INRIA

INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

# *Project-Team in-situ*

# *Situated Interaction*

*Futurs*

THEME COG

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# 1. Team

*Established in 2002, the In Situ project is a collaboration between INRIA Futurs and the Laboratoire de Recherche en Informatique (Laboratory for Computer Science) of Paris-Sud University, within the framework of the PCRI (Pôle Commun de Recherche en Informatique).*

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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 users can no longer understand or control, lowering productivity and increasing frustration.

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.

The desktop metaphor that has driven personal computing for the past 25 years has reached its limits, with no short-term alternative. Our approach both expands today's graphical user interfaces and explores new possibilities, addressing the following goals:

- Flexibility to support end-user customization 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 visualization 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.

## 2.2. Research Themes

In Situ's research is organized according to the following themes:

**Interaction paradigms** including 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.

**Research methods**, including 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. Our goal is to develop, test and disseminate these methods to both researchers and practitioners in industry.

**Engineering tools** that enable us to facilitate the design and adoption of effective interaction techniques and paradigms and componentbased 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 each theme is articulated separately, we often intermix them in actual projects in order to address real-world problems. We thus 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. In the long run, we seek to create a new generation of interactive environments as an alternative to the current generation of desktop computers.

# 3. Scientific Foundations

## 3.1. Scientific Foundations

In Situ 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 [2].

# 4. Application Domains

## 4.1. Application Domains

In Situ works actively with users from various application domains in order to understand their specific needs. By studying similar problems in different domains, we can begin to generalise our results. Our current application domains include:

- Biological research, in cooperation with the Institut Pasteur, INRA and other laboratories of the University Paris-Sud;
- Creative industries (music composition), in cooperation with IRCAM (Paris);
- Domestic technologies, in cooperation with France Telecom, Philips, KTH (Sweden), and the Royal College of Art (U.K.);
- Research Archives, in cooperation with the French National Archives;
- Semantic Web data management, in cooperation with MIT and W3C;
- Business Intelligence with EDF (French Electricity Supplier), Univeristy Paris-Dauphine and LIMSI;
- Social Networks Analysis and Visualization with France Telecom, FING, LIAFA and LIMSI.

# 5. Software

## 5.1. The Zoomable Visual Transformation Machine

**Keywords:** *Distortion Lenses*, *Graphical User Interface (GUI) Toolkit*, *Java*, *Structured Graphics Editors*, *Visual Programming Languages*, *Zoomable User Interface (ZUI)*.

**Participant:** Emmanuel Pietriga [correspondant].

Current Graphical User Interface toolkits like Java/Swing are powerful, generic and portable, but cannot be used for some application classes such as structured graphics editors (e.g. graph editors, development environments for visual programming languages, etc.). Programmers are required to use lower-level APIs such as Java2D which are more expressive but harder to use. The ZVTM is a Zoomable User Interface (ZUI) toolkit implemented in Java, aimed at promoting the development of the HCI aspects of such applications by making their implementation easier, while favoring the rapid integration of novel interaction techniques.

ZVTM provides application programmers with building blocks for implementing complex multiscale interface components that cannot be handled by traditional WIMP widgets. Featuring off-the-shelf visualization 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 modification. This ranges from camera movements and distortion lens activation, to graphical objects' visual variables modifications. Various temporal pacing functions are available to control the execution of these animations. Current development activities around the toolkit now focus on multiscale navigation techniques (focus+context, overview+detail).

Initially developed by Xerox Research Centre Europe and the World Wide Web Consortium (W3C) team at MIT, ZVTM is open-source (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 (Figure 1 - left), RDQLPlus (http://rdqlplus.sourceforge.net/), or ZGRViewer (http://zvtm.sourceforge.net/zgrviewer.html) for viewing large graphs generated by AT&T GraphViz[1] (Figure 1 - middle). The toolkit's development is now supported by INRIA.

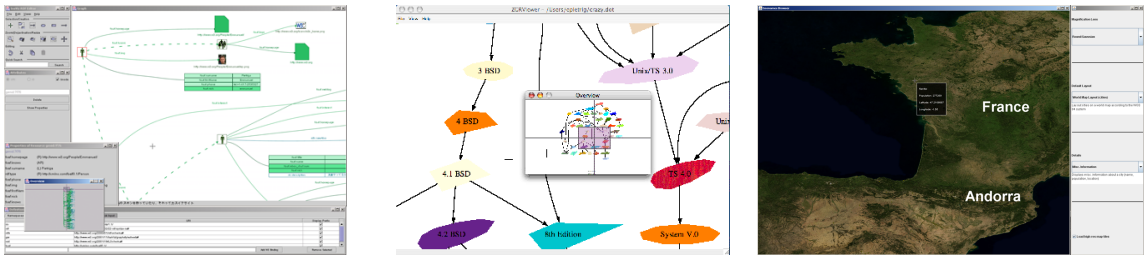


*Figure 1. ZVTM used in various applications*

More information can be found at http://zvtm.sourceforge.net and [63].

## 5.2. IsaViz - A Visual Authoring Tool for RDF

**Keywords:** *Java*, *RDF*, *Semantic Web*, *Visual Graph Authoring Tool*.

**Participant:** Emmanuel Pietriga [correspondant].

IsaViz [62] is a visual authoring tool for RDF [69] designed and distributed by the World Wide Web Consortium (W3C). RDF models are graphs whose textual serializations in RDF/XML or other triple-oriented formats are not user-friendly, partly because they fail to convey the models' graph structure. IsaViz generates editable visual representations as zoomable 2D graphs which are often easier to understand.

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

IsaViz is also used as a testbed for experimenting with new methods and vocabularies for presenting RDF data. IsaViz features a rendering engine capable of interpreting Graph Stylesheets (GSS [39]) and another one for the Fresnel vocabulary [38]. As shown in Figure 2, IsaViz provides a visual debugger for FSL path expressions and now supports most elements of the Fresnel core vocabularies (see section 6.5).

