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CNRS

Université des sciences et technologies de Lille (Lille 1)

Activity Report 2012

Project-Team MINT

Methods and tools for gestural interactions

RESEARCH CENTER
Lille - Nord Europe

THEME
Interaction and Visualization

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Project-Team MINT

Keywords: Interaction, Interactive Computing, User Interface, Interactive Graphics

Created in January 2010, http://www.lifl.fr/mint/Mint is a collaboration between http://www.inria.fr/centres-de-recherche-inria/lille-nord-europeInria Lille, the LIFL and L2EP labs of Lille 1 University, and CNRS (Centre National de la Recherche Scientifique).

Creation of the Project-Team: January 01, 2010 *, Updated into Project-Team:* January 01, 2012 .

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2. Overall Objectives

2.1. Overall Objectives

The Mint team focuses on *gestural interaction*, i.e. the use of gesture for human-computer interaction (HCI). The New Oxford American Dictionary defines *gesture* as *a movement of part of the body, especially a hand or the head, to express an idea or meaning*. In the particular context of HCI, we are more specifically interested in movements that a computing system can sense and respond to. A gesture can thus be seen as a function of time into a set of sensed dimensions that might include but are not limited to positional information (the pressure exerted on a contact surface being an example of non-positional dimension).

Simple pointing gestures have long been supported by interactive graphics systems and the advent of robust and affordable sensing technologies has somewhat broadened their use of gestures. Swiping, rotating and pinching gestures are now commonly supported on touch-sensitive devices, for example. Yet the expressive power of the available gestures remains limited. The increasing diversity and complexity of computer-supported activities calls for more powerful gestural interactions. Our goal is to foster the emergence of these new interactions, to further broaden the use of gesture by supporting more complex operations. We are developing the scientific and technical foundations required to facilitate the design, implementation and evaluation of these interactions. Our interests include:

- gestures captured using held, worn or touched objects or contactless perceptual technologies;
- transfer functions possibly used during the capture process;
- computational representations of the captured gestures;
- methods for characterizing and recognizing them;
- feedback mechanisms, and more particularly haptic ones;
- tools to facilitate the design and implementation of tactile and gestural interaction techniques;
- evaluation methods to assess the usability of these techniques.

2.2. Highlights of the Year

- F. Giraud, M. Amberg, B. Lemaire-Semail, G. Casiez, P. Olivo and N. Roussel's demonstration of transparent tactile devices was nominated for the best demonstration award by the HAPTICS 2012 conference (Vancouver, March 4-7);
- About 500 people participated in FITG 2012, the third *Forum on Tactile and Gestural Interaction* co-organized by N. Roussel in cooperation with Plaine Images (November 13-14) in Tourcoing;
- equipex IrDIVE has been funded by french ministry of research, and started officially 1st of january 2012 (scientific coordinator Yann Coello, Pr. psychology of university Lille 3, ends in 2020); it gathers 3600 Keuros from ANR, associated to 3000 Keuros of FEDER funds; this platform is associated to a pluridisciplinary scientific project, that associates Lille 1 and Lille 3 universities, and gathers computer scientists, psychologists, and historians of arts. L. Grisoni is responsible for the art-science activity in this initiative.

3. Scientific Foundations

3.1. Human-Computer Interaction

The scientific approach that we follow considers user interfaces as means, not an end: our focus is not on interfaces, but on interaction considered as a phenomenon between a person and a computing system [30]. We *observe* this phenomenon in order to understand it, i.e. *describe* it and possibly *explain* it, and we look for ways to significantly *improve* it. HCI borrows its methods from various disciplines, including Computer Science, Psychology, Ethnography and Design. Participatory design methods can help determine users' problems and needs and generate new ideas, for example [35]. Rapid and iterative prototyping techniques allow to decide between alternative solutions [31]. Controlled studies based on experimental or quasi-experimental designs can then be used to evaluate the chosen solutions [37]. One of the main difficulties of HCI research is the doubly changing nature of the studied phenomenon: people can both adapt to the system and at the same time adapt it for their own specific purposes [34]. As these purposes are usually difficult to anticipate, we regularly *create* new versions of the systems we develop to take into account new theoretical and empirical knowledge. We also seek to *integrate* this knowledge in theoretical frameworks and software tools to disseminate it.

3.2. Numerical and algorithmic real-time gesture analysis

Whatever is the interface, user provides some curves, defined over time, to the application. The curves constitute a gesture (positionnal information, yet may also include pressure). Depending on the hardware input, such a gesture may be either continuous (e.g. data-glove), or not (e.g. multi-touch screens). User gesture can be multi-variate (several fingers captured at the same time, combined into a single gesture, possibly involving two hands, maybe more in the context of co-located collaboration), that we would like, at higher-level, to be structured in time from simple elements in order to create specific command combinations.

One of the scientific fundations of the research project is an algorithmic and numerical study of gesture, which we classify into three points:

- *clustering*, that takes into account intrinsic structure of gesture (multi-finger/multi-hand/multi-user aspects), as a lower-level treatment for further use of gesture by application;
- *recognition*, that identifies some semantic from gesture, that can be further used for application control (as command input). We consider in this topic multi-finger gestures, two-handed gestures, gesture for collaboration, on which very few has been done so far to our knowledge. On the contrary, in the case of single gesture case (i.e. one single point moving over time in a continuous manner), numerous studies have been proposed in the current literature, and interestingly, are of interest in several communities: HMM [38], Dynamic Time Warping [40] are well-known methods for computer-vision community, and hand-writing recognition. In the computer graphics community, statistical classification using geometric descriptors has previously been used [36]; in the Human-Computer interaction community, some simple (and easy to implement) methods have been proposed, that provide a very good compromise between technical complexity and practical efficiency [39].
- *mapping to application*, that studies how to link gesture inputs to application. This ranges from transfer function that is classically involved in pointing tasks [32], to the question to know how to link gesture analysis and recognition to the algorithmic of application content, with specific reference examples.

We ground our activity on the topic of numerical algorithm, expertise that has been previously achieved by team members in the physical simulation community (within which we think that aspects such as elastic deformation energies evaluation, simulation of rigid bodies composed of unstructured particles, constraint-based animation... will bring up interesting and novel insights within HCI community).

3.3. Design and control of haptic devices

Our scientific approach in the design and control of haptic devices is focused on the interaction forces between the user and the device. We search of controlling them, as precisely as possible. This leads to different designs compared to other systems which control the deformation instead. The research is carried out in three steps:

- *identification:* we measure the forces which occur during the exploration of a real object, for example a surface for tactile purposes. We then analyze the record to deduce the key components – *on user's point of view* – of the interaction forces.
- *design:* we propose new designs of haptic devices, based on our knowledge of the key components of the interaction forces. For example, coupling tactile and kinesthetic feedback is a promising design to achieve a good simulation of actual surfaces. Our goal is to find designs which leads to compact systems, and which can stand close to a computer in a desktop environment.

- *control:* we have to supply the device with the good electrical conditions to accurately output the good forces.

