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Activity Report 2014

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

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

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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.

3. Research Program

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 [46]. 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 [52]. Rapid and iterative prototyping techniques allow to decide between alternative solutions [47]. Controlled studies based on experimental or quasi-experimental designs can then be used to evaluate the chosen solutions [54]. 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 [51]. 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 foundations 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 [55], Dynamic Time Warping [57] 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 [53]; 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 [56].
- *mapping to application*, that studies how to link gesture inputs to application. This ranges from transfer function that is classically involved in pointing tasks [48], 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 [49]. 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.

5. New Software and Platforms

5.1. LibGINA

Participant: Laurent Grisoni [correspondant].

This year we used it with Ankama SME for a 3D videogame installation (La mine), done in collaboration with Idées-3com and LightUp. The library architecture has been rethought in order to provide ease of use and genericity.

Current version: version 1.1

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: Marc-Antoine Dupre, Matthieu Falce, Nicolas Roussel [correspondant], Takashi Miyaki.

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 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.

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

5.4. libpointing

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

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 publicly available under the GPLv2 license.

Izzatbek Mukhanov was recruited in October 2014 for two years as an engineer (IJD) to support the development and deployment of the library.

Web site: http://libpointing.org/

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

5.5. PIRVI platform

Participants: Fabrice Aubert [correspondant], Damien Marchal.

MINT participates to the PIRVI platform (Framework for Computer Human Animation, Virtual Reality and Images, 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. The PIRVI allows these research teams to share a Virtual-Reality Room and various mid-size research equipments : multitouch tables, cameras (depth, infrared, ...), interactive devices (force-feedback, multitouch, smartphones...), a configurable multitouch wall.

6. New Results

6.1. Highlights of the Year

- "Adoiraccourcix : sélection de commandes sur écrans tactiles multi-points par identification des doigts" [31] received the *best paper award* from the IHM 2014 conference;
- "L'ordinateur portable comme instrument de musique" [41] received the *best demo award* from the IHM 2014 conference.

6.2. Impact of form factors and input conditions on absolute indirect-touch pointing tasks

Absolute indirect interaction maps the absolute position of a device's end-effector to the absolute position of a remote on screen object. Despite its long-time use with graphics tablets and growing use in research prototypes, little is known on the influence of form factors and input conditions on pointing performance with such a mapping. The input and display can have different sizes and aspect ratios, for example. The on-screen targets can vary in size. Users can look solely at the display or at the input device as well. They can also hold the input device in certain cases, or let it rest on a table. We ran two experiments designed to investigate the influence of all these factors on absolute indirect-touch pointing performance [20], [11].

The first experiment focused on input device size and input conditions and revealed that users get higher performance when they can look at the input surface (even if nothing is displayed on it). In addition we found that the smallest target size users can acquire in motor space is not constant across different input dimensions but degrades as the input size increases. The second experiment focused on scale effects and aspect ratio and revealed users' performance is not affected by scale but that aspect ratio matters: similar input and output aspect ratios lead to better performance. This findings led us to list four main recommendations for the design of touch input surfaces with applications supporting absolute direct interaction.

6.3. Direct and indirect multi-touch interaction on a wall display

Multi-touch wall displays allow to take advantage of co-located interaction (direct interaction) on very large surfaces. However interacting with content beyond arms' reach requires body movements, introducing fatigue and impacting performance. Interacting with distant content using a pointer can alleviate these problems but introduces legibility issues and loses the benefits of multi-touch interaction. We introduced WallPad [30], [11], a widget designed to quickly access remote content on wall displays while addressing legibility issues and supporting direct multi-touch interaction (Figure 1). To support multi-touch on such a wall display, we developed a custom system using front diffuse illumination and 4 cameras. Our system can detect 50+ simultaneous contacts with a precision between 3 and 5 mm.