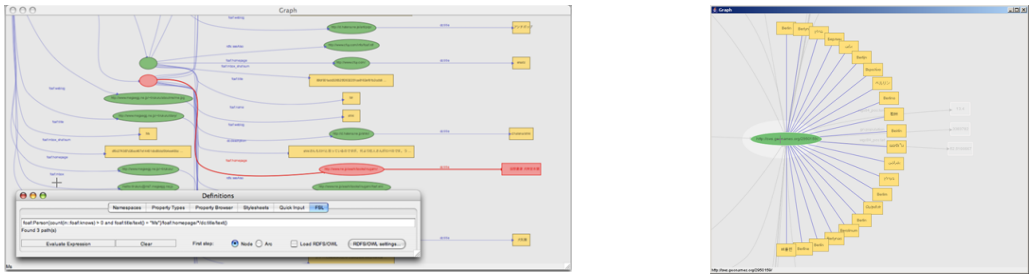

*Figure 2. Support for the Fresnel Vocabulary in IsaViz*

More information can be found at http://www.w3.org/2001/11/IsaViz/

## 5.3. The Núcleo toolkit

**Keywords:** *Multimedia*, *Rapid prototyping*, *Telecommunications*, *Toolkit*, *Video*.

**Participant:** Nicolas Roussel.

Núcleo, the latest version of VideoSpace [64], is a software toolkit designed to help HCI and CSCW researchers to explore new uses of images and image streams within interactive systems. Núcleo supports both rapid prototyping and incremental development of video applications and is the basis for most of the video-based systems implemented by In Situ over the past few years, including: a web-based mediaspace, the Well, an informal video communication system,VideoProbe and MirrorSpace (Figure 3).

Núcleo provides developers with a set of tools and a C++ class library that makes is easy to integrate image streams within documents and applications. For example, users may display image streams in HTML documents in place of static images. The library makes it easy to create a video link with only a few lines of code, and managing mulitple sources and processing video is only slightly more complex. The source code compiles on Linux and Mac OS X and is freely available under the GNU Lesser General Public License (LGPL). For more information, see http://insitu.lri.fr/~roussel/projects/nucleo/

## 5.4. The Metisse window system

**Keywords:** *OpenGL*, *Window management*, *X Window*, *window system*.

**Participants:** Olivier Chapuis [correspondant], Nicolas Roussel.

Metisse [5] is a window system that facilitates the design, implementation and evaluation of innovative window management techniques. The Metisse architecture is uses a compositing approach, making a clear distinction between rendering and the interactive compositing process. The Metisse server is a modified X server that can render application windows off-screen. The default compositor is a combination of a slightly modified version of a standard X window manager, FVWM, combined with an interactive viewer application called FvwmCompositor.


*Figure 3. Sample Núcleo applications: a web-based mediaspace [66]; the well, an informal video communication system [65]; VideoProbe [54] and MirrorSpace [10].*

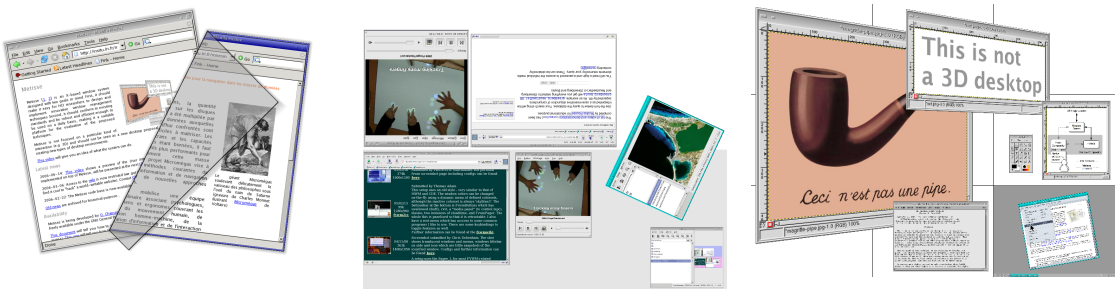


*Figure 4. Sample window management techniques implemented with Metisse: extended paper metaphor (left), interactive table configuration that allows to duplicate and rotate windows (middle) and zoomable 3D desktop (right).*

FvwmCompositor uses OpenGL to display windows. This library 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 4, 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 4, middle and right).

Metisse has been used by Mekensleep[2] to develop *Poker3D*, a multiplayer poker game. This application acts as a new compositor and uses the Metisse server to integrate external applications and 2D GTK+ interfaces into its OpenGL-based 3D scene (Figure 5). Metisse is similarly used by the ALCOVE INRIA project to integrate standard applications into their Spin|3D [55] collaborative platform.

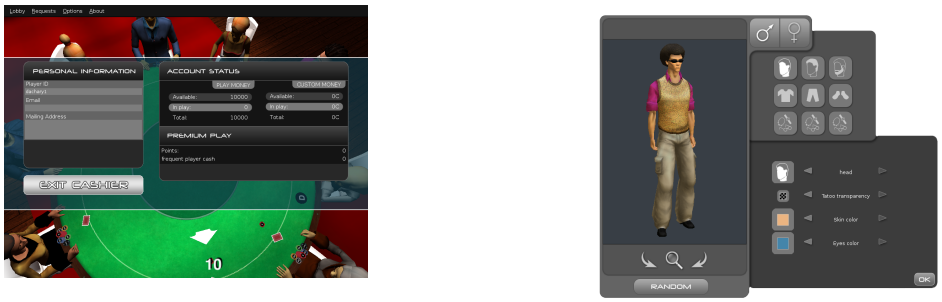


*Figure 5. Poker3D as a Metisse compositor: windows containing GTK+ interface elements are rendered by the Metisse server and displayed by Poker3D on top of the 3D scene.*

Metisse is implemented in C and C++. It compiles and runs on Linux and Mac OS X and is freely available under the GNU General Public License (GPL). It is currently being integrated into a major Linux distribution. For more information, see http://insitu.lri.fr/metisse/.

## 5.5. Wmtrace

**Keywords:** *Window management*, *activity log*.

**Participant:** Olivier Chapuis [correspondant].

Wmtrace [52] includes two tools that help us the study of a user's window management activity. The first one runs in the background of an X Window session and continuously logs information about windows and how they are being manipulated. The second one uses a VCR-like interface (Figure 6) 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.

Wmtrace is freely available under the GNU General Public License (GPL) and the CeCILL licence. The log recorder compiles and runs on any X Window system (e.g. Linux or FreeBSD). The log viewer, written in Java, is more or less platform independent. Both software can be downloaded from http://insitu.lri.fr/~chapuis/software/wmtrace/.