4. Application Domains

4.1. Next-generation desktop systems

The term *desktop system* refers here to the combination of a window system handling low-level graphics and input with a window manager and a set of applications that share a distinctive look and feel. It applies not only to desktop PCs but also to any other device or combination of devices supporting graphical interaction with multiple applications. Interaction with these systems currently rely on a small number of interaction primitives such as text input, pointing and activation as well as a few other basic gestures. This limited set of primitives is one reason the systems are simple to use. There is, however, a cost. Most simple combinations being already used, few remain to trigger and control innovative techniques that could facilitate task switching or data management, for example. Desktop systems are in dire need of additional interaction primitives, including gestural ones.

4.2. Ambient Intelligence

Ambient intelligence (AmI) refers to the concept of being surrounded by intelligent systems embedded in everyday objects [33]. Envisioned AmI environments are aware of human presence, adapt to users' needs and are capable of responding to indications of desire and possibly engaging in intelligent dialogue. Ambient Intelligence should be unobtrusive: interaction should be relaxing and enjoyable and should not involve a steep learning curve. Gestural interaction is definitely relevant in this context.

4.3. Serious Games

Serious game refers to techniques extensively used in computer games, that are being used for other purposes than gaming. Fields such as learning, use of Virtual Reality for rehabilitation, 3D interactive worlds for retail, art-therapy, are specific context with which the MINT group has scientific connection, and industrial contacts. This field of application is a good opportunity for us to test and transfer our scientific knowledge and results.

4.4. Interactive Art

The heart of Mint project is about interaction gesture, and aims at making relation between application and user more intimate through the production of tools and methods for application to use more information from user gesture. There seems to be, at first sight, very strong difference of fields, tools, vocabulary, between Science and Art. Up to basic intellectual schemes are classically thought to be different. Yet, a closer look needs to be taken on things. Through time, Art is more and more involved in relation between people and content. For example, *relational art* [1] is centered on inter-human relations and social context. Because of this similar analysis about relation between person and content, research on interactive systems probably has a lot to develop relations with Art, this is also true for research on gestural interaction.

5. Software

5.1. LibGINA

Participant: Laurent Grisoni [correspondant].

[1] http://en.wikipedia.org/wiki/Relational_Art

This library has been developped within the context of the ADT GINA, for one of the installation that have been made in collaboration with Le Fresnoy national studio (Damassama, Léonore Mercier). This library is currently being posted as APP, and has been used by Idées-3com small company, in the context of our join I-lab program. This library allows for use of gesture for command, and is able to handle strong variability into recognized patterns.

Current version: version 1.0

Software characterization: A-2 SO-3 SM-2-up EM-3 SDL-3 OC-DA4-CD4-MS2-TPM4

5.2. 3D interaction using mobile phone

Participants: Samuel Degrande [correspondant], Laurent Grisoni.

This work has been achieved in the context of the Idées-3com I-lab. In this context a module, that allows to use any android based smartphone to control an Explorer module for navigation and interaction with VRML-based content. This module was used as a basis by Idées-3com in their commercial product this year.

Current version: version 1.0

Software characterization: A-2 SO-3 SM-2-up EM-2-up SDL-3 OC-DA4-CD4-MS2-TPM4

5.3. tIO (tactile input & output)

Participants: Paolo Olivo, Nicolas Roussel [correspondant], Ibrahim Yapici.

tIO is a library designed to facilitate the implementation of doubly tactile interaction techniques (tactile input coupled with tactile feedback) based on the STIMTAC technology. Supporting all current STIMTAC prototypes, it makes it easy to move the system pointer of the host computer according to motions detected on them and adapt their vibration amplitude based on the color of the pointed pixel or the nature of the pointed object. The library includes a set of `Qt` demo applications that illustrate these two different approaches and makes it easy to "augment" existing `Qt` applications with tactile feedback. It also makes it possible to supplement or substitute tactile feedback with basic auditory feedback synthesized using `portaudio` (friction level is linearly mapped to the frequency of a sine wave). This not only facilitates the development and documentation of tactile-enhanced applications but also makes it easier to demonstrate them to a large audience.

Current version: 0.1 - June 2011 (IDDN.FR.001.270005.000.S.P.2011.000.10000)

Software characterization: A2, SO3-up, SM-2, EM2, SDL1.

5.4. libpointing

Participants: Géry Casiez [correspondant], Damien Marchal, Nicolas Roussel.

Libpointing is a software toolkit that provides direct access to HID pointing devices and supports the design and evaluation of pointing transfer functions [2]. The toolkit provides resolution and frequency information for the available pointing and display devices and makes it easy to choose between them at run-time through the use of URIs. It allows to bypass the system's transfer functions to receive raw asynchronous events from one or more pointing devices. It replicates as faithfully as possible the transfer functions used by Microsoft Windows, Apple OS X and Xorg (the X.Org Foundation server). Running on these three platforms, it makes it possible to compare the replicated functions to the genuine ones as well as custom ones. The toolkit is written in C++ with Python and Java bindings available. It is scheduled to be publicly released in 2012, the licence remaining to be decided.

Web site: http://libpointing.org/

Software characterization: A3, SO3, SM-2, EM2, SDL4

6. New Results

6.1. Noisy input filtering for interactive systems

Participants: Géry Casiez [correspondant], Nicolas Roussel.

Noisy signals occur when an original time varying value undergoes undesirable and unpredictable perturbations. These may be caused by things like heat and magnetic fields affecting hardware circuitry, the limits of sensor resolution, or even unstable numerical computation. Noisy signals are a common problem when tracking human motion, particularly with custom sensing hardware and inexpensive input devices like the Kinect or Wiimote.

We developed the 1€ filter ("one Euro filter") is a simple algorithm to filter noisy signals for high precision and responsiveness. It uses a first order low-pass filter with an adaptive cutoff frequency: at low speeds, a low cutoff stabilizes the signal by reducing jitter, but as speed increases, the cutoff is increased to reduce lag. The algorithm is easy to implement, uses very few resources, and with two easily understood parameters, it is easy to tune. When compared with other filters, the 1€ filter shows less lag for a reference amount of jitter reduction [15].

The 1€ filter is already used on a daily basis by many other researchers and companies.

6.2. Transfer functions for subpixel interaction

Participants: Jonathan Aceituno, Géry Casiez [correspondant], Nicolas Roussel.

The current practice of using integer positions for pointing events artificially constrains human precision capabilities (Figure 1). The high sensitivity of current input devices can be harnessed to enable precise direct manipulation "in between" pixels, called subpixel interaction. In [23], we provide a detailed analysis of subpixel theory and implementation, including the critical component of revised control-display gain transfer functions. A prototype implementation is described with several illustrative examples. Guidelines for subpixel domain applicability are provided and an overview of required changes to operating systems and graphical user interface frameworks are discussed.