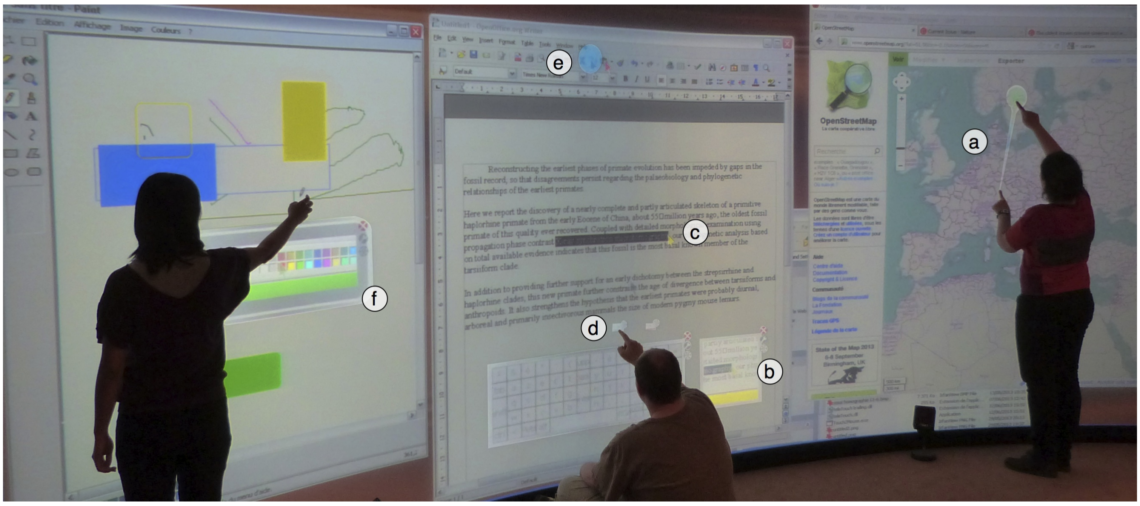

Figure 1. A user creating a WallPad (a). Another using two WallPads to select (b) some text (c) and click (d) on Copy/Paste buttons (e) beyond reach. A third user accessing a color palette located at the bottom of the screen through a WallPad (f).

6.4. Sketching dynamic and interactive illustrations

We collaborated with Autodesk Research in Toronto (as a scientific consultant) on a project whose focus was to design and develop tools that enable artists to bring life to illustrations with subtle, continuous animation effects and infusing interactive behavior to the drawings. We believe designers, artists and creators should be able to communicate with computers the way they think about art and animation. This motivated Autodesk to develop interfaces that facilitate powerful ways of thinking and content creation with freeform sketching and direct manipulation, thus offering an alternative to complex professional animation tools. Our design combines the complementary affordances of humans and computers by utilizing by-example phenomena, thus preserving expressiveness and personal style, yet reducing tedium.

The outcome of the collaboration is Kitty [23], a sketch-based tool for authoring dynamic and interactive illustrations (Figure 2). Artists can sketch animated drawings and textures to convey the living phenomena, and specify the functional relationship between its entities to characterize the dynamic behavior of systems and environments. An underlying graph model, customizable through sketching, captures the functional relationships between the visual, spatial, temporal or quantitative parameters of its entities. As the viewer interacts with the resulting dynamic interactive illustration, the parameters of the drawing change accordingly, depicting the dynamics and chain of causal effects within a scene. The generality of this framework makes our tool applicable for a variety of purposes, including technical illustrations, scientific explanation, infographics, medical illustrations, children's e-books, cartoon strips and beyond. A user study demonstrates the ease of usage, variety of applications, artistic expressiveness and creative possibilities of our tool.

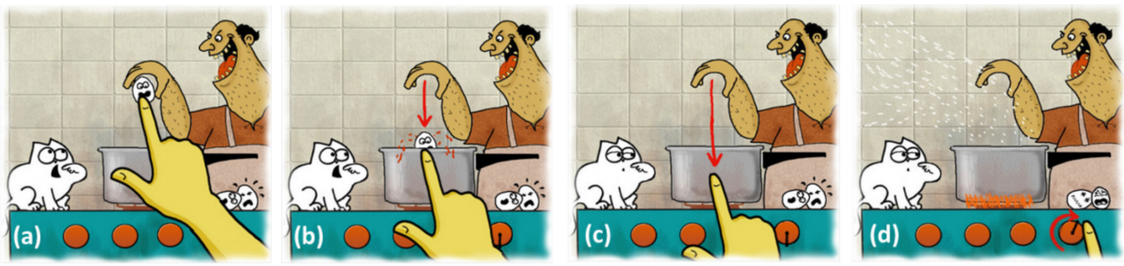

Figure 2. Example of a dynamic interactive illustration authored with Kitty. (a) Objects in the scene are interactive: the egg held by the cook can be dragged down, as if falling into the pot, triggering subsequent animations, such as soup splashes (b) and closing of the cat's eyelids (c). Turning the knob increases the fire and steam (d). The resulting dynamic illustration captures the living nature of the scene, where the gas stove flames burn and steam emits from the pot.