## 5.6. The InfoVis Toolkit

**Keywords:** *Information Visualization*, *Java*, *Toolkit*.

[2] http://www.mekensleep.com/

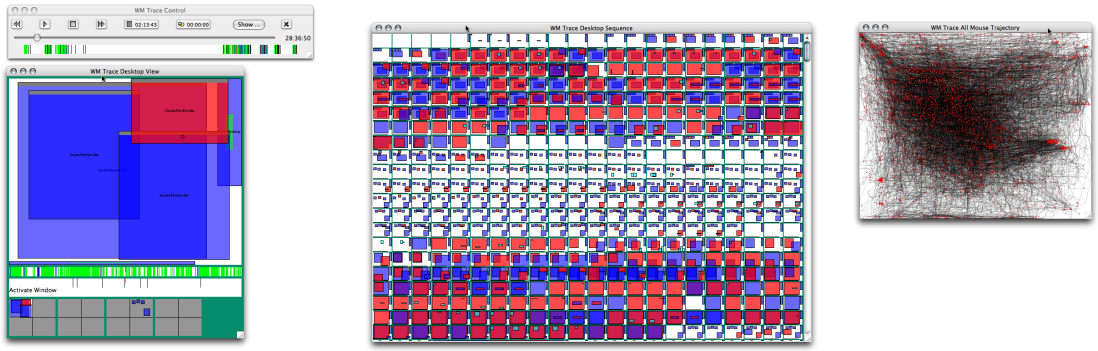

*Figure 6. VCR-like interface, session overview and sample plots of mouse trajectories (black) and mouse clicks (red)*

**Participants:** Jean-Daniel Fekete [correspondant], Howard Goodell, Nathalie Henry, Nghi Do-Thanh.

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

The main characteristics of the InfoVis Toolkit are:

Unified data structure The base data structure is a table of columns. Columns contain objects of homogeneous types, such as integers or strings. Trees and Graphs are derived from Tables.

Small memory footprint Using homogeneous columns instead of compound types dramatically reduces the memory required to store large tables, trees or graphs, and usually also the time required to manage them.

Unified set of interactive components Interactive filtering (a.k.a. dynamic queries) can be performed with the same control objects and components regardless of the data structure, simplifying the reuse of existing components and the design of generic ones.

Fast the InfoVis Toolkit can use accelerated graphics provided by Agile2D[3], an implementation of Java2D based on the OpenGL API for hardware accelerated graphics [56]. On machine with hardware acceleration, some visualizations redisplay 100 times faster than with the standard Java2D implementation.

Extensible the InfoVis Toolkit is meant to incorporate new information visualization techniques and is distributed with the full source and a very liberal license. It can be used for student projects, research projects or commercial products.

The InfoVis Toolkit, as of version 0.9, implements nine types of visualization (Figure 7): Time Series, Scatter Plots, Parallel Coordinates and Matrices for tables, Node-Link diagrams, Icicle trees and Treemaps for trees, Adjacency Matrices and Node-Link diagrams (with several layouts) for graphs.

The InfoVis toolkit is used for teaching the Information Visualization course (Masters level, Univ. of Paris-Sud) and is the basis for all contracts related to Information Visualization.

More information can be found at http://insitu.lri.fr/~fekete/InfovisToolkit or [6]

## 5.7. The SwingStates Toolkit

**Keywords:** *Canvas*, *GUI*, *Java*, *State Machines*, *Swing*, *Toolkit*.

[3] http://www.cs.umd.edu/hcil/agile2d

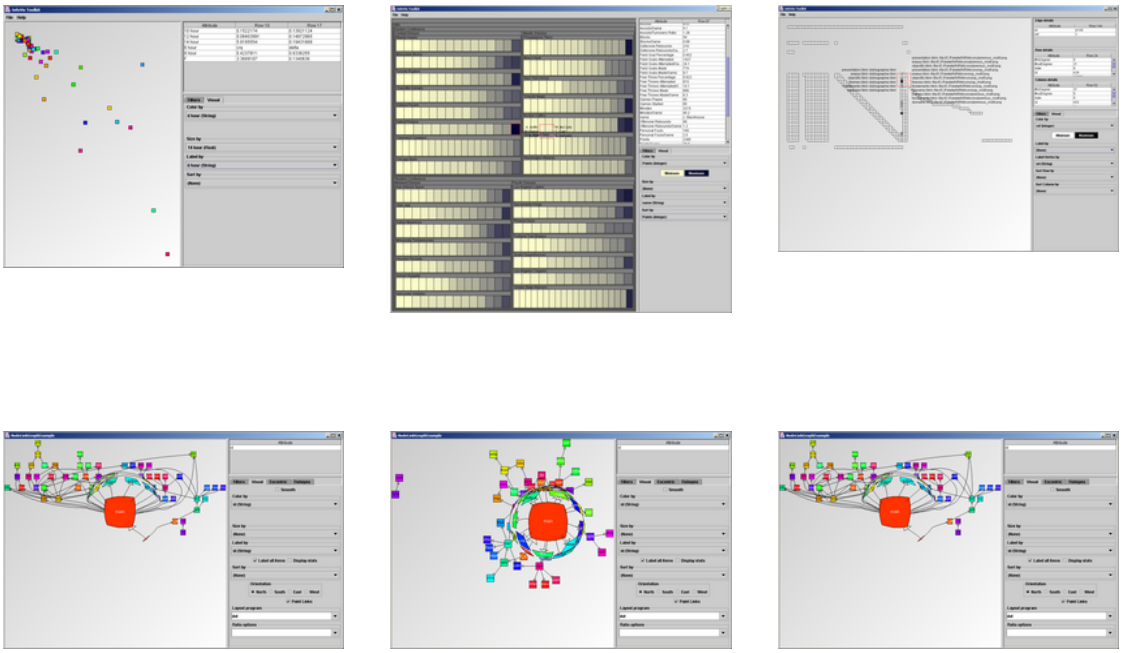

*Figure 7. Several visualizations produced using the Infovis Toolkit*

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

SwingStates [24], [21] 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 research toolkits tend to not get used outside the lab. By extending the popular Java Swing toolkit rather than starting from scratch, we hope to facilitate the dissemination and adoption of SwingStates by practitioners.

The first contribution of SwingStates is to provide *state machines* to specify interaction. While listeners and callbacks tend to split the code of a single interaction into several unrelated parts, state machines provide a powerful control structure and localize all of the interaction code in one place. By using Java's inner class, SwingStates provides programmers with a natural syntax to specify state machines and facilitates debugging and maintenance. It 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, while being compatible with traditional listeners. For example, a 20-line state machine can be assigned to Swing buttons and checkboxes so that they can be selected by crossing rather than clicking. State machines can also be used with the SwingStates canvas (see below) and to control high-level dialogues.