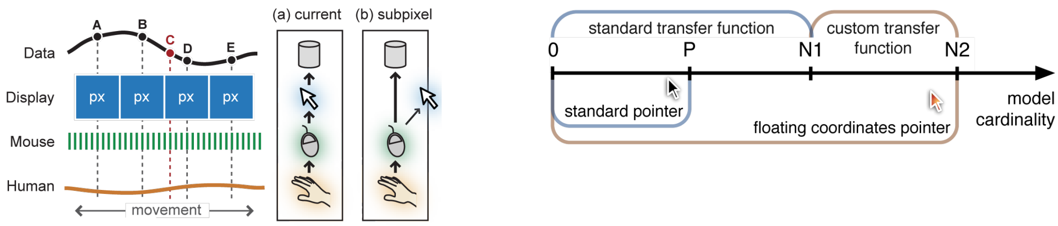
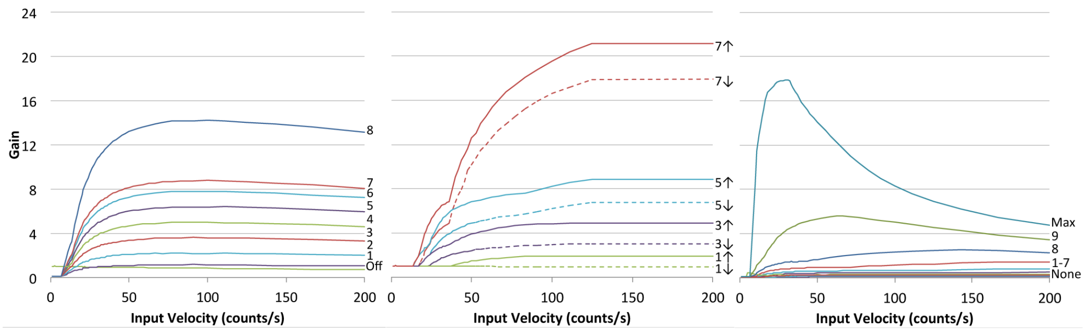


Figure 1. Input mappings: (a) currently, human movements are discretized by mouse sensitivity, then again by display density: data points "in between" pixels like 'C' are unreachable; (b) a subpixel mapping discretizes human movements by mouse sensitivity only, for precise data manipulation (left). Four zones of applicability for subpixel and custom transfer functions (see text for description) (right).

6.3. Transfer functions for scrolling tasks

Participants: Géry Casiez [correspondant], Nicolas Roussel.

Scrolling is controlled through many forms of input devices, such as mouse wheels, trackpad gestures, arrow keys, and joysticks. Performance with these devices can be adjusted by introducing variable transfer functions to alter the range of expressible speed, precision, and sensitivity. However, existing transfer functions are typically "black boxes" bundled into proprietary operating systems and drivers. This presents three problems for researchers: (1) a lack of knowledge about the current state of the field; (2) a difficulty in replicating research that uses scrolling devices; and (3) a potential experimental confound when evaluating scrolling devices and techniques. These three problems are caused by gaps in researchers' knowledge about what device and movement factors are important for scrolling transfer functions, and about how existing devices and drivers use these factors (Figure 2). We fill these knowledge gaps with a framework of transfer function factors for scrolling, and a method for analysing proprietary transfer functions demonstrating how state of the art commercial devices accommodate some of the human control phenomena observed in prior studies [22].



(a) Mac OS X (Generic Device). (b) Microsoft IntelliPoint: up (solid) and down (dashed). (c) Logitech Control Center.

Figure 2. Gain scale factors across input velocity (counts per second) with Mac OS X, Microsoft IntelliPoint (under Windows 7), and Logitech drivers under Mac OS X. Gain is measured as the level of amplification in the system's base unit (pixels per count for Mac OS X and Logitech; lines per count for Microsoft IntelliPoint), and is plotted at varying levels of each driver's respective UI sliders for acceleration.

6.4. Design of transparent tactile stimulators

Participants: Michel Amberg, Frédéric Giraud, Betty Lemaire-Semail [correspondant].

Friction reduction based tactile devices are able to modulate the friction between the fingertip and the active touched surface as a function of fingertip's position. This type of tactile stimulator is thus based on two main components: an active area which vibrates and produces a squeezed air film bearing and a position sensor. Our previous design was made up with a copper plate fully covered by piezo cells, a material which bent when energized by a voltage.

However, this design no longer makes sense when we look forward using tactile feedback on a transparent display. Indeed, for co-localized operation, we can't place piezo cells on the bottom surface of a touch screen since the touched surface would not be transparent; moreover, glass is a non conductive material which complicates the electrical connection.

To cope with these problems, a new design has been introduced. Two copper exciters are firmly bonded on the touch screen to obtain the vibration. These exciters vibrate and propagate their vibration to the glass touch screen. To be efficient, the size of the exciters has to be perfectly adapted to the glass plate. This is why, we not only propose a new way to obtain the vibration of the active area, but we also provide the key design rules of the exciters[19].

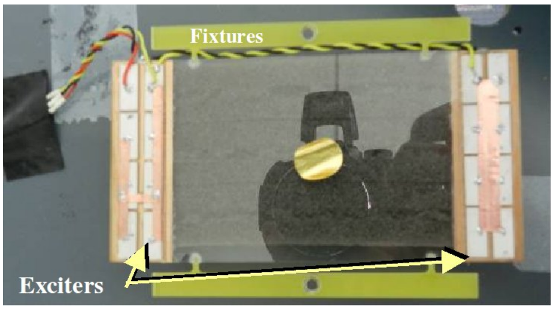


Figure 3. The transparent tactile display, during test procedure (left) and in a co-localized operation (right).

6.5. Methodology for developing textures on friction based interfaces

Participants: Géry Casiez, Thomas Pietrzak, Ludovic Potier, Nicolas Roussel [correspondant], Ibrahim Yapici.

The design of textures for so-called variable friction technologies requires multiple perspectives, which this paper aims to outline and discuss. We first propose a definition of texture and describe the current state of knowledge on their perception. After presenting two technologies for variable friction and comparing them to other tactile interfaces, we describe several particular uses for these devices (Figure 4). We then discuss psychophysical methods for signal perception evaluation and finally discuss methodologies for creating multidimensional tactile content [26].

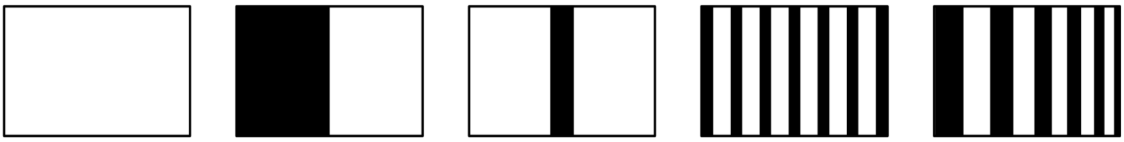


Figure 4. Examples of textures with increasing complexity in one dimension.

6.6. Hand occlusion on mutitouch surfaces

Participant: Géry Casiez [correspondant].

Operating a computer by directly touching the display surface has many benefits, and in tabletop computing, multi-touch is arguably the most natural form of input. However, with any form of direct input, where the input device and the output display are coincident, the hand and arm cover - or occlude part - of the display. This can be a problem, because compared to manipulating objects on a real tabletop, a tabletop computer is dynamic and can display relevant information, sequential widgets, and system messages in occluded areas.

