Activity Report 2017

Team Mjolnir

Computing tools to empower users

Inria teams are typically groups of researchers working on the definition of a common project, and objectives, with the goal to arrive at the creation of a project-team. Such project-teams may include other partners (universities or research institutions).

RESEARCH CENTER
Lille - Nord Europe

THEME
Interaction and visualization

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Team Mjolnir

Creation of the Team: 2015 January 01, end of the Team: 2017 December 31

Keywords:

Computer Science and Digital Science:

A5.1. - Human-Computer Interaction
A5.1.1. - Engineering of interactive systems
A5.1.2. - Evaluation of interactive systems
A5.1.3. - Haptic interfaces
A5.1.4. - Brain-computer interfaces, physiological computing
A5.1.5. - Body-based interfaces
A5.1.8. - 3D User Interfaces
A5.2. - Data visualization
A5.5.4. - Animation
A5.7.2. - Music

Other Research Topics and Application Domains:

B1.1.5. - Genetics
B2.2.6. - Neurodegenerative diseases
B2.8. - Sports, performance, motor skills
B5.2.1. - Road vehicles
B6.1.1. - Software engineering
B6.5. - Information systems
B9.1. - Education
B9.2.1. - Music, sound
B9.2.2. - Cinema, Television
B9.4.1. - Computer science
B9.5.10. - Digital humanities
B9.6. - Reproducibility

1. Personnel

Research Scientists

Stéphane Huot [Team leader, Inria, Senior Researcher, HDR]
Nicolas Roussel [Team leader until Jul. 2017, Inria, Senior Researcher, until Jul. 2017, HDR]
Fanny Chevalier [Inria, Researcher]
Sylvain Malacria [Inria, Researcher]
Mathieu Nancel [Inria, Researcher]
Marcelo Wanderley [Inria, International Chair & professor at McGill University]

Faculty Members

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Thomas Pietrzak [Univ des sciences et technologies de Lille, Assistant Professor]
Edward Lank [Univ des sciences et technologies de Lille, Inria & Univ of Waterloo, Associate Professor]

Post-Doctoral Fellow

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Justin Dan Mathew [Inria, until Sep. 2017]
Nicole Pong [Inria]
Thibault Raffaillac [Inria]

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Karine Lewandowski [Inria]

Visiting Scientists

Jeff Avery [Univ of Waterloo, from Jun. to Aug. 2017]
Keiko Katsuragawa [Univ of Waterloo, Mar. 2017]
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Rina Wehbe [Univ of Waterloo, Mar. 2017]

2. Overall Objectives

2.1. Introduction

Human-Computer Interaction (HCI) is a constantly moving field. Changes in computing technologies extend their possible uses and modify the conditions of existing ones. People also adapt to new technologies and adapt them to their own needs. Different problems and opportunities thus regularly appear. Over the recent years, though, we believe incremental news have unfortunately eclipsed fundamental HCI topics on which a lot of work remains to be done. In what follows, we summarize the essential elements of our vision and the associated long-term goals.

2.2. Computers as tools

In the early 1960s, at a time where computers were scarce, expensive, bulky and formal-scheduled machines used for automatic computations, Engelbart saw their potential as personal interactive resources. He saw them as *tools*, as things we would purposefully use to carry out particular tasks [41]. Others at the same time had a different vision. They saw computers as *partners*, intelligent entities to whom we would delegate tasks. These two visions constitute the roots of today's predominant human-computer interaction paradigms, *use* and *delegation*. Our focus is on computer users and our work should ultimately benefit them. Our interest is not in solving the difficult problems related to machine understanding. It is not in what machines understand, but in what people can do with them. Instead of intelligent systems, we aim for systems supporting intelligent use and empowering people. We do not reject the delegation paradigm but clearly favor the one of tool use.

2.3. Tools supporting transparent use

Technology is most empowering when it is transparent. But the transparent tool is not the one you cannot see, it is the one invisible in effect, the one that does not get into your way but lets you focus on the task. Heidegger used the term *zuhanden* (*ready-to-hand*) to characterize this unobtruded relation to things [42]. Transparency of interaction is not best achieved with tools mimicking human capabilities, but with those taking full advantage of them and fitted to the context and task. Our actions towards the digital world need to be digitized, and the digital world must provide us with proper feedbacks in return. Input and output technologies pose inevitable constraints while the digital world calls for more and more sophisticated perception-action couplings for increasingly complex tasks. We want to study the means currently available for perception and action in the digital world. We understand the important role of the body on the human side, and the importance of hardware elements on the computer side. Our work thus follows a systems approach encompassing these elements and all the software layers above, from device drivers to applications.