The second contribution of SwingStates is a powerful *canvas widget*. The canvas can contain any Java2D shape, including geometric shapes, images, text strings and even Swing widgets. Beyond the usual functions of a canvas display list, such as changing the order of objects, specifying a parent relative to which the coordinate system is specified and specifying a clipping object, SwingStates provides powerful *tags*, inspired by the Tcl/Tk toolkit. Any number of tags can be assigned to the canvas objects and an intensive use of polymorphism allows to apply almost any commands that works for a canvas object to a tag: the command is then applied to all objects with this tag. SwingStates provides extensional tags, which are explicitely assigned to objects, and intentional tags, which are specified by a predicate. Tags are also used in conjunction with state machines: transitions can be specified to occur only even if the event took place on an object with the specified tag.

While a single state machine can control the whole canvas, it is also possible to assign separate state machine to different objects. For example, pie menus can be implemented by creating a canvas in the overlay layer of any Swing application (Figure 8).

In summary, 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://insitu.lri.fr/SwingStates.


*Figure 8. 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)*

# 6. New Results

## 6.1. Towards fully adaptable user interfaces

**Keywords:** *Adaptable user interfaces*, *Window management*.

**Participants:** Olivier Chapuis [correspondant], Nicolas Roussel.

User interfaces are becoming more and more complex as the underlying applications add more and more features. Although most people use only a small subset of the functionalities of a given program, most software make all commands available all the time, which significantly increases the amount of screen space dedicated to interface components such as menus, toolbars and palettes. This quickly becomes a problem, as users often want to maximize the space available for the artifacts they are working on. One reason for this problem is probably that most user interfaces are still designed by software programmers. However, even trained interface designers cannot always foresee how a software package is going to be used in practice, especially if it is used by a large variety of users. This makes creating flexible user interfaces a major challenge.

One way of dealing with this problem is to allow applications or users to customize the interface. These two concepts have been studied for some time by the HCI community and are most often referred to as *adaptable* and *adaptive* interfaces [61]: adaptive interfaces change their appearance based on some algorithm (e.g. a least-recently used criterion), while adaptable ones can be configured by the user to suit his or her own criteria. Adaptive interfaces can exhibit some unpleasant side effects such as surprising the user by moving or removing menu entries. Adaptable interfaces suffer from the problem that new 'secondary' interfaces and interaction techniques must be added to support the customization of the 'primary' interface.

We believe that users should be in control of the adaptation process, not the original software authors. Together with some colleagues from York University (Canada), we have designed and implemented the *User Interface Façades* [42] system that allows users to quickly, flexibly and seamlessly change or recombine user interface elements without coding. This system supports cutting, copying and pasting of rectangular interactive screen regions. It supports both ad-hoc opportunistic customizations as well as persistent ones. It also supports deep customizations such as the modification of the interactive behavior of arbitrary applications, something that previous work has not supported. User Interface Façades are freely available as part of our Metisse window system (see 5.4). This work was partially funded by the French *ACI Masses de données* (Micromégas project).

## 6.2. A multiscale approach to computer-mediated communication

**Keywords:** *Computer-mediated communication*, *multiscale communication*, *variable engagement*.

**Participants:** Sofiane Gueddana, Nicolas Roussel [correspondant].

Instant messaging applications make it easy for users to indicate their status and adapt the pace of the conversation to their current context, supporting transparent transitions between synchronous and asynchronous communication. Existing video communication systems lack this ability to seamlessly transition back and forth between loosely-coupled interactions and highly-coupled ones: video is most often used for short, synchronous and highly-engaged face-to-face interactions. Although previous work has demonstrated the potential value of long-term video links for casual awareness and informal interaction [60], very few video systems manage to effectively support both general awareness and face-to-face interactions. As a notable exception, MirrorSpace [10] supports both forms of communication by providing users with a simple way of adjusting the level of detail of the communication.

This idea of supporting a variable degree of engagement through an adaptable level of detail and smooth transitions between levels led us to the general concept of *multiscale communication systems* [48]. As part of a research project funded by France Télécom R&D, we are designing a series of image-based communication systems to explore this concept in the context of the home environment. This work builds on experiences and results from a previous multi-disciplinary project that investigated the communication patterns and needs of distributed families [58] and pointed out the importance and difficulty of coordination between and within households, and the need for more subtle, less intrusive forms of communication than the telephone. Our first prototype, Pêle-Mêle [29], is a multiparty communication system that combines computer vision techniques, spatial and temporal filtering of the video streams and an original layout to support different forms of communication ranging from casual awareness to focused face-to-face interactions.

## 6.3. Designing for Web revisitation: a contextual approach

**Keywords:** *Web navigation*, *Web revisitation*, *contextual bookmarks*.

**Participants:** Catherine Letondal, Wendy Mackay, Nicolas Roussel, Aurélien Tabard [correspondant].

The Web has dramatically expanded over the past decade. Unfortunately, as far as user interaction is concerned, Web browsers have not kept pace. As an example, early aids for finding previously visited pages, such as bookmarks and history mechanisms, have not evolved significantly since their introduction in the early 1990s. And several studies have shown that these mechanisms are rarely used, even though revisitation accounts for 60 to 80% of visited pages [68], [53]. As part of the Micromégas project (see 7.2), we have been studying a particularly Web-intensive group of users: research biologists. These users consider the Web as both a database and an analysis tool. They repeat collections of tasks and revisit the same sets of pages over and over again, browsing sequentially or in parallel as they analyze data sets and pursue hypotheses. Unfortunately, their improvised and fluctuating workflow is poorly supported by the websites and browsers they use. Finding data often require long navigation paths through complex hierarchical directories and when found, these data pages rarely point to the apropriate analysis programs.

While full-featured automation tools for some of their workflow exist, we observed that few of the biologists used them. They complained about their complexity and lack of robustness, and the loss of control when using a comprehensive tool. To address this problem, we designed PageLinker, a Firefox extension allowing biologists to "contextualize" their navigation by associating Web pages. PageLinker was initially designed as a way to associate data pages and analysis forms by simply copying and pasting text from one to another. But users' response to our first prototype quickly showed its potential value as a general tool for contextual bookmarking. Our study showed that it improves Web page revisitation and that it is less prone to information overload than traditional history and bookmarks mechanisms. Letting users manually handle their links allowed the tool to be far simpler (Figure 9) and simultaneously robust to changes in Web pages and user practices. Three months after the study, more than half of the participants were still using PageLinker. The latest version is freely available for download from http://rabidfox.mozdev.org.