We examined the shape of hand and forearm occlusion on a multi-touch table for different touch contact types and tasks. Individuals have characteristic occlusion shapes, but with commonalities across tasks, postures, and handedness. Based on this, we create templates for designers to justify occlusion-related decisions and we propose geometric models capturing the shape of occlusion. A model using diffused illumination captures performed well when augmented with a forearm rectangle, as did a modified circle and rectangle model with ellipse "fingers" suitable when only X-Y contact positions are available (Figure 5). Finally, we describe the corpus of detailed multi-touch input data we generated which is available to the community [24].

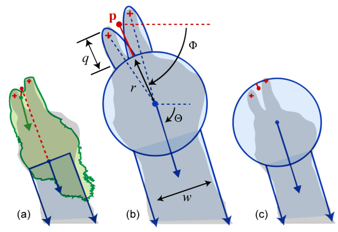


Figure 5. Three occlusion shape models: (a) DI and rectangle; (b) multi-touch circle and rectangle; (c) Vogel et al.

6.7. Indirect multitouch interaction on large screens

Participants: Géry Casiez [correspondant], Jérémie Gilliot, Nicolas Roussel.

Multitouch interaction shows its limits with large display surfaces. Indirect interaction allows to use control surfaces that are much smaller than display surfaces. Absolute indirect interaction raises accuracy problems and relative indirect interaction only allows to interact with a single cursor. We present a relative indirect multitouch interaction technique allowing to create, control, delete several cursors without sacrifying precision for interacting with small objects (Figure 6) [25].

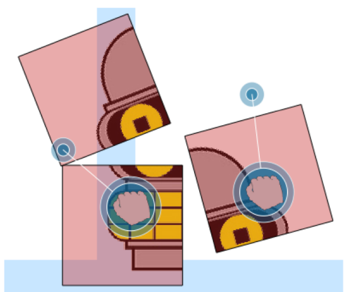


Figure 6. Overview of cursors and cursels used to manipulate two objects.

6.8. Pseudo-rigid movements for flexible multi-finger interactions

Participants: Laurent Grisoni [correspondant], Yosra Rekik, Nicolas Roussel.

Multi-touch interaction requires a trade-off between users' desires and capabilities and gesture recognition constraints. Current approaches to that problem lack flexibility. The number of fingers used for a gesture usually plays a key part in the recognition process, for example. To increase the flexibility of this process, we proposed the use of *pseudo-rigid movements* [27]. We showed how these movements can be determined in real time from the contact information usually available. We explained how they allow to free the recognition process from the number of fingers used and to move towards multi-movement gestures, independent or coordinated. We also presented an interaction technique that takes advantage of this increased flexibility.

6.9. 3D manipulation on multitouch displays

Participants: Anthony Martinet, Géry Casiez [correspondant], Laurent Grisoni.

Multitouch displays represent a promising technology for the display and manipulation of data. While the manipulation of 2D data has been widely explored, 3D manipulation with multitouch displays remains largely unexplored. Based on an analysis of the integration and separation of degrees of freedom, we propose a taxonomy for 3D manipulation techniques with multitouch displays. Using that taxonomy, we introduce Depth-Separated Screen-Space (DS3), a new 3D manipulation technique based on the separation of translation and rotation. In a controlled experiment, we compared DS3 with Sticky Tools and Screen-Space. Results show that separating the control of translation and rotation significantly affects performance for 3D manipulation, with DS3 performing faster than the two other techniques [13].

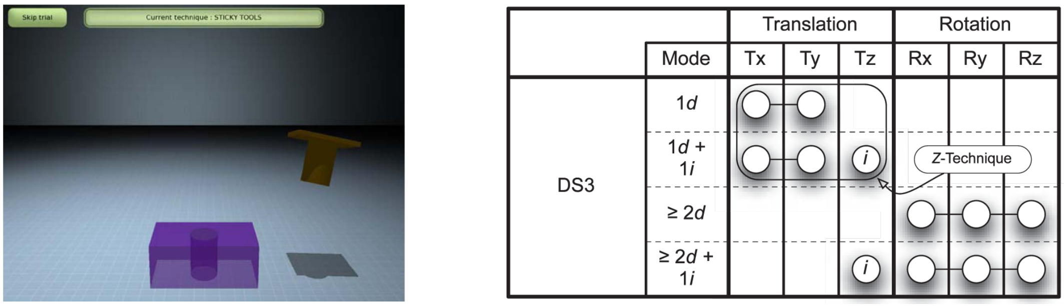


Figure 7. Screen capture of the peg-in-hole task used in the experiment (left). Description of the DS3 technique using the proposed taxonomy (right).

6.10. 3D navigation on multitouch displays

Participants: Clément Moerman, Damien Marchal [correspondant], Nicolas Roussel.

Navigation is one of the elementary tasks of 3d virtual environment. It is composed of two parts: locomotion where there is a physical control of the camera and the wayfinding where a path is found through the environment. Despite being widely studied, there is still need for more efficient and intuitive techniques especially for novice users. Within the context the I-Lab, we worked on a new locomotion technique that combines the advantages of multi-scale navigation and of direct manipulation (Figure 8). The technique, called *Drag'n Go*, was evaluated with a comparative experiment against three other techniques. The results show that *Drag'n Go*: improves performances, reduces learning time and get good user satisfaction either from novice and expert users. The approach and the associated experiment are published in [20].

6.11. Modeling on and above a multitouch surface

Participants: Géry Casiez [correspondant], Bruno De Araujo.

We introduced a semi-immersive environment for conceptual design where virtual mockups are obtained from gestures we aim to get closer to the way people conceive, create and manipulate three- dimensional shapes. We presented on-and-above-the-surface interaction techniques following Guiard's asymmetric bimanual model to take advantage of the continuous interaction space for creating and editing 3D models in a stereoscopic environment. To allow for more expressive interactions, our approach continuously combines hand and finger tracking in the space above the table with multi-touch on its surface. This combination brings forth an alternative design environment where users can seamlessly switch between interacting on the surface or in the space above it depending on the task (Figure 9). Our approach integrates continuous space usage with bimanual interaction to provide an expressive set of 3D modeling operations. Preliminary trials with our experimental setup show this as a very promising avenue for further work [17], [16].

Figure 8. With the Drag'n Go method user can navigate in a 3D virtual environment with a multi-touch device. The movement speed is calculated using perspective based progression scale and it is let under the user's control.

