUDOUIN-LAFON. *VIGO: Instrumental Interaction in Multi-Surface Environments*, in "CHI '09: Proceedings of the SIGCHI conference on Human factors in computing systems", ACM, 2009, p. 869–878, http://doi.acm.org/10.1145/1518701.1518833.

[43] E. PIETRIGA. *A Toolkit for Addressing HCI Issues in Visual Language Environments*, in "IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC'05)", September 2005, p. 145–152, http://doi.ieeecomputersociety.org/10.1109/VLHCC.2005.11.

[44] J. REKIMOTO. *Pick-and-drop: a direct manipulation technique for multiple computer environments*, in "Proceedings of the 10th annual ACM symposium on User interface software and technology", New York, NY, USA, UIST '97, ACM, 1997, p. 31–39, http://doi.acm.org/10.1145/263407.263505.

[45] W. STUERZLINGER, O. CHAPUIS, D. PHILLIPS, N. ROUSSEL. *User Interface Façades: Towards Fully Adaptable User Interfaces*, in "Proceedings of UIST'06, the 19th ACM Symposium on User Interface Software and Technology", ACM, 2006, p. 309-318, http://doi.acm.org/10.1145/1166253.1166301.