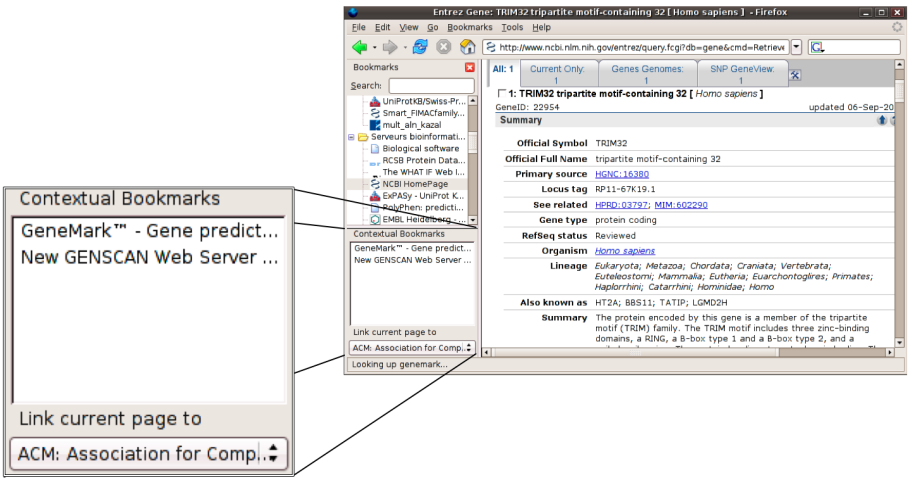


*Figure 9. PageLinker*

## 6.4. Matrix Visualization of Social Networks

**Keywords:** *Graph Layout*, *Matrix*, *Reordering*, *Social Networks*, *Visualization*.

**Participants:** Nathalie Henry [correspondant], Jean-Daniel Fekete.

Social networks analysis and visualization is becoming more and more important, due to the development of onlince communities on the Web, but also to the increase of security-related threats such qs terrorist attacks and epidemic speads.

Visualizing large or dense social networks is simply not possible using current node-link diagram representations. We have shown that the matrix representation was a good alternative to node-link diagrams. However, it has not received as much attention as node-link diagrams in the past and the research community needs to design good navigation and layout methods to improve it.

We have worked in that direction and proposed two enhancements to Matrix Visualization: better reordering algorithms to show the overall structure of a network and synchronized views of node-link diagrams and matrices to get the benefit of both representations [19]. We have also started working on hybrid representations using links overlaid on top of a matrix (Fig. 10). We have shown that this representation improved the performance the matrix representation for tasks related to path-finding.

We have also worked with international researchers to improve evaluation methods of network visualization systems by proposing a taxonomy of network-related tasks [36].

## 6.5. End User Interaction with Semantic Web Data

**Keywords:** *Information Visualization*, *RDF*, *Semantic Web*, *Structured data representation*.

**Participant:** Emmanuel Pietriga [correspondant].

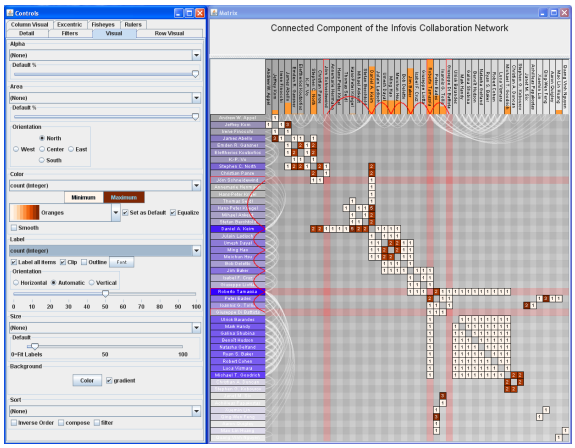


*Figure 10. MatLink visualization of a social network*

The Semantic Web aims at extending the current Web with information that is "given well-defined meaning, better enabling computers and people to work in cooperation" [51]. Software agents are the primary consumers of Semantic Web content. RDF [69], the foundational framework for describing information in the Semantic Web, is thus designed to facilitate machine interpretability of information and does not define a visual presentation model since human readability is not one of its stated goals. However, RDF applications are not only about the semantic processing of information. Information coming from the Semantic Web, either directly from RDF repositories or as a result of complex processes, often must be presented to users. This requires transforming logically-structured, computer-oriented data so as to produce representations better suited for human consumption.

The work on Fresnel [38], an RDF vocabulary for describing Semantic Web presentation knowledge, has yielded new results. The application- and representation paradigm-independence of core Fresnel vocabularies has been demonstrated through the implementation of the specification in various applications: MIT Simile's Longwell (a generic Web-based faceted RDF Semantic Web browser[4]), W3C/INRIA's IsaViz (a visual authoring tool for RDF, see 5.2), IBM's Cardovan (a Java/SWT-based Semantic Web browser and Fresnel editor), Freie Universität Berlin's Horus, and a prototype geographical browser based on a multiscale version of NASA's very high resolution Blue Marble Next Generation world map [67], using the geonames ontology[5].

Work has also started on two generic Fresnel APIs aimed at helping Semantic Web application developers add support for Fresnel in their applications. One of these APIs is part of MIT Simile's Longwell effort, the other is in its early stages of development at In Situ[6].

## 6.6. Evaluation and Optimization of Pointing and Interaction Techniques

**Keywords:** *Fitts' law*, *Interaction Technique*.

**Participants:** Caroline Appert, Michel Beaudouin-Lafon [correspondant], Olivier Chapuis, Yangzhou Du, Jean-Daniel Fekete, Wendy Mackay, Emmanuel Pietriga.

Graphical user interfaces (GUIs) are based on a small set of interaction techniques, which rely heavily on two elementary actions: pointing a target on the screen, e.g. an icon or button, and navigating to a non-visible part of the information space, e.g. by scrolling or zooming.

[4] http://simile.mit.edu
[5] http://www.geonames.org/ontology/
[6] http://gforge.inria.fr/projects/jfresnel/


*Figure 11. Various applications using Fresnel for the presentation of RDF data*

We are working on improving pointing and navigation performance in GUIs. Indeed, the performance of pointing on a screen is similar to that of pointing in the physical world, and it should be possible to take advantage of the computing power to get a significant advantage when pointing in an information world. The major theoretical tool to study pointing performance is Fitts' law [57] [7], which defines the movement time as an affine function of the index of difficulty (ID), defined as the log of the ratio between target distance and target width. In other words, pointing performance strictly depends on the relative size of the target to the distance to the target. Our approach is based on the concept of *multiscale interface* where objects can be represented at different levels of scale in order to combine an overview of the document and details of its parts [7].