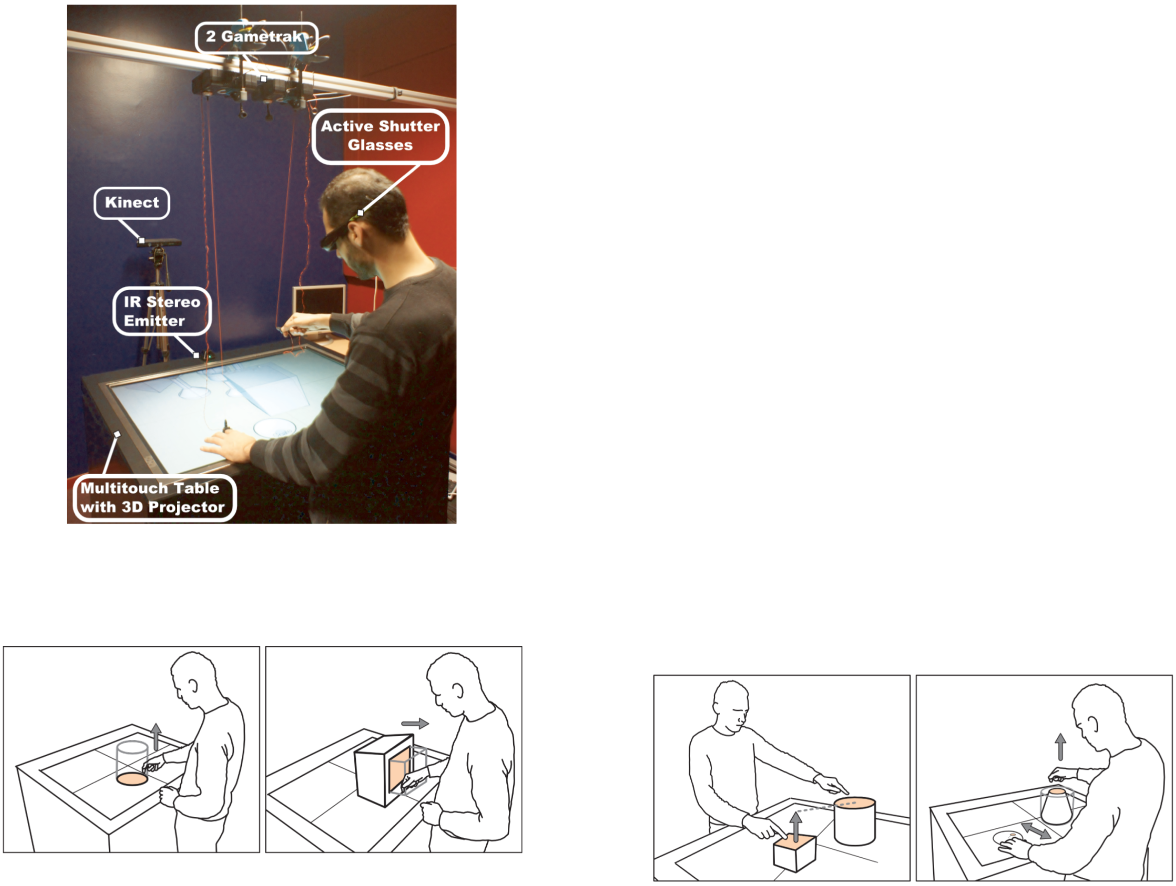


Figure 9. Overview of MockupBuilder setup (left). Examples of face straight extrusion, height constraint and scaling (right).

6.12. Paper-based annotation of digital content from a mobile device

Participant: Thomas Pietrzak [correspondant].

S-Notebook is a hybrid system that makes it possible to take notes on paper about digital content one is exploring on a mobile device (Figure 10). The user can link notes on paper with the content he is currently interacting with, making it possible to reopen it at a later time by tapping the note on his notebook with the digital pen. Therefore he can create bookmarks and hyperlinks on paper notes [21].

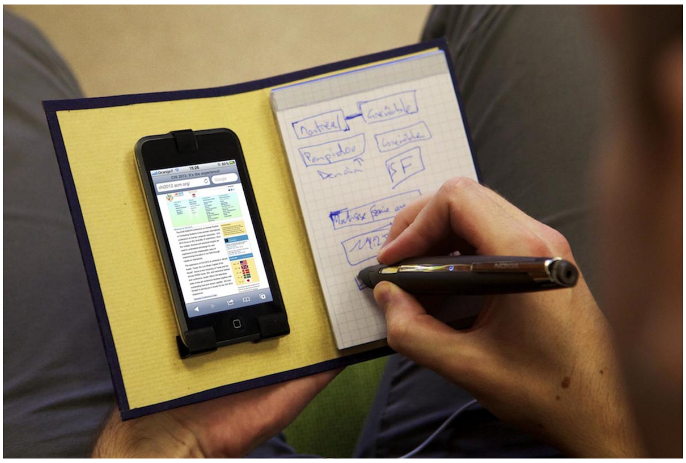


Figure 10. Annotation of digital content on paper.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. I-Lab Idées-3com (2009-2012)

Participants: Clément Moerman, Samuel Degrande, Damien Marchal, Laurent Grisoni [correspondant].

This year, our join research program with the small company Idées-3com is terminating. This program is supported by Inria, with a 3 year young engineer contract. During this join project, we have proposed interaction systems that is based on mobile phone, library for gestural interaction and a new navigation technique for fast and intuitive visiting of 3D virtual world [20].

8. Partnerships and Cooperations

8.1. Regional Initiatives

MINT is associated to the CPER (2007-2013), and participates to the PIRVI platform (handled by F. Aubert, co-animated by F. Aubert and D. Marchal), which aims at promoting research achieved by participant research teams (6 research teams, among which MINT), as well as encouraging collaborations with regional economical tissue on the knowledge fields covered within the associated research teams. This dissemination activity has been supported with a regional contract 500 Keuros.

8.2. National Initiatives

8.2.1. InSTInCT (ANR ContInt, 2009-2012)

Participants: Géry Casiez [correspondant], Frédéric Giraud, Laurent Grisoni, Nicolas Roussel.

This project focuses on the design, development and evaluation of new simple and efficient touch-based interfaces, with the goal of bringing widespread visibility to new generations of interactive 3D applications.

Partners: Inria [Mint, Iparla], Immersion, Cap Sciences

Web site: http://anr-instinct.cap-sciences.net/

8.2.2. TOUCHIT (13th FUI, 2012-2015)

Participants: Michel Amberg, Géry Casiez, Frédéric Giraud, Thomas Pietrzak, Nicolas Roussel [correspondant], Betty Lemaire-Semail [correspondant].

The purpose of this project is twofold. It aims at designing and implementing hardware solutions for tactile feedback based on programmable friction. It also aims at developing the knowledge and software tools required to use these new technologies for human-computer interaction. Grant for MINT is balanced on 272 keuro handled at University for L2EP, and 220 Keuros for Inria.

Partners: STMicroelectronics, CEA/LETI, Lille 1 Univ., Inria, Orange Labs, CNRS, EASii IC, MENAPIC and ALPHAUI.

Competitive clusters involved: Minalogic, Cap Digital and MAUD.

8.2.3. Smart-Store (12th FUI, 2011-2014, extended to 2015)

Participants: Samuel Degrande [correspondant], Laurent Grisoni, Fabrice Aubert.

The aim of this project is to set up, in the context of retail, some middleware and hardware setup for retail interactive terminal, that allows customer to connect with their own smart-phone on a system that includes a large screen, and allows to browse some store offer, as well as pre-order and/or link to further reconsulting. SME Idées-3com leads this FUI, which also includes Immochan, Oxylane, and VisioNord. Grant for MINT is 301 Keuros. This project start on september 2012 (start of this project has been delayed due to administrative problems), for a duration of 36 months.

associated competitivity cluster: PICOM (retail)

8.3. European Initiatives

8.3.1. Sm(art)^2

Participants: Laurent Grisoni [correspondant], Betty Lemaire-Semail, Frédéric Giraud, Géry Casiez.