Kitty is a follow up of a previous project, Draco [50], a prototype sketch-based interface that allows artists and casual users alike to add a rich set of animation effects to their drawing, seemingly bringing illustrations to life such as a school of fish swimming, tree leaves blowing in the wind, or water rippling in a pond. Draco was realized before Fanny Chevalier joined Inria. Kitty is the result of a collaboration between Autodesk Research (inventor) and Inria (scientific consultant). A patent has been filed by Autodesk Research for Kitty, and the company is currently developping a commercial application based on the research protoype.

6.5. The not-so-staggering effect of staggered animations

Interactive visual applications often rely on animation to transition from one display state to another. There are multiple animation techniques to choose from, and it is not always clear which should produce the best visual correspondences between display elements. One major factor is whether the animation relies on staggering—an incremental delay in start times across the moving elements. It has been suggested that staggering may reduce occlusion, while also reducing display complexity and producing less overwhelming animations, though no empirical evidence has demonstrated these advantages. We empirically evaluated the effect of two staggering techniques on tracking tasks, focusing on cases that should most favour staggering [14]. We found that introducing staggering has a negligible, or even negative, impact on multiple object tracking performance. The potential benefits of staggering may be outweighed by strong costs: a loss of common-motion grouping information about which objects travel in similar paths, and less predictability about when any specific object would begin to move.

6.6. Flexible contextual retrieval of chosen documents and windows

Users of Personal Computers interact with a large number of resources to do their work. To handle their different tasks, they need their documents to be readily available, and as the number of activities and documents increase, systems must offer adequate support for quick retrieval of these resources. The Hotkey Palette [29] is a quick retrieval facility that we designed that uses hotkeys and makes them visible and configurable through a quasi-modal always-available on-screen keyboard. This facility contributes to the state of the art in three ways. It extends on-screen keyboard interaction by providing feedback on the state of the linked resources, it provides persistent and integrated access to local windows and files and other online resources, and it provides flexible control over contextualization by leveraging existing resource hierarchies.

6.7. Multi-touch command selection using finger identification

Hotkeys are a critical factor of performance for expert users in WIMP interfaces. Multi-touch interfaces, by contrast, do not provide such efficient command shortcuts. Adoiraccourcix leverages finger identification to introduce quick command invocation integrated with direct manipulation in this context (Figure 3). We illustrated its use in a vectorial drawing application and ran preliminary user studies comparing it to classical user interfaces. Results suggest that once mastered, it provides very powerful means of interaction [31], [44], [43].

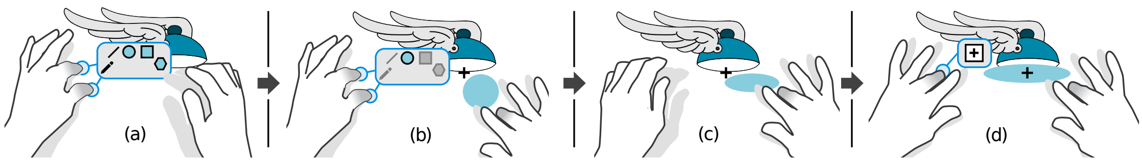

Figure 3. Partial illustration of the Adoiraccourcix' logics.

6.8. Impact of the localization and activation of mode switchers

Input devices have a limited number of buttons and degrees of freedom, but they are used to control many functionnalities. Modes and quasi-modes makes it possible to map several actions to the same input. For example keys of a keyboard either input a letter or trigger a command. Delimiters allow users to switch between the modes. On the keyboard, the default mode is often text entry and pressing the Ctrl key switches the mode to command mode. This choice was made at a time when the mouse was not widespread. In [33] , we explored the possibility to place mode switchers on the mouse and experimented the benefits. We showed that there is a performance benefit if the current tasks are essentially mouse-based. In particular we showed that using mode switchers on the mouse reduces homing the dominant hand between the mouse and the keyboard.

6.9. A serial Architecture for a collaborative robot

The haptic magnifier consists in using a serial architecture, where a motor is inserted between a tool and a user's hand (figure 4). By this way, the tool's speed v_o can be changed relatively to user's speed v_i, by controlling motor's speed. The haptic rendering of a load can then be changed, and fine details can be more easily detected.