We have developed OrthoZoom Scroller [23], a novel multiscale interaction technique to improve target acquisition in very large one-dimensional spaces. The OrthoZoom Scroller requires only a mouse to perform panning and zooming into a 1D space. Panning is performed along the scrolling dimension while zooming is performed along the orthogonal one. We conducted a controlled experiment to compare OrthoZoom Scroller with the only other multi-scale technique requiring only a mouse, Speed Dependant Automatic Zooming [59]. The results show that OrthoZoom Scroller is about twice as fast as Speed Dependant Automatic Zooming to perform pointing tasks whose index of difficulty is in the 10-30 bits range. We have also developed an application to browse large textual documents to show how OrthoZoom Scroller is usable and useful in situ.

We have also explored *perspective pointing and navigation* in the context of the MicroMegas project. Document navigation in standard graphical user interfaces can be described through the metaphor of a user-controlled video-camera flying over a planar surface. While traditional GUIs have exploited only translating and zooming this camera, we have started to explore the design space that opens up when camera tilting is allowed. An ecological optics analysis leads us to the conclusion that the current GUI is similar to a flight simulator that deprives the pilot of one kind of information critically needed to control navigation, namely, prospective visual information [31].

We have shown with a controlled experiment that a perspective visualization of the document improves both performance and user satisfaction. However one problem with perspective viewing is that the visualization scale implodes at some critical viewing distance. We have shown mathematically and empirically that perspective pointing and navigation collapses for targets located too far, when the ID is beyond 15, and we have developed a techniques to avoid this barrier [27].

# 7. Contracts and Grants with Industry

## 7.1. Experimental communication systems for the home environment

**Keywords:** *Computer-mediated communication, domestic settings.*

**Participants:** Sofiane Gueddana, Nicolas Roussel [correspondant].

Research project funded by France Télécom R&D, 36 months (2005-2008). The goal of this project is to design innovative communication systems for the home environment. In this context, we are particularly interested in supporting smooth transitions between alternative forms of communication involving different media combination.

## 7.2. Micromégas

**Keywords:** *Familiar data management*, *interaction histories*, *multiscale navigation*.

**Participants:** Michel Beaudouin-Lafon, Olivier Chapuis, Jean-Daniel Fekete, Wendy Mackay, Nicolas Roussel [correspondant].

Research project funded by the French *ACI Masses de données*, 36 months (2003-2006). Partners: LMP (Marseille, coordinator), In Situ, MErLIn (INRIA, Rocquencourt) and Institut Pasteur (Paris).

The goal of this project was to design and prototype new interactive systems for managing large data sets. It focused on multiscale interactions with familiar data: personal or professional data that users have somehow manipulated (e.g. created, received or downloaded). The final report [46] provides an overview of the work that was carried by the different partners.

## 7.3. WebContent: the Semantic Web Platform

**Keywords:** *Peer-to-peer*, *RDF*, *Semantic Web*, *Visualization Components*, *Web Services*, *XML*.

**Participant:** Emmanuel Pietriga [correspondant].

Research project funded by national network on software technology (RNTL), 36 months (2006-2008). Partners: INRIA/Gemo, LIMSI/CNRS, EADS, CEA, INRA, Thalès, LRI/IASI, Xylème, LIP6, INRIA/Mostrare, and more.

The WebContent project is creating a software platform to accommodate the tools necessary to efficiently exploit and extend the future of the Internet : the Semantic Web. Its objective is to produce a flexible and generic platform for content management and to integrate Semantic Web technologies in order to show their effectiveness on real applications with strong economic or societal stakes. In Situ and LIMSI collaborate on the design and implementation of the platform's visualization components.

## 7.4. Classification and Visualization for Business Intelligence

**Participants:** Jean-Daniel Fekete [correspondant], Nghi Do-Thanh.

SEVEN is a Business Intelligence project conducted by EDF, the main European electricity supplier with INRIA, LIMSI, and the Univ. Paris-IX (Dauphine). Its goal is to develop a Visual Analytics software platform to understand market segments for EDF. The platform is made of modules that analyze textual documents or numerical data and integrate them to find profiles of clients. This profiling leads to understanding the main concerns of market segments and plan price offerings targeted to these segments.

The partners are experts in language processing (LIMIS), data analysis (Dauphine) and Information Visualization (INRIA and LIMSI).

## 7.5. Analysis and visualization of the Auto-organization process of online social communities

**Participants:** Jean-Daniel Fekete [correspondant], Howard Goodell, Nathalie Henry.

The aim of Autograph is to develop tools and services for governance of big cooperative organizations on Internet. This exploratory project intends to draw thorough research on several online communities (Debian, Wikipedia, international activists, Blogs, SIMS). In order to study the organizational properties of these collectives, the graph theory gives new directions for sociologists, linguists, computer scientists and mathematicians who want to describe social, semantic and computer networks and analyze their structures. The aim of the project is to develop new visualization services, enabling the actors in these communities to "see" the universe in which they cooperate to help them make decisions about the life of their communities. Cartographic and dynamic representations will be given, enabling an exploration of the structure of the links and the thematic universe of the exchanges. All these results will be developed in a tight relationship with the user communities.

Partnership: France Telecom, ENST, LIAFA, LIMSI, INRIA Futurs/LRI, FING

More information can be found at http://autograph.fing.org/.

## 7.6. Integrated Resources for Microbial Genomics

**Participants:** Jean-Daniel Fekete [correspondant], Howard Goodell.

The project we propose is designed to address the challenges raised by the ongoing deluge of genomic data. We plan to design an integrated resource for microbial genomics. The objective is to gather together the maximum of relevant data and to make them available for a number of data mining approaches despite its heterogeneity. A graphic interface will be designed for efficient and simple but still expressive queries, letting users extract relevant pieces of knowledge through a visual interactive system. This will make cross-fertilization between domains possible, and allow detailed analysis of a wide range of available genomic data.

## 7.7. Analysis and Visualization of the History of the French Central Institutions

**Participant:** Jean-Daniel Fekete [correspondant].

The Millefeuilles project ("Archeology of Administrative Knowledge") is led by the French "École nationale des Chartes" with the French National Archives, INRIA, Univ. Sorbonne-Paris I and Univ. Paris X, as partners. It is aimed at analyzing the evolution of the organizational structure before and after the French revolution. The structure of French institutions is represented as a hierarchical or mostly hierarchical structure that evolves with time. This organization is used as a backbone for further analysis, such as the structural evolution of the organization or the path taken by administrative forms in the structure. From these perspectives, the project can study how various structural changes have affected the administrative practices and visualize their evolution through time.