We submitted in april 2012 the IP proposal Sm(art)^2 on the call 9, priority 8.2 "ICT for access to cultural ressources". Laurent Grisoni is the scientific coordinator of this proposal. It includes 25 partners, with a global budget of 10 489 Keuros. This proposal ranks 4th on the call among 40 submissions, three proposals are currently in the negociation phasis. Our proposal is currently ranking first on the additionnal list.

Program: FP7-ICT-2011-9

Project acronym: Sm(art)^2

Project title: Smart art: smart tools for personnalised and engaging experiences in cultural heritage

Duration: 48 months

Coordinator: L. Grisoni

Other partners: organisme, labo (pays): Musee du louvres-lens (france), Fraunhoffer (germany), CNRS (france), University Hasselt (belgium), Softkinetic (Belgium), immersion (france), InescID (portugal), France Telecom (france), ...

Abstract: Sm(art)^2 project is based on the extended model of museum visit concept (pre-, during and post experience) combining physical and online museum and addresses visitors as participants rather than passive consumers.The next generation of museum practitioners will have to think through these challenges carefully, drawing the links more closely between the physical and the virtual so that the museum create more engaging and personalizing experiences and reaches more people meaningfully. The Sm(art)^2 project aims to implement an interoperable platform with a reusable set of tools and compatible equipment for advanced innovative digital technologies that are able to demonstrate enhanced engaging and personalized experiences of cultural heritage in museums. Moreover the development of economic models for the efficient and legal exploitation of high quality content and technologies will permit the implementation of new services related to the cultural heritage and the use of new technologies.

8.3.2. SHIVA (InterReg II-Seas, 2010-2014)

Participants: Fabrice Aubert, Géry Casiez, Samuel Degrande, Laurent Grisoni [correspondant], Damien Marchal, Yosra Rekik, Nicolas Roussel.

Program: Interreg-II seas IV-A

Project acronym: SHIVA

Project title: Sculpture for Haelth-care: Interaction and Virtual Art in 3D

Duration: february 2010-march 2014

Coordinator: L. Grisoni

Other partners: organisme, labo (pays) : University Bournemouht (UK), Victoria education center (Poole, UK), Fondation Hopale (Berck/mer, France)

Abstract: The SHIVA project aims to create a tool that combines virtual reality, advanced geometric modelling, gesture analysis and digital fabrication in a framework for the modelling and physical fabrication of 3-dimensional shapes and objects. The system will be simple to use and disseminate, specifically enabling and improving the quality of life for individuals with impairments, by facilitating and promoting social inclusion and interaction. It will use, provided that patient pathologies allows for it, hands-free interaction, based on currently available hardware systems. Some of the most complex aspects of the system will be transparent to the user or patient. This will enable individuals with or without impairments who use the system to be able to interact with and model 3-dimensional objects that can then be physically manufactured. A set of specific interfaces will also be implemented for children with very low physical abilities (two-states interfaces for example).

Web site: http://www.lifl.fr/mint/pmwiki.php?n=SHIVA.Php

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Masaya Takasaki (from March 2012 until july 2012)

Subject: Design of transparent tactile displays

Institution: Saitama University (Japan)

8.4.2. Internships

Yy Yang (from May 2012 until Aug 2012)

Subject: Design and control of large tactile feedback device

Institution: Beihang University of Aeronautics and Astronautics (China)

8.4.3. Visits to International Teams

Frédéric Giraud, Sept 2012–Aug 2013, University of Toronto: Invited professor in the Energy System Group hosted by the department of Electrical and Computer Engineering.

9. Dissemination

9.1. Scientific Animation

Invited talks:

- “From input devices to interaction techniques”: G. Casiez, University of Waterloo, Canada (June)
- “Les interfaces du passé ont encore de l’avenir”: N. Roussel, L3I, La Rochelle (July 5th)
- “Les interfaces du passé ont encore de l’avenir”: N. Roussel, SIGCHI Toulouse (June 18th)
- "Une démarche art-science" L. Grisoni, journée Contact innovation, Ministère de la recherche, Paris (january 17th)
- "gesture toolkit through artistic experiments": L. Grisoni, Workshop on movement qualities and physical models visualizations, IRCAM (Paris), (march 2nd).
- "Art and research, open source and open minds": L. Grisoni, main track/Open-Arts session, FoSSa 2012 conference, Lille (december 5th)
- inter-regional meeting organized by pole images of Liege, november 9th: L. Grisoni, 15 minutes talk on collaboration with V. Ciciliato (artistic installation tempo scaduto, Fresnoy)

Journal editorial board:

- Journal d’Interaction Personne-Système (JIPS): N. Roussel (co-editor in chief), G. Casiez

Journal reviewing:

- Interacting with Computers (Elsevier): N. Roussel
- Lavoisier, art-science: L. Grisoni

Conference organization:

- FITG 2012, the third *Forum on Tactile and Gestural Interaction*: N. Roussel, co-organizer
- Ergo’IHM 2012: N. Roussel, short papers chair
- Ergo’IHM 2012: T. Pietrzak, program committee
- ACM UIST 2012: G. Casiez, program committee
- ACM VRST 2012: G. Casiez, program committee
- VRIPHYS 2012 (workshop on Virtual Reality and Physical Simulation): L. Grisoni, program committee

Conference reviewing:

- ACM CHI 2012: N. Roussel, T. Pietrzak, L. Grisoni (3D workshop)
- ACM UIST 2012: N. Roussel, T. Pietrzak
- ACM Mobile HCI 2012: T. Pietrzak
- ACM NordiCHI 2012: T. Pietrzak
- WWW 2012: N. Roussel (poster track)
- VRST 2012: N. Roussel
- TEI 2012: G. Casiez
- Ergo’IHM 2012: N. Roussel, G. Casiez, T. Pietrzak, L. Grisoni

Scientific associations:

- AFIHM, the French speaking HCI asssociation: N. Roussel and T. Pietrzak, members of the Executive Committee (vice-president and secretary since November 2011)
- RTP (pluridisciplinar thematic network) Visual studies (2010-2012): L. Grisoni, member of the RTP board
- SCV (Science et culture du visuel) website: L. Grisoni, scientific board, responsible of the art-science activity. This initiative covers the CNRS scientific project ICAVS, and the funded equipex project IrDIVE (2012-2020).
- SCV (Science et culture du visuel) website: S. Degrande, leader of Virtual Reality room design (funded by equipex IrDIVE).
- LIFL (University Lille 1 Computer science laboratory) counsil: L. Grisoni

Evaluation committees and invited expertise:

- uTOP (open university project) working groups: N. Roussel
- UNIT (engineering and technology digital university) scientific committee: N. Roussel
- Inria's *Science mediation* committee: N. Roussel
- Inria's admission jury for junior researcher positions: N. Roussel
- Université Lille 1, Computer Science hiring committees: L. Grisoni, G. Casiez, N. Roussel (PR 0498 & PR 1631)
- Université Paul Sabatier, Toulouse, Computer Science hiring committee: N. Roussel (MCF 0822)
- Université de Bretagne Orientale, Brest, Computer Science hiring committee: L. Grisoni (PR 0030)
- Université de Lille 3, Psychology hiring committe: L. Grisoni (PR 0457)
- ANR emergence axes 2 et 3: L. Grisoni (review)
- ANR INS ingénieur num et sécurité: L. Grisoni (review)
- ANR JCJC SIMI2 : L. Grisoni (review)
- ANRT CIFRE: L. Grisoni (review)