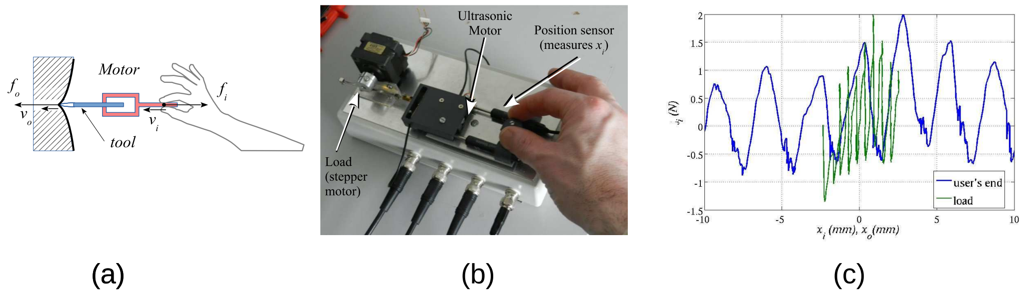

Figure 4. The Haptic Magnifier; (a) the serial architecture with a motor inserted to achieve a haptic magnifier, (b) the implementation with an ultrasonic Motor, and (c) the resulting rendering at load's end and user's end.

The haptic magnifier is built up with an ultrasonic motor, whose characteristic is low speed - high torque. So the tool and the end-effector can be directly connected to the motor, leading to a lightweight architecture. The user's study presented in [21] have shown that the precision in using the tool could be improved during a freehand manipulation.

6.10. Mimetic Interaction Spaces: Controlling Distant Displays in Pervasive Environments

Pervasive computing is a vision that has been an inspiring long-term target for many years now. Interaction techniques that allow one user to efficiently control many screens, or that allow several users to collaborate on one distant screen, are still hot topics, and are often considered as two different questions. Standard approaches require a strong coupling between the physical location of input device, and users. We propose to consider these two questions through the same basic concept, that uncouples physical location and user input, using a mid-air approach. We present the concept of mimetic interaction spaces (MIS), a dynamic user-definition of an imaginary input space thanks to an iconic gesture, that can be used to define mid-air interaction techniques. We describe a participative design user-study, that shows this technique has interesting acceptability and elicit some definition and deletion gestures. We finally describe a design space for MIS-based interaction, and show how such concept may be used for multi-screen control, as well as screen sharing in pervasive environments [26].

6.11. Match-Up & Conquer: A Two-Step Technique for Recognizing Unconstrained Bimanual and Multi-Finger Touch Input

We present a simple, two-step technique for recognizing multi-touch gesture input independently of how users articulate gestures, i.e., using one or two hands, one or multiple fingers, synchronous or asynchronous stroke input. To this end, and for the first time in the gesture literature, we introduce a preprocessing step specifically for multi-touch gestures (Match-Up) that clusters together similar strokes produced by different fingers, before running a gesture recognizer (Conquer). We report gains in recognition accuracy of up to 10% leveraged by our new preprocessing step, which manages to construct a more adequate representation for multi-touch gestures in terms of key strokes. It is our hope that the Match-Up technique will add to the practitioners toolkit of gesture preprocessing techniques, as a first step toward filling todays lack of algorithmic knowledge to process multi-touch input and leading toward the design of more efficient and accurate recognizers for touch surfaces. [27]

6.12. Understanding Users's perceived Difficulty of Multi-Touch Gesture Articulation

We show that users are consistent in their assessments of the articulation difficulty of multi-touch gestures, even under the many degrees of freedom afforded by multi-touch input, such as (1) various number of fingers touching the surface, (2) various number of strokes that structure the gesture shape, and (3) single-handed and bimanual input. To understand more about perceived difficulty, we characterize gesture articulations captured under these conditions with geometric and kinematic descriptors computed on a dataset of 7,200 samples of 30 distinct gesture types collected from 18 participants. We correlate the values of the objective descriptors with users' subjective assessments of articulation difficulty and report path length, production time, and gesture size as the highest cor- relators (max Pearson's r=.95). We also report new findings about multi-touch gesture input, e.g., gestures produced with more fingers are larger in size and take more time to produce than single-touch gestures; bimanual articulations are not only faster than single-handed input, but they are also longer in path length, present more strokes, and result in gesture shapes that are deformed horizontally by 35% in average. We use our findings to outline a number of 14 guidelines to assist multi-touch gesture set design, recognizer development, and inform gesture-to-function mappings through the prism of the user-perceived difficulty of gesture articulation.[28]

6.13. Dynamic Modelling of Electrovibration

Electrostatic attraction may be used to modulate the apparent friction coefficient between a fingertip and a surface to create a tactile stimulator. In this work, we want to propose an accurate modelling of the force generation. For that purpose, a specific experimental test bench has been manufactured, as presented in figure 5.