## 7.8. The Interaction Museum

**Participants:** Caroline Appert, Michel Beaudouin-Lafon [correspondant], Jean-René Courtois, Wendy Mackay [correspondant], Emmanuel Pietriga.

The Interaction Museum is a project funded by the CONVIVIO European Network of Excellence. The goal is to create an interactive website to collect and present interaction techniques and interactive systems, both historical and new. The main audience for this on-line resource are practitioners and software developers, who are often unaware of the advances of the state-of-the-art in HCI because they do not read the research literature. The museum is then seen as a vehicle for technology transfer. A secondary audience are students, educators and researchers, who could take advantage of the museum for their studies, courses and research as well as contribute new material. The meseum is then seen as a medium for the HCI community at large.

# 8. Other Grants and Activities

## 8.1. National actions

- Michel Beaudouin-Lafon is member of the board of the RNTL national network on software technology, a program of the French ANR.
- Jean-Daniel Fekete is member of the Scientific Committee of the French ANR for the *Data Masses* program
- Jean-Daniel Fekete is co-responsible of the Working Group: Tools and Formalisms for HCI (ALF) with Eric Lecolinet
- Jean-Daniel Fekete is a member of the directing committee of the French GDR I3

## 8.2. European actions

- Wendy Mackay is workpackage leader of the Convivio European network of excellence

## 8.3. International actions

- *Fresnel: modeling presentation knowledge for the display of Semantic Web data*. Emmanuel Pietriga participates in a community-based effort initiated in the context of MIT project Simile[7]. The partners are In Situ, MIT DIG (Decentralized Information Group), MIT project Haystack, MIT Libraries, Freie Universität Berlin, and W3C. See section 6.5 for more details.
- *EDGE: Evaluation methods, Design Guidelines and Environments for Virtual Reality and Information Visualization Techniques*. This project is a French-Brazilian collaboration supported by INRIA and CNPq (36 months, 2005-2008). The partners are MErLIn and In Situ (INRIA), the CS Institute of the Federal University of Rio Grande do Sul and the CS Department of PUC-Rio University. Members of In Situ involved: Nicolas Roussel (coordinator of the French side) and Jean-Daniel Fekete.
- *Navigation and Visualization of Large Social Networks*. Nathalie Henry is preparing a joint PhD (co-tutelle) with the University of Sidney, Information Visualization Research Group (Australia). Members of In Situ involved: Nathalie Henry and Jean-Daniel Fekete (advisor).
- *Evaluation of Information Visualization*. Jean-Daniel Fekete and Catherine Plaisant of the University of Maryland are gathering resources to improve the evaluation techniques used in the domain of Information Visualization. They have initiated an international contest, taking place every year during the IEEE Symposium on Information Visualization. They gather and maintain the benchmarks and results on an open web site at http://www.cs.umd.edu/hcil/InfovisRepository.

# 9. Dissemination

## 9.1. Keynote addresses and Invited Lectures

- COPADD workshop (Augmented Paper Then and Now), in conjunction with ACM CSCW 2006: Wendy Mackay
- Workshop of the French Statistical Society, IRISA, Rennes. Jan 2006: Jean-Daniel Fekete
- Universidad Politécnica de Valencia, March 2006, Valencia, Spain: Emmanuel Pietriga
- Human-Computer Interaction Laboratory, University of Maryland: Jean-Daniel Fekete

[7] http://simile.mit.edu

- UCLIC Seminar, University College, London, May 2006: Michel Beaudouin-Lafon
- Rencontres 2005 du Pôle Méthodologique “Analyse des Données Relationnelles — EHESS-INED”: Nathalie Henry, Jean-Daniel Fekete
- Launch of Digiteo Labs, research park in information science and technology : Wendy Mackay
- 10th anniversary of the creation of AFIHM (French HCI Association), Anglet, Nov. 2006: Michel Beaudouin-Lafon
- Journée Interfaces Innovantes organisée par la FING (Fédération pour un Internet Nouvelle Génération), Paris, Sept. 2006 : Wendy Mackay and Michel Beaudouin-Lafon
- Séminaire ARISTOTE “Les implications du numérique pour le patrimoine scientifique et culturel”, Paris, June 2006: Michel Beaudouin-Lafon
- Toulouse SIGCHI Chapter, Feb. 2006: Michel Beaudouin-Lafon

## 9.2. Journal editorial board

- ACM Transactions on Computer Human Interaction: Wendy Mackay
- Associate Editors of the International Journal of Human-Computer Study (IJHCS): Michel Beaudouin-Lafon, Jean-Daniel Fekete
- Special issue on Awareness systems of the HCI Journal: Wendy Mackay, invited co-editor
- Special issue on “Visualization for Digital Libraries” of the “Document Numérique” Journal: Jean-Daniel Fekete, coordinator

- Member of the editorial board for a French encyclopedia of information systems and computer science [14]: Michel Beaudouin-Lafon

## 9.3. Journal reviewing

- ACM Transactions on Computer Human Interaction: Wendy Mackay
- ACM Transactions on Applied Perception: Jean-Daniel Fekete
- HCI Journal: Wendy Mackay
- International Journal on Human-Computer Studies: Wendy Mackay
- IEEE Transactions on Visualization and Computer Graphics: Jean-Daniel Fekete
- Software Practice and Experience : Michel Beaudouin-Lafon
- Information Visualization Journal, Palgrave Macmillan: Jean-Daniel Fekete
- Computer Supported Cooperative Work Journal: Michel Beaudouin-Lafon
- Data & Knowledge Engineering Journal: Emmanuel Pietriga
- Journal of Visual Languages and Computing: Emmanuel Pietriga
- Journal of Graph Algorithms and Applications: Jean-Daniel Fekete
- Document Numérique, Hermès, France: Jean-Daniel Fekete
- Revue de l’Interaction Homme-Machine (RIHM), Cepadues, France: Jean-Daniel Fekete

## 9.4. Conference organization

- IEEE Symposium on Visual Languages and Human-Centric Computing 2006, Brighton, UK: Emmanuel Pietriga (Program Committee members)
- IEEE Symposium on Information Visualization 2006: Jean-Daniel Fekete (Program Committee member)