9.2. Teaching - Supervision - Juries

9.2.1. Teaching

Licence

- Introduction to Programming, 48h, L1, University of Lille, France, F. Aubert
- Advanced Programming, 36h, L3, University of Lille, France, F. Aubert, G. Casiez
- Compilation, 36h, L3, University of Lille, France, T. Pietrzak
- Algorithms and data structures, 36h, L3, University of Lille, France, T. Pietrzak
- Algorithms and imperative programming, 40h, L2, University of Lille, France, T. Pietrzak

Master

- Introduction to Computer Graphics, 42h, M1, University of Lille, F. Aubert
- Human-Computer Interaction, 48h, M1, University of Lille, G. Casiez, L. Grisoni, P. Plénacoste, T. Pietrzak
- Multi-Touch Interaction, 24h, M1, University of Lille, G. Casiez, F. Aubert
- Advanced 3D modeling, 20h, M2, University of Lille, L. Grisoni, F. Aubert
- Virtual Reality, 36h, M2, University of Lille, G. Casiez, F. Giraud, F. Aubert, T. Pietrzak
- Artificial Vision, 12h, M2, University of Lille, G. Casiez, L. Grisoni
- Multitouch interaction, 7h, M2, Telecom Lille 1, G. Casiez
- Gesture recognition, 5h, M2, Telecom Lille 1, G. Casiez
- Introduction to virtual reality, 3h, M2, Telecom Lille 1, G. Casiez
- Human-Computer Interaction, 24h, M2, Polytech'Lille, G. Casiez, L. Grisoni
- Human-Computer Interaction, 6h, G2, Ecole Centrale de Lille: N. Roussel
- Introduction to Unity for Virtual Reality, 10h, M2, University of Lille: D. Marchal
- Game Developement with Unity, 8h, Formation professionnelle, University of Lille: D. Marchal

9.2.2. Supervision

Completed Habilitation thesis

Géry Casiez, "Du mouvement à l'interaction et au geste : études, techniques, outils et périphériques", Lille 1 Univ., November 12th 2012, [11]

Frédéric Giraud, "Modélisation et commande des actionneurs piézoélectriques : des applications mécatroniques au domaine de la réalité virtuelle", Lille 1 Univ., March 19th 2012

Completed PhD thesis

T. Zheng, "Actionneurs piézo-électriques dans des interfaces homme-machine à retour d'effort", Lille 1 Univ., March 23rd 2012, co-advised by B. Lemaire-Semail and F. Giraud

J-P. Deblonde, "Exploitation de la dynamique du geste en IHM - Application aux fonctions de transfert pour le pointage et l'extraction d'événements discrets", Lille 1 Univ., September 28th 2012, co-advised by L. Grisoni and G. Casiez, [12]

Ongoing PhD thesis

N. Bremard, "interaction hybride via smartphone", Lille 1 Univ., started December 2012, advised by L. Grisoni

J. Aceituno, "Designing the ubiquitous desktop", Lille 1 Univ., started October 2011, advised by N. Roussel

J. Gilliot, "Indirect multi-touch interaction", Lille 1 Univ., started December 2010, co-advised by N. Roussel and G. Casiez

Y. Rekik, "Multi-finger gestural interaction", Lille 1 Univ., started September 2010, co-advised by L. Grisoni and N. Roussel

E-G. Craciun, "Nouvelles interfaces pour la simulation des opérations d'assemblage dans des environnements virtuels ", Suceava Univ. (Romania), started October 2009, co-advised by L. Grisoni and S-G. Pentiuc

C. Moerman, "Interactions multi-touch intuitive sur un contenu 3D, application à l'agencement virtuel d'habitation ", Lille 1 Univ., started October 2009, co-advised by C. Chaillou and L. Grisoni

D. Selosse, "Annotation interactive de modèles 3D, application à la reconstruction ", Lille 1 Univ., started October 2009, co-advised by L. Grisoni and J. Dequidt

9.2.3. Juries

Habilitation committees

- Géry Casiez (Lille 1 Univ., November 2012): N. Roussel, warrant and examiner

PhD committees

- Mathieu Nancel (Paris-Sud Univ., December 2012): G. Casiez, examiner
- Khaled Aslan Almoubayed (Nantes Univ., November 2012): N. Roussel, reviewer
- Christophe Bortolaso (Toulouse Univ., June 2012): N. Roussel, president

9.3. Popularization

- Presentation of recent HCI works to about twenty students from ENS Cachan visiting LIFL (December 14th): N. Roussel
- Animation of FITG 2012, the third Forum on tactile and gestural interaction, and its round table on the place of HCI in Inria's strategic plan for 2013-2017 (November 13-14): N. Roussel
- Ten minutes interview for Radio Campus on FITG 2012 and Human-Computer Interaction (October 31st): N. Roussel
- Presentation of recent HCI works to journalists visiting Inria's *Plateau* at EuraTechnologies (September 25th): N. Roussel
- Invited talk as part of the "*Pépites de la Métropole*" series organized by Lille Métropole (June 28th): N. Roussel
- Presentation of recent HCI works to ENSCI visitors on Inria's *Plateau* at EuraTechnologies (June 12th): N. Roussel
- Interview for a regional popular science magazine project (*NordEka !*, May 24th): N. Roussel
- Interview for La Recherche ("*Des tablettes tactiles à sensation*", dossiers n°49, April 18th): N. Roussel
- Invited talk for a round table on design, innovation and intellectual property organized by students from Lille 2 University's Master of Industrial Property (March 16th): N. Roussel
- Interviews for the third edition of the Transdigital Cookbook on science, technology, art and business (June 2012): L. Grisoni, N. Roussel
- Animation of a half-day public conference on the World Wide Web Consortium, new standards and the mobile web at EuraTechnologies (February 14th): N. Roussel
- Co-animation of the second edition of Inria's internal *Science mediation seminar* (January 23rd): N. Roussel
- Organization of a three-days visit of LIFL and Inria Lille for about 30 students from ENS Cachan Bretagne and Rennes University's Master of Computer Science & talk on Human-Computer Interaction (January 4-6): N. Roussel
- Interview on Radio campus, 25 january 2012, about equipex IrDIVE: L. Grisoni (30 minutes)
- Interview for Le Monde Science & techno, cahier n°21049, september 22th, article "Interagir à distance avec un écran": L. Grisoni
- Interview for L'Usine Nouvelle, article on technologies for gestural interaction, november 2012: L. Grisoni
- Invited talk for a round table on Innovation and digital contents, organized by town counsil of Lens urban area, november 30th (regional innovation week): L. Grisoni, representing Inria institute

10. Bibliography

Major publications by the team in recent years

[1] M. BIET, F. GIRAUD, B. LEMAIRE-SEMAIL. *Squeeze film effect for the design of an ultrasonic tactile plate*, in "IEEE Transactions on Ultrasonic, Ferroelectric and Frequency Control", December 2007, vol. 54, n^{o} 12, p. 2678-2688, http://dx.doi.org/10.1109/TUFFC.2007.596.