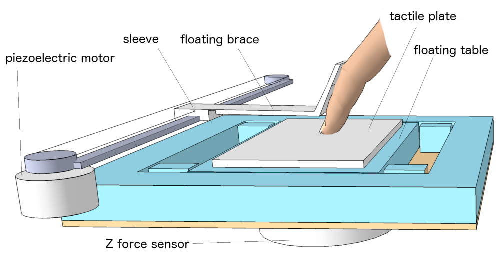

Figure 5. Representation of the measurement system, the finger is moved on the plate by the motor.

Then, an investigation on the current modeling were carried out, with a focus on the temporal evolution and frequency dependence of the stimulus. More particularly, we considered the charge lost through the stratum corneum. Indeed, lost charges is gathered on the surface of the insulator as free surface charge, for this reason it no longer participates to the generation of the force on the finger, and consequently, to the measured force (Fig. 6). This happens because the charges on the surface of the insulator are no longer mechanically bounded to the finger and the insulator sustains the induced electrostatic force.

The improvement of the modeling is proposed to take into account this major effect, and then, it is checked with an experimental set-up and compared with literature results.

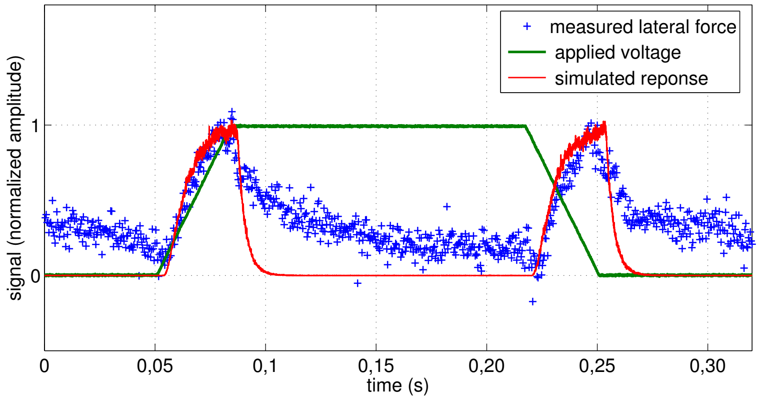

Figure 6. Charge configuration at the border of the stratum corneum (SC) and insulator (I). The conductive part of the system is represented like the electrode of a capacitor. (1) Initial configuration on the charge when the voltage v is applied. (2) Discharge through the stratum corneum with the two equivalent capacitors. (3) Final configuration of the charges after the transient.

6.14. Coupling between Electrovibration and squeeze filmfor tactile stimulation

Electrovibration and squeeze film effect are two different principles which modify user perception of a surface. The first is generated by a polarization of a finger approaching a high voltage supplied plate, and the latter by an ultrasonic vibrating plate. Their compatibility on the same stimulator has been analysed and their concomitant has been proven as well as the increased range of sensations [34]. A joint model has been proposed to describe the behaviour of the friction when both principles are merged. For the analysis, a specific experimental test bench has been built to measure the forces induced, as shown in figure 7.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Autodesk Research (Feb. 2014-Apr. 2014)

Participant: Fanny Chevalier [correspondant].

The correspondant worked with Autodesk Research as a consultant for the Kitty project. The Inria correspondant, Fanny Chevalier, providied scientific advices on the design and evaluation of the prototype of Kitty [23], a sketch-based tool for authoring dynamic and interactive illustrations.

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. TurboTouch (ANR, Oct 2014-2018)

Participants: Géry Casiez [correspondant], Nicolas Roussel, Thomas Pietrzak.

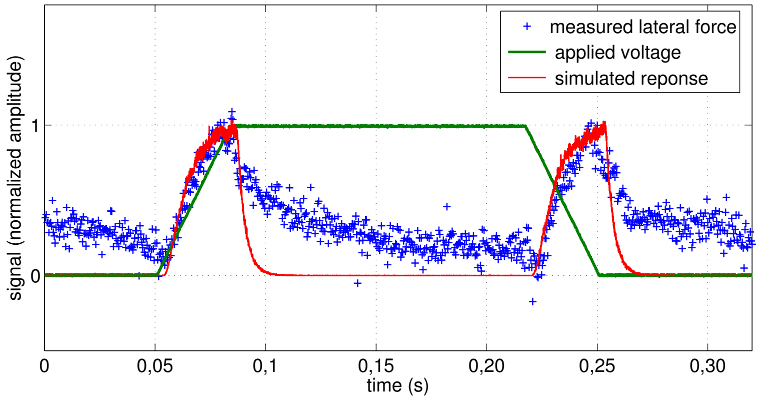

Figure 7. The experimental setup, and the recorded friction modulation.