2.4. But tools also designed for analytic use

Engelbart believed in the coevolution of humans and their tools. He was not just interested in designing a personal computer but also in changing people, to radically improve the way we manage complexity. The human side of this coevolutionary process has been largely ignored by the computing industry which has focused on the development of walk-up-and-use interfaces for novice users. As a result of this focus on initial performance, we are trapped in a “beginner mode” of interaction with a low performance ceiling [6]. People find it acceptable to spend considerable amounts of time learning and practicing all sorts of skills. We want to tap into these resources to develop digital skills. We must accept that new powerful tools might not support immediate transparent use and thus require attention. Heidegger used the term *vorhanden* (present-at-hand) to characterize the analytic relation to things that not only occurs when learning about them, but also when handling breakdowns, when they change or need to be adapted, or when teaching others how to use them. Analytic use is unavoidable and its interplay with transparent use is essential to tool accommodation and appropriation [40]. We want to study this interplay.

3. Research Program

3.1. Introduction

Our research program is organized around three main themes: leveraging human control skills, leveraging human perceptual skills, and leveraging human learning skills.

3.2. Leveraging human control skills

Our group has developed a unique and recognized expertise in *transfer functions*, i.e. the algorithmic transformations of raw user input for system use. Transfer functions define how user actions are taken into account by the system. They can make a task easier or impossible and thus largely condition user performance, no matter the criteria (speed, accuracy, comfort, fatigue, etc). Ideally, the transfer function should be chosen or tuned to match the interaction context. Yet the question of how to design a function to maximize one or more criteria in a given context remains an open one, and on-demand adaptation is difficult because functions are usually implemented at the lowest possible level to avoid latency problems. Latency management and transfer function design are two problems that require cross examination to improve human performance with interactive systems. Both also contribute to the senses of *initiation* and *control*, two crucial component of the sense of *agency* [44]. Our ultimate goal on these topics is to adapt the transfer function to the user and task in order to support stable and appropriate control. To achieve this, we investigate combinations of low-level (embedded) and high-level (application) ways to take user capabilities and task characteristics into account and reduce or compensate for latency in different contexts, e.g. using a mouse or a touchpad, a touch-screen, an optical finger navigation device or a brain-computer interface.

3.3. Leveraging human perceptual skills

Our work under this theme concerns the physicality of human-computer interaction, with a focus on haptic perception and related technologies, and the perception of animated displays.

Vibrators have long been used to provide basic kinesthetic feedback. Other piezoceramic and electro-active polymer technologies make it possible to support programmable friction or emboss a surface, and thin, organic technologies should soon provide transparent and conformable, flexible or stretchable substrates. We want to study the use of these different technologies for static and dynamic haptic feedback from both an engineering and an HCI perspective. We want to develop the tools and knowledge required to facilitate and inform the design of future haptic interactions taking best advantage of the different technologies.

Animations are increasingly common in graphical interfaces. Beyond their compelling nature, they are powerful tools that can be used to depict dynamic data, to help understand time-varying behaviors, to communicate a particular message or to capture attention. Yet despite their popularity, they are still largely under-comprehended as cognitive aids. While best practices provide useful directions, very little empirical research examine different types of animation, and their actual benefits and limitations remain to be determined. We want to increase current knowledge and develop the tools required to best take advantage of them.

3.4. Leveraging human learning skills

By looking at ways to leverage human control and perceptual skills, the research yet proposed mainly aims at improving perception-action coupling to better support transparent use. This third research theme addresses the different and orthogonal topic of skill acquisition and improvement. We want to move away from the usual binary distinction between “novices” and “experts” and explore means to promote and assist digital skill development in a more progressive fashion. We are interested in means to support the analytic use of computing tools. We want to help people become aware of the particular ways they use their tools, the other ways that exist for the things they do, and the other things they might do. We want to help them increase their performance by adjusting their current ways of doing, by providing new and more efficient ways, and by facilitating transitions from one way to another. We are also interested in means to foster reflection among users and facilitate the dissemination of best practices.

4. Application Domains

4.1. Application Domains

Mjolnir works on fundamental aspects of Human-Computer Interaction that can be applied to diverse application domains. Our 2017 research concerned desktop, touch-based, haptics, and BCI interfaces with notable applications to education, genetics research, as well as creativity support tools (3D audio production and design of Digital Musical Instruments).