[2] G. CASIEZ, N. ROUSSEL. *No more bricolage! Methods and tools to characterize, replicate and compare pointing transfer functions*, in "Proceedings of UIST'11", ACM, October 2011, p. 603-614, http://dx.doi.org/10.1145/2047196.2047276.

[3] G. CASIEZ, N. ROUSSEL, R. VANBELLEGHEM, F. GIRAUD. *Surfpad: riding towards targets on a squeeze film effect*, in "Proceedings of CHI 2011", ACM, May 2011, p. 2491-2500, "Honorable mention" award (top 5%), http://dx.doi.org/10.1145/1978942.1979307.

[4] G. CASIEZ, D. VOGEL, R. BALAKRISHNAN, A. COCKBURN. *The impact of control-display gain on user performance in pointing tasks*, in "Human-Computer Interaction", 2008, vol. 23, n^{o} 3, p. 215–250, Taylor and Francis, http://dx.doi.org/10.1080/07370020802278163.

[5] G. CASIEZ, D. VOGEL, Q. PAN, C. CHAILLOU. *RubberEdge: reducing clutching by combining position and rate control with elastic feedback*, in "Proceedings of UIST'07", ACM, 2007, p. 129–138, http://dx.doi.org/10.1145/1294211.1294234.

[6] A. MARTINET, G. CASIEZ, L. GRISONI. *The design and evaluation of 3D positioning techniques for multi-touch displays*, in "Proceedings of 3DUI'10", United States Waltham, IEEE Computer Society, 2010, p. 115–118, http://dx.doi.org/10.1109/3DUI.2010.5444709.

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[10] D. VOGEL, G. CASIEZ. *Conté: multimodal input inspired by an artist's crayon*, in "Proceedings of UIST'11", ACM, October 2011, http://dx.doi.org/10.1145/2047196.2047242.

Publications of the year

Doctoral Dissertations and Habilitation Theses

[11] G. CASIEZ. *Du mouvement à l'interaction et au geste : études, techniques, outils et périphériques*, Université des Sciences et Technologie de Lille - Lille I, November 2012, Habilitation à Diriger des Recherches, http://hal.inria.fr/tel-00759023.

[12] J.-P. DEBLONDE. *Exploitation de la dynamique du geste en IHM. Application aux fonctions de transfert pour le pointage et l'extraction d'évènements discrets.*, Université des Sciences et Technologie de Lille - Lille I, September 2012, http://hal.inria.fr/tel-00759026.

Articles in International Peer-Reviewed Journals

[13] A. MARTINET, G. CASIEZ, L. GRISONI. *Integrality and Separability of Multi-touch Interaction Techniques in 3D Manipulation Tasks*, in "IEEE Transactions on Visualization and Computer Graphics", January 2012, vol. 18, n^{o} 3, p. 369-380 [*DOI :* 10.1109/TVCG.2011.129], http://hal.inria.fr/hal-00670530.

International Conferences with Proceedings

[14] J. ACEITUNO, J. CASTET, M. DESAINTE-CATHERINE, M. HACHET. *Improvised interfaces for real-time musical applications*, in "Tangible, embedded and embodied interaction (TEI)", Kingston, Canada, February 2012, http://hal.inria.fr/hal-00670576.

[15] G. CASIEZ, N. ROUSSEL, D. VOGEL. *1€ Filter: A Simple Speed-based Low-pass Filter for Noisy Input in Interactive Systems*, in "CHI'12, the 30th Conference on Human Factors in Computing Systems", Austin, United States, ACM, May 2012, p. 2527-2530 [*DOI :* 10.1145/2207676.2208639], http://hal.inria.fr/hal-00670496.

[16] B. DE ARAUJO, G. CASIEZ, J. JORGE. *Mockup Builder: Direct 3D Modeling On and Above the Surface in a Continuous Interaction Space*, in "GI'12 - 38th Graphics Interface conference", Toronto, Canada, Canadian Information Processing Society, May 2012, p. 173-180, http://hal.inria.fr/hal-00687891.

[17] B. DE ARAUJO, G. CASIEZ, J. JORGE, M. HACHET. *Modeling On and Above a Stereoscopic Multitouch Display*, in "3DCHI - The 3rd Dimension of CHI", Austin, United States, May 2012, http://hal.inria.fr/hal-00670565.

[18] F. GIRAUD, M. AMBERG, B. LEMAIRE-SEMAIL. *Transparent Tactile Stimulator Based on Friction Reduction for Hand-held Device*, in "Actuator", Bremen, Allemagne, June 2012, http://hal.inria.fr/hal-00750050.

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[20] C. MOERMAN, D. MARCHAL, L. GRISONI. *Drag'n Go: Simple and Fast Navigation in Virtual Environment*, in "IEEE Symposium on 3D User Interface", Costa Mesa, United States, March 2012, p. 15-18, 4 pages., http://hal.inria.fr/hal-00676444.

[21] T. PIETRZAK, S. MALACRIA, É. LECOLINET. *S-Notebook: Augmenting Mobile Devices with Interactive Paper for Data Management*, in "Advanced Visual Interfaces 2012", Capri, Italie, ACM, May 2012, p. 733-736 [*DOI :* 10.1145/2254556.2254696], http://hal.inria.fr/hal-00757125.

[22] P. QUINN, A. COCKBURN, G. CASIEZ, N. ROUSSEL, C. GUTWIN. *Exposing and understanding scrolling transfer functions*, in "UIST'12, 25th ACM Symposium on User Interface Software and Technology", Cambridge, United States, ACM, October 2012, http://hal.inria.fr/hal-00719465.

[23] N. ROUSSEL, G. CASIEZ, J. ACEITUNO, D. VOGEL. *Giving a hand to the eyes: leveraging input accuracy for subpixel interaction*, in "UIST'12, 25th ACM Symposium on User Interface Software and Technology", Cambridge, United States, ACM, October 2012, http://hal.inria.fr/hal-00719464.

[24] D. VOGEL, G. CASIEZ. *Hand Occlusion on a Multi-Touch Tabletop*, in "CHI'12, the 30th Conference on Human Factors in Computing Systems", Austin, United States, ACM, May 2012, p. 2307-2316 [*DOI :* 10.1145/2207676.2208390], http://hal.inria.fr/hal-00670516.

National Conferences with Proceeding

[25] J. GILLIOT, G. CASIEZ, N. ROUSSEL. *Technique multi-points indirecte relative pour l'interaction avec des écrans de grandes dimensions*, in "Ergo'IHM 2012", Biarritz, France, ACM, October 2012, http://hal.inria.fr/hal-00719788.

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Research Reports

[28] D. SELOSSE, J. DEQUIDT, L. GRISONI. *A Sketch-Based Interface for Annotation of 3D Brain Vascular Reconstructions*, Inria, April 2012, n^{o} RR-7954, 19, http://hal.inria.fr/hal-00698832.

Scientific Popularization

[29] N. ROUSSEL, C. CASTRO. *Le Kinect n'est pas qu'une révolution de salon*, Mai 2012, Rubrique "Le saviez-vous ?" du site Inria, republié sur Inriality, http://www.inriality.fr/informatique/kinect/innovation/le-kinect-nest.

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