Touch-based interactions with computing systems are greatly affected by two interrelated factors: the transfer functions applied on finger movements, and latency. Little is actually known on these functions, and latency only recently received attention in this context. This project aims at transforming the design of touch transfer functions from black art to science to support high-performance interactions. We will precisely characterize the functions used and the latency observed in current touch systems. We will develop a testbed environment to support multidisciplinary research on touch transfer functions. We will use this testbed to design latency reduction and compensation techniques, and new transfer functions.

Partners: Inria Lille's NON-A team and the "Perceptual-motor behavior group" from the Institute of Movement Sciences.

8.1.2. Touchit (13th FUI, May 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, Orange Labs, CNRS, EASii IC, MENAPIC and ALPHAUI.

Competitive clusters involved: Minalogic, Cap Digital and MAUD.

8.1.3. 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 started 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)

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. Happiness (H2020-ICT-2014-1/ICT-03-2014/RIA, Jan 2015 - Jan 2018)

Participants: Thomas Pietrzak, Nicolas Roussel [correspondant].

The main objective of this project is to develop and evaluate new types of haptic actuators based on Advanced Thin, Organic and Large Area Electronics (TOLAE) technologies for use in car dashboards.

Partners: CEA (coordinator), Inria Rennes' HYBRID team, Arkema, Bosch, Glasgow University, ISD, Walter Pack, Fundacion Gaiker.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

Inria Northern lab with LUCID group (Liege, P. Leclercq). We initiated this year a joint work on collaborative tools for architects. One of the goal of this collaboration is to initiate discussions and early results for a H2020 proposal.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Marcelo Wanderley (McGill, dec. 2014)
- Masaya Takasaki (Profesor at Saitama Univerity), one month (july 2014)

9. Dissemination

9.1. Promoting Scientific Activities

9.1.1. Conference Organization

- IHM (Villeneuve d'Ascq, Oct 28-31): Géry Casiez & Thomas Pietrzak (General Chairs), Fanny Chevalier (Workshops Co-Chair), Alix Goguey (Student Volunteer Chair), Nicolas Roussel (Communication Chair)
- IEEE VIS, Paris, France: Fanny Chevalier (Arts Program Co-Chair)
- ACM UIST, Honolulu, USA: Géry Casiez (Poster Co-chair), Fanny Chevalier (Video Previews Co-Chair)
- ACM CHI, Toronto, Canada: Fanny Chevalier (Video Previews Co-Chair), Nicolas Roussel (Video Showcase Co-Chair)
- FITG (Tourcoing, May 13-14): Nicolas Roussel (scientific chair), Thomas Pietrzak
- Eurohaptics: Frédéric Giraud, Betty Semail

9.1.2. Program Committees

- ACM UIST: Fanny Chevalier
- ACM CHI: Fanny Chevalier, Thomas Pietrzak (works in progress)
- Eurohaptics: Thomas Pietrzak, Frédéric Giraud, Betty Semail

- 3DUI: Géry Casiez
- GRAPP: Laurent Grisoni
- International Workshop on Movement and Computing: Laurent Grisoni, Nicolas Roussel

9.1.3. Editorial boards

- IEEE Transactions on Haptics : Frédéric Giraud (Associate Editor)
- IEEE Transactions on Power Electronics: Betty Semail (Associate Editor)

9.1.4. Journal and Conference Reviewing

- IEEE Transactions on Visualization and Computer Graphics (TVCG): Fanny Chevalier
- IEEE Transactions on Haptics (ToH): Frédéric Giraud, Betty Semail
- ACM Transactions on Interactive Intelligent Systems: Fanny Chevalier
- Behaviour & Information Technology: Thomas Pietrzak
- HCI Journal: Géry Casiez
- ACM UIST: Nicolas Roussel, Laurent Grisoni
- ACM CHI: Géry Casiez, Fanny Chevalier, Nicolas Roussel, Laurent Grisoni
- ACM SIGGRAPH: Géry Casiez, Fanny Chevalier
- IEEE INFOVIS: Fanny Chevalier
- 3DUI: Laurent Grisoni
- ErgoIHM : Laurent Grisoni
- EuroHaptics: Laurent Grisoni
- Graphics Interface: Fanny Chevalier