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Personnel

Nicolas Roussel, founder and former leader of the team, left Inria Lille in July 2017 after being promoted Director of the Inria Bordeaux - Sud-Ouest research center. Stéphane Huot has been appointed team leader since then, and until the team comes to an end in December 2017.

Ed Lank, Associate Professor at University of Waterloo who already spent one year in our team funded by Région Hauts-de-France and Université Lille 1 until Aug. 2017, extended his stay for 6 months (funded by Inria).

In partnership with Campus France and Inria, Mitacs’ Globalink Research Award program sponsored the visit of a Canadian student in our group: Jeff Avery (University of Waterloo).

5.1.2. Publications

Mjolnir presented four papers at ACM CHI and three papers at ACM UIST, the most prestigious conferences in our field.

5.1.3. Awards

"Honorable mention" (top 5% of the 2400+ submissions) from the ACM CHI conference to the paper "Visualization Literacy at Elementary School", from B. Alper, N. Henry Riche, F. Chevalier, J. Boy & T. M. Sezgin .

"Best paper honorable mention" (top 5% of the 173 submissions) from the IEEE VIS-VAST conference to the paper "Supporting Handoff in Asynchronous Collaborative Sensemaking Using Knowledge-Transfer Graphs", from J. Zhao, M. Glueck, P. Isenberg, F. Chevalier & A. Khan .

BEST PAPERS AWARDS:

[17]
B. ALPER, N. HENRY RICHE, F. CHEVALIER, J. BOY, T. M. SEZGIN. *Visualization Literacy at Elementary School*, in "CHI '17 - Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems", Denver, CO, United States, ACM, May 2017, pp. 5485-5497 [*DOI :* 10.1145/3025453.3025877], https://hal.inria.fr/hal-01558717

[16]
J. ZHAO, M. GLUECK, P. ISENBERG, F. CHEVALIER, A. KHAN. *Supporting Handoff in Asynchronous Collaborative Sensemaking Using Knowledge-Transfer Graphs*, in "IEEE Transactions on Visualization and Computer Graphics", 2018, vol. 24, n^{o} 1, pp. 340-350 [*DOI :* 10.1109/TVCG.2017.2745279], https://hal.inria.fr/hal-01565560

6. New Software and Platforms

6.1. InspectorWidget

An opensource suite to track and analyze users behaviors in their applications
KEYWORD: Instrumentation
FUNCTIONAL DESCRIPTION: InspectorWidget is a set of opensource tools to track and analyze users' behaviors in interactive software. It works with closed applications that do not provide source code nor scripting capabilities, covers the whole pipeline of software analysis and does not require programming skills. To achieve this, InspectorWidget combines low-level event logging (e.g. mouse and keyboard events) and high-level screen features (e.g. interface widgets) captured though computer vision techniques, or through accessibility hooks when exposed by applications.
NEWS OF THE YEAR: InspectorWidget now supports the collection and annotation of User Interface accessibility features.

- Participants: Christian Frisson, Sylvain Malacria, Stéphane Huot and Gilles Bailly
- Contact: Sylvain Malacria
- Publication: InspectorWidget: a System to Analyze Users Behaviors in Their Applications
- URL: https://github.com/InspectorWidget/InspectorWidget

6.2. WhichFingers

WhichFingers: Identifying Fingers on Touch Surfaces and Keyboards using Vibration Sensors
KEYWORDS: Interaction - HCI
SCIENTIFIC DESCRIPTION: HCI researchers lack low-latency and robust systems to support the design and development of interaction techniques using finger identification. We developed a low-cost prototype using piezo-based vibration sensors attached to each finger. By combining the events from an input device with the information from the vibration sensors we demonstrate how to achieve low-latency and robust finger identification. Our prototype was evaluated in a controlled experiment, using two keyboards and a touchpad, showing single-touch recognition rates of 98.2% for the keyboard and 99.7% for the touchpad, and 94.7% for two simultaneous touches. These results were confirmed in an additional laboratory-style experiment with ecologically valid tasks. Last we present new interaction techniques made possible using this technology.

FUNCTIONAL DESCRIPTION: WhichFingers consists in a hardware and a software components.

The hardware component consists of five Minisense 100 vibration sensors attached to each finger. The sensors use flexible PVDF piezoelectric polymer film loaded by a mass to offer high sensitivity to detect contact vibrations. They produce a voltage as large as 90V depending on the intensity of the shock or vibration. The five sensors are plugged into a micro-controller and sends the raw values to the host computer at 1000 Hz.