- ACM CHI 2006, Human Factors in Computing Systems, Montreal, Canada: Wendy Mackay, Michel Beaudouin-Lafon (Program Committee members)
- ACM CSCW 2006, Computer Supported Cooperative Work, Banff, Canada: Wendy Mackay (Program Committee member)
- ACM Multimedia 2006, Santa Barbara, USA: Nicolas Roussel (Program Committee member)
- ACM UIST 2006, User Interface Sofware and Technology, Montreux, Switzerland: Nicolas Roussel (Demos co-chair)
- AVI 2006, Advanced Visual Interfaces, Venice, Italy: Michel Beaudouin-Lafon (Program Committee member)
- SOUPS 2006, Symposium on Usable Privacy and Security, Pittsburgh, USA: Wendy Mackay (Program Committee member)
- IHC 2006, 7th HCI conference organized by the Brasilian Computer Science Society, Natal, Brazil: Nicolas Roussel (Program Committee member)
- UbiMob 2006, Ubiquité & Mobilité, Paris, France: Michel Beaudouin-Lafon (co-president) and Nicolas Roussel (Program Committee member, workshop organizer)
- CRIWG, 12th International Workshop on Groupware, Valladolid, Spain: Nicolas Roussel (Program Committee member)

## 9.5. Conference reviewing

- ACM CHI 2006, Montreal, Canada: Michel Beaudouin-Lafon, Jean-Daniel Fekete, Wendy Mackay, Nicolas Roussel, Caroline Appert, Emmanuel Pietriga
- ACM UIST 2006, Montreux, Switzerland: Michel Beaudouin-Lafon, Olivier Chapuis, Jean-Daniel Fekete, Wendy Mackay, Nicolas Roussel
- IEEE Symposium on Visual Languages and Human-Centric Computing 2006, Brighton, UK: Emmanuel Pietriga
- Conférence Francophone d'Interaction Homme-Machine (IHM) 2006, Montréal, Canada: Michel Beaudouin-Lafon, Olivier Chapuis, Jean-Daniel Fekete, Emmanuel Pietriga, Nicolas Roussel
- IEEE Symposium on Information Visualization 2006: Jean-Daniel Fekete, Nathalie Henry
- VIEW (Visual Information Expert Workshop) 2006: Jean-Daniel Fekete
- ACM Multimedia 2006, Santa Barbara, USA: Nicolas Roussel
- IHC 2006, Natal, Brazil: Nicolas Roussel
- CRIWG, Valladolid, Spain: Nicolas Roussel
- UbiMob 2006, Paris, France: Nicolas Roussel

## 9.6. Scientific associations

- AFIHM (French speaking HCI asssociation): Michel Beaudouin-Lafon, Jean-Daniel Fekete, Executive Committee members
- ACM: Michel Beaudouin-Lafon member at large of the ACM Council and member of the ACM Publications Board

## 9.7. Evaluation committees and invited expertise

- EPSRC Senior Fellowships, UK: Wendy Mackay, reviewer
- International award committee, USA (250k$ prize, name cannot be disclosed): Wendy Mackay, member of the jury

- ACM CHI Best Paper award committee: Wendy Mackay, member of the jury
- MDD program (ANR, National Research Agency): Jean-Daniel Fekete, member of the evaluation committee since 2005
- RNTL program on Software Technology (ANR, National Research Agency): Michel Beaudouin-Lafon, member of the evaluation committee since 2000
- LIP6, Paris: Jean-Daniel Fekete, member of the evaluation committee
- LIRMM, Montpellier: Michel Beaudouin-Lafon, member of the evaluation committee
- LIG, Grenoble: Michel Beaudouin-Lafon, member of the evaluation committee
- IRCAM, Paris: Michel Beaudouin-Lafon, member of the evaluation committee
- I3S, Nice: Michel Beaudouin-Lafon, member of the evaluation committee
- OFTA (Observatoire Français des Techniques Avancées): Wendy Mackay and Nicolas Roussel, members of Groupe Informatique Diffuse

## 9.8. PhD defenses

- Thomas Riisgaard Hansen (Univ. Aarhus, Denmark), Ph.D. Thesis, “Pervasive interaction: designing interactive pervasive systems for complex work environments”: Wendy Mackay, reviewer
- Eric Barboni (Univ. Toulouse 1), Ph.D. Thesis, “Méthodes formelles pour les composants logiciels appliquées aux systèmes interactifs critiques”: Jean-Daniel Fekete, reviewer
- Greg Ross (Univ. of Glasgow), Ph.D. Thesis, “An Algorithmic Framework for Visualising and Exploring Multidimensional Data”: Jean-Daniel Fekete, reviewer
- François Laborie (Univ. Toulouse), Ph.D. Thesis, “Le concept de salle de décision collective et son application aux processus complexes EADS”: Michel Beaudouin-Lafon, reviewer
- Vincent Chevrin (Univ. Lille), Ph.D. Thesis, “L’interaction usagers/services, multimodale et multi-canale : une première proposition appliquée au domaine du e-commerce”: Michel Beaudouin-Lafon, reviewer
- Jérôme Thièvre (Univ. Montpellier), Ph.D. Thesis, “Cartographies pour la recherche et l?exploration de données documentaires”: Michel Beaudouin-Lafon, reviewer
- Pierre Cubaud (CNAM, Paris), Habilitation à diriger des recherches “Du texte au volume : contributions aux bibliothèques numériques”: Michel Beaudouin-Lafon, reviewer
- Monia Ziat (Univ. Tech. Compiègne), Ph.D. Thesis, “Conception et implémentation d’une fonction de zoom haptique sur PDAs”: Michel Beaudouin-Lafon, member of the jury
- Maxime Collomb (Univ. Montpellier), Ph.D. Thesis, “Vers des systèmes de fenêtrage distribués : l’évolution du drag-and-drop”: Michel Beaudouin-Lafon, reviewer
- Nicolas Barallon (Univ. Grenoble), Ph.D. Thesis, “Couplage de ressources d’interaction en informatique ambiante”: Michel Beaudouin-Lafon, reviewer
- Cyril Rousseau (Univ. Paris-Sud), Ph.D. Thesis, “Présentation multimodale et contextuelle de l’information”: Michel Beaudouin-Lafon, president of the jury
- Yacine Bellik (Univ. Paris-Sud), Habilitation à diriger des recherches, “Présentation multimodale de l’information”: Michel Beaudouin-Lafon, president of the jury
- Victoria Miny (Ecole Spéciale d’Architecture, Paris), Masters in Architecture: Wendy Mackay, member of the jury
- Narumi Kang (Ecole Spéciale d’Architecture, Paris), Masters in Architecture: Wendy Mackay, member of the jury

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## Major publications by the team in recent years

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