9.1.5. Invited Expertises

- Agence d'évaluation de la recherche et de l'enseignement supérieur (AERES): Nicolas Roussel
- Agence Nationale de la Recherche (ANR): Fanny Chevalier, Thomas Pietrzak, Frédéric Giraud
- MITACS Accelerate Program: Géry Casiez, Fanny Chevalier, Frédéric Giraud
- FNRS (Fédération nationale de recherche scientifique, belgique): Laurent Grisoni
- Conseil régional Aquitaine: Laurent Grisoni

9.1.6. Scientific Associations

- AFIHM, the French speaking HCI asssociation: G. Casiez (president), S. Huot (member of the Executive Committee and of the Scientific Council), Thomas Pietrzak (member of the Executive Committee)

9.1.7. Hiring Committees

- Inria's acceptance jury for junior researcher positions: N. Roussel
- Inria Lille's eligibility jury for junior researcher positions: N. Roussel (president)
- Inria Saclay's eligibility jury for junior researcher positions: N. Roussel
- Université Paris-Sud, Comité de Sélection MCF 27ème section (Computer Science): Géry Casiez, Fanny Chevalier
- Université Nancy, Comité de sélection PR 63ième section (Electrical Engineering): Betty Semail
- Université de Compiègne, Comité de selection PR 63ième: Betty Semail (president)

9.2. Teaching - Supervision - Juries

9.2.1. Teaching

IUT : Géry Casiez, Algorithmique, 80, niveau 1A, Bases de données, 24, niveau 1A, modélisation mathématique, 14, niveau 2A, Conception orientée objet, 24, niveau 2A, IHM, 77, niveau 2A, projets, 18, niveau 2A, Université Lille 1, France

Licence : Thomas Pietrzak, AEL : Automates et Langages, 36, niveau L3, Université Lille 1, France

Licence : Thomas Pietrzak, ASD : Algorithmes et Structures de Données, 36, niveau L3, Université Lille 1, France

Master : Géry Casiez, Thomas Pietrzak & Nicolas Roussel, IHM : Interaction Homme-Machine, (8h, 56h, 32h), niveau M1, Université Lille 1, France

Master: Géry Casiez & Fabrice Aubert; Multi-Touch Interaction, 24h, M1, Univ. Lille 1, Université Lille 1, France

Master : Frédéric Giraud: Power Electronics (40h) niveau M1, Université Lille1, France

Master : Géry Casiez, Fanny Chevalier, Laurent Grisoni & Thomas Pietrzak, NIHM : nouvelles Interactions Homme-Machine, (14h, 12h, 6h, 16h), niveau M2, Université Lille 1, France

Master: Laurent Grisoni, représentation et compression de données (24h), introduction à la programmation (38h), cryptographie (8h), Ecole Polytech'lille (dept IMA)

Master : Laurent Grisoni & Thomas Pietrzak, IHM et Interface à Gestes, (24, 12h), niveau M2 (IMA5), Polytech Lille, France

Master : Géry Casiez & Thomas Pietrzak, 3DETech : 3D Digital Entertainment Technologies, (?, 10.5h), niveau M2, Télécom Lille, France

Introduction to HCI, haptics and computer graphics, 24h, Ecole Centrale de Lille (G2): N. Roussel

9.2.2. Supervision

- PhD in progress : Amira Chalbi, "Understanding and designing animations for graphical user interfaces", Univ. Lille 1, started October 2014, co-advised by N. Roussel and F. Chevalier
- PhD in progress: Alix Goguey, "Ìnteracting between physical and digital tools", Univ. Lille 1, started October 2013, co-advised by G. Casiez and T. Pietrzak
- PhD in progress: Andéol Evain, "Smart user interfaces based on BCI", Univ. Rennes 1, started September 2013, co-advised by A. Lecuyer (in Rennes), G. Casiez and N. Roussel
- PhD in progress: Jonathan Aceituno, "Designing the ubiquitous desktop", Univ. Lille 1, started October 2011, advised by N. Roussel
- PhD in progress: Sofiane Ghenna, "multimodal control of piezoelectric actuators", Univ. Lille 1, started October 2013, co-advised by F. Giraud and C. Giraud-Audine
- PhD in progress: Eric Vezzoli, "friction control techniques for tactile rendering", started September 2013, advised by B. Semail
- PhD in progress: Thomas Sednaoui started September 2013, co-advised by B. Semail and C. Chappaz
- Yosra Rekik, "Multi-finger gestural interaction", Univ. Lille 1, co-advised by L. Grisoni and N. Roussel, defended December 10th 2014
- Jérémie Gilliot, "Interactions multi-points indirectes sur grands écrans", Univ. Lille 1, co-advised by N. Roussel and G. Casiez, defended February 26th
- Farzan Kalantari, "shape feedback interaction devices", Univ. Lille 1, started oct. 2014, co-advised by L. Grisoni and F. Giraud.
- Frederic Largilière, "Soft robots", Univ. Lille 1, started oct 2013, co-advised by L. Grisoni and C. Duriez (SHACRA/DEFROST team)
- Vincent Gouezou, "architects and tools", ANMA Architect cabinet (CIFRE funding)/Lille 3, co-advised by L. Grisoni and F. Vermandel (ecole d'architecture de Lille)

9.2.3. Juries

- Arnaud Hamon, PhD (Univ. de Toulouse, December): Nicolas Roussel (reviewer)
- Anthony Talvas, PhD (Univ. Rennes 1, December): Géry Casiez (reviewer)
- David Bertolo, PhD (Univ. Lorraine, November): Géry Casiez (reviewer)
- Jean-Luc Vinot, PhD (Univ. Toulouse 3, November): Géry Casiez (reviewer)
- Liuqing Wang (Insa de Lyon, November): Frédéric Giraud (reviewer)
- Olivier Beaudoux, HDR (Univ. d'Angers, August): Nicolas Roussel (reviewer)
- Christophe Winter (EPF Lausanne - Suisse) : Betty Semail (reviewer)
- Jérémie Garcia, PhD (Univ. Paris-Sud, June): Nicolas Roussel (examiner)
- Guillaume Trannoy (ESPCI, April): Betty Semail (reviewer)
- Charles Hudin 2014 (ESPCI, march): Betty Semail (reviewer)
- Fabien Danieau, PhD (Univ. Rennes 1, January): Géry Casiez (reviewer)
- Simon Courtemanche, PhD (Univ. Grenoble, dec): Laurent Grisoni (reviewer)

9.3. Popularization

- Fête de la science (October), "chercheurs itinérants": Jonathan Aceituno, Fanny Chevalier, Alix Goguey, Damien Marchal, Hanaë Rateau, Nicolas Roussel, Laurent Grisoni
- "30 minutes de science" (September): Fanny Chevalier
- Guest of the *Place de la toile* France Cultures radio program (March): Nicolas Roussel
- technical advising of "zoomachines" week-end (imaginarium, Tourcoing, nov. 2014): Laurent Grisoni

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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, pp. 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, pp. 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, pp. 2491-2500, "Honorable mention" award (top 5%), http://dx.doi.org/10.1145/1978942.1979307

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Articles in International Peer-Reviewed Journals

[12] A. AMANCI, F. GIRAUD, C. GIRAUD-AUDINE, M. AMBERG, F. DAWSON, B. LEMAIRE-SEMAIL. *Analysis of the energy harvesting performance of a piezoelectric bender outside its resonance*, in "Sensors and Actuators A: Physical", September 2014, vol. 217, pp. 129-138 [*DOI :* 10.1016/J.SNA.2014.07.001], https://hal.archives-ouvertes.fr/hal-01044406

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[29] J. ACEITUNO, N. ROUSSEL. *The Hotkey Palette: Flexible Contextual Retrieval of Chosen Documents and Windows*, in "IHM'14, 26e conférence francophone sur l'Interaction Homme-Machine", Lille, France, ACM, October 2014, pp. 55-59 [*DOI :* 10.1145/2670444.2670452], https://hal.archives-ouvertes.fr/hal-01089631

[30] J. GILLIOT, G. CASIEZ, N. ROUSSEL. *Direct and Indirect Multi-Touch Interaction on a Wall Display*, in "IHM'14, 26e conférence francophone sur l'Interaction Homme-Machine", Lille, France, ACM, October 2014, pp. 147-152 [*DOI :* 10.1145/2670444.2670445], https://hal.archives-ouvertes.fr/hal-01090435

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