The software component monitors low-level interaction touch and key events, and declares the vibration sensor that created the highest voltage as the finger that produced the input event.

- Participants: Géry Casiez and Sylvain Malacria
- Contact: Géry Casiez
- Publication: WhichFingers: Identifying Fingers on Touch Surfaces and Keyboards using Vibration Sensors

6.3. Lagmeters

Systems to measure end-to-end latency in interactive systems
KEYWORDS: Interaction - Latency
FUNCTIONAL DESCRIPTION: The first method works with most optical mice and allows accurate and real time latency measures up to 5 times per second. In addition, the technique allows easy insertion of probes at different places in the system – i.e. mouse events listeners – to investigate the sources of latency.

The second method relies on a vibration sensor attached to a finger and a photo-diode to detect the screen response. Both are connected to a micro-controller connected to a host computer using a low-latency USB communication protocol in order to combine software and hardware probes to help determine where the latency comes from. We provide source code and materials to replicate both the hardware and software.

- Participants: Géry Casiez, Nicolas Roussel, Stéphane Huot, Thomas Pietrzak, Sébastien Poulmane, Stéphane Conversy, Damien Marchal and Matthieu Falce
- Partners: Université Lille 1 - Inria
- Contact: Géry Casiez
- Publications: Characterizing Latency in Touch and Button-Equipped Interactive Systems - Looking through the Eye of the Mouse: A Simple Method for Measuring End-to-end Latency using an Optical Mouse
- URL: http://ns.inria.fr/mjolnir/lagmeter/

6.4. libParamTuner

Cross-platform library to ease the interactive tuning of parameters at run time and without the need to recompile code.
KEYWORD: Interaction
FUNCTIONAL DESCRIPTION: libParamTuner provides a lightweight syntax to bind some variables of an application to the parameters defined in an XML file. Each modification of the XML file updates in real time the associated parameters in the application. A graphical interface allows editing the XML file, using interactive controls dynamically created for each parameter.

- Participants: Géry Casiez, Marc Baloup and Veis Oudjail
- Partners: Université Lille 1 - Inria
- Contact: Géry Casiez
- Publication: libParamTuner : interactive tuning of parameters without code recompilation
- URL: https://github.com/casiez/libparamtuner

6.5. liblag

Library implementing latency compensation techniques for interactive systems
KEYWORDS: Interaction - Latency
FUNCTIONAL DESCRIPTION: The library comprises the management of a set of multitouch input devices, the implementation of latency compensation techniques from the state-of-the-art and new latency compensation techniques developed in the project, and a system to handle artificial latency.

The library is developed in C++ using the Qt framework to allow compiling the same code on a wide range of devices and platforms.

- Contact: Géry Casiez
- Publication: Dispositif à affichage prédictif
- URL: http://mjolnir.lille.inria.fr/turbotouch/

7. New Results

7.1. Introduction

The following sections summarize our main results of the year. For a complete list, see the list of publications at the end of this report.

7.2. Understanding and modeling users

Participants: Géry Casiez [correspondent], Stéphane Huot, Edward Lank, Justin Dan Mathew, Mathieu Nancel, Sylvain Malacria, Nicolas Roussel, Marcelo Wanderley.

7.2.1. Understanding the practices of 3D audio production professionals

3D audio production tools vary from low-level programming libraries to higher-level user interfaces that are used across a wide range of applications. However, many of the user interfaces for authoring 3D audio parameters are underdeveloped, forcing users to resort to ad hoc solutions with other tools or programming languages, which limits creativity and productivity. Even though there is a significant increase of interest in this problem, usability issues with the manipulation of spatial parameters in 3D audio tools are still not well identified. We have thus conducted an on-line survey with practitioners to gather ethnographic information on their tools, methods, and assessments [15]. Our goal was to identify limitations and custom methods to circumvent them, in order to inform the development of better user interfaces for 3D audio production. Results of the survey revealed specific methods and limitations with regards to *Audio Rendering & Recording*, *Visual Feedback*, *Functionality*, and *Workflow Integration*. We also identified three basic but important tasks that have to be performed interactively with 3D audio production tools: *Defining the Rendering Space*, *Creation and Manipulation of Audio Objects*, and *Monitoring with Audio/Visual Feedback*. As part of Justin Mathew's PhD [11], this classification helped to identify the needs and to experiment new 3D audio tools that address issues with low-level functionality of 3D audio production systems such as the specification of 3D audio trajectories.

7.2.2. Exploring playfulness in the design of new musical instruments

Play and playfulness compose an essential part of our lives as human beings. From childhood to adulthood, playfulness is often associated with remarkable positive experiences related to fun, pleasure, intimate social activities, imagination, and creativity. Not surprisingly, playfulness has been recurrently considered an important criterion in the design of interfaces for Digital Musical Instruments. It is supposed to engage people, often non-expert, in short term musical activities. Yet, designing for playfulness remains a challenging task, as little knowledge is available for designers to support their decisions. To address this issue, we have followed a design rationale approach using the context of Live Looping as a case study [21]. We first surveyed 101 Live Looping tools and summarized our analysis into a new design space. We used this design space to discuss potential guidelines to address playfulness in a design process: (i) advanced looping capacity, so as to extend the musical possibilities of Live Looping; (ii) low input capacity and direct mappings, in order to help getting familiar with the instrument and to favor direct control; and (iii) transparent and intense visual feedback to help infer what is happening inside the device when an action is performed. These guidelines were implemented and discussed in a new prototype of Live Looping instrument, the *Voice Reaping Machine*.

7.2.3. Use of brain-computer interfaces

BCIs are presumably supposed to require the full attention of their users, and to lose accuracy if users pay attention to another task. This assertion has been verified with several BCI paradigms (e.g. P300). But the cognitive demand of the promising SSVEP paradigm had never been specifically assessed. We measured the accuracy of an SSVEP-based BCI used by 26 participants in various conditions of mental workload [23]. Our analysis revealed that surprisingly, for this type of BCI, little attention is actually needed from participants to reach optimal accuracy: participants were able to successfully perform a complex secondary task (N-back) without degrading the BCI accuracy. The same observation was made whether visual or auditive attention was solicited. These results indicate that SSVEP is a low-demanding paradigm in terms of cognitive resources, and are encouraging for its use in complex interaction settings. Last we did a survey on the use of BCIs in augmented reality. The results of the survey show that most of the previous work made use of P300 or SSVEP paradigms with EEG in Video See-Through systems, and that robotics is a main field of application with the highest number of existing systems [34].

7.2.4. Modeling user performance on curved constrained paths

In 2D and 3D interfaces, a “steering task” consists in following a predefined path of arbitrary shape, with a given and possibly varying tolerance (or “width”), using the finger or the cursor. While less common than target acquisition, this family of pointing tasks is a distinct component of modern interaction, e.g. selecting items in a hierarchical linear menus, or deep-etching an image in Photoshop. Previous work have essentially modeled straight or circular paths of constant width, and argued that more complex paths can be modeled using combinations of these primitives. We demonstrated that existing models actually fail to correctly model constrained paths of varying, arbitrary curvature [30]. We proposed a new model that integrates instantaneous curvature and width into its formulation, and validated it empirically for direct touch.

7.3. Interactive visualization and animations

Participants: Amira Chalbi-Neffati, Fanny Chevalier [correspondent], Nicolas Roussel.

7.3.1. Visualization literacy at elementary school

This work advances our understanding of children’s visualization literacy, and aims to improve it with a novel approach for teaching visualization at elementary schools. We contributed an analysis of data graphics and activities employed in grade K to 4 educational materials, and conducted a survey with 16 elementary school teachers. We found that visualization education could benefit from integrating pedagogical strategies for teaching abstract concepts with established interactive visualization techniques. Building on these insights, we have developed and studied design principles for novel interactive teaching material aimed at increasing children’s visualization literacy. We developed *C’est la vis*, an online platform for teachers and students to respectively teach and learn about pictographs and bar charts (see Fig. 1), and reported on our initial observations of its use in grades K and 2 [17]. The application can be tested at https://cestlavis.github.io. This work was awarded a Best Paper Honorable Mention award at the ACM CHI conference and highlighted on FlowingData and Data Stories, two famous blogs on visualization.

Figure 1. C'est la Vis is a tablet-based application co-designed with elementary teachers to support the teaching and learning of pictographs and bar charts in Grades K-4.

7.3.2. Supporting handoff in asynchronous collaborative sensemaking

During asynchronous collaborative analysis, handoff of partial findings is challenging because externalizations produced by analysts may not adequately communicate their investigative process. To address this challenge, we developed techniques to automatically capture and help encode tacit aspects of the investigative process based on an analyst's interactions, and streamline explicit authoring of handoff annotations [16]. We designed our techniques to mediate awareness of analysis coverage, support explicit communication of progress and uncertainty with annotation, and implicit communication through playback of investigation histories. To evaluate our techniques, we developed an interactive visual analysis system, *KTGraph*, that supports an asynchronous investigative document analysis task. We conducted a two-phase user study to characterize a set of handoff strategies and to compare investigative performance with and without our techniques. The results suggest that our techniques promote the use of more effective handoff strategies, help increase an awareness of prior investigative process and insights, as well as improve final investigative outcomes. This work received a Best Paper Honorable Mention award at the IEEE VIS-VAST conference.

7.3.3. Phenotype comparison visualizations for disease subtyping via topic models

PhenoLines is a visual analysis tool for the interpretation of disease subtypes, derived from the application of topic models to clinical data [26]. Topic models enable one to mine cross-sectional patient comorbidity data (e.g., electronic health records) and construct disease subtypes—each with its own temporally evolving prevalence and co-occurrence of phenotypes—without requiring aligned longitudinal phenotype data for all patients. However, the dimensionality of topic models makes interpretation challenging, and *de facto* analyses provide little intuition regarding phenotype relevance or phenotype interrelationships. PhenoLines allows to compare phenotype prevalence within and across disease subtype topics (see Fig. 2), thus supporting subtype characterization, a task that involves identifying a proposed subtype's dominant phenotypes, ages of effect, and clinical validity. We contributed a data transformation workflow that employs the Human Phenotype Ontology to hierarchically organize phenotypes and aggregate the evolving probabilities produced by topic models. We introduced a novel measure of phenotype relevance that can be used to simplify the resulting topology. The design of PhenoLines was motivated by formative interviews with machine learning and clinical experts. We conducted initial evaluations with machine learning experts and a medical domain expert. Results suggest that PhenoLines supports promising approaches for the characterization and optimization of topic models.

7.3.4. Understanding and designing animation for visualization

Figure 2. PhenoLines facilitates the visual analysis of topics that describe disease symptoms, in support of topic model optimization and characterization. Hierarchical relationships, temporal trends, correlated measures, and rank-ordered lists enable for comparisons within and between topics.

Animations are increasingly used in interactive systems in order to enhance the usability and aesthetics of user interfaces. While animations are proven to be useful in many cases, we still observe defective ones causing many problems, such as distracting users from their main task or making data exploration slower. The fact that such animations still exist proves that animations are not yet very well understood as a cognitive aid, and that we have not yet definitely decided what makes a well designed one. Our work on this topic aims at better understanding the different aspects of animations for user interfaces and exploring new methods and guidelines for designing them.

We explored the concept of *dataTours*, semi-automated narratives for prompting and sustaining exploratory analysis, as a complement to the predominant interactive data overview. Narratives are commonly and widely used for presenting and communicating results of data analyses and thus generally lead an observer to a specific resolution or conclusion regarding the question(s) they address. A dataTour, on the other hand, is meant to be an open-ended and adaptive narrative that can act as a scaffolding for the iterative process of exploration. Preliminary results were presented as a poster at the IEEE Infovis conference [38].

7.4. Interaction techniques

Participants: Axel Antoine, Géry Casiez, Fanny Chevalier, Stéphane Huot, Sylvain Malacria [correspondent], Thomas Pietrzak, Sébastien Poulmane, Nicolas Roussel.

7.4.1. Touch interaction with finger identification: which finger(s) for what?

HCI researchers lack low latency and robust systems to support the design and development of interaction techniques that leverage finger identification. We developed a low cost prototype, called *WhichFingers* (see Fig. 3), using piezo based vibration sensors attached to each finger [29]. By combining the events from an input device with the information from the vibration sensors we demonstrated how to achieve low latency and robust finger identification. We evaluated our prototype in a controlled experiment, showing recognition rates of 98.2% for keyboard typing, and 99.7% for single touch and 94.7% for two simultaneous touches on a touchpad. These results were confirmed in an additional laboratory experiment with ecologically valid tasks.

We also explored the large input space made possible by such finger identification technology. *FingerCuts* for instance is an interaction technique inspired by desktop keyboard shortcuts [14]. It enables integrated command selection and parameter manipulation, it uses feed-forward and feedback to increase discoverability, it is backward-compatible with current touch input techniques, and it is adaptable for different form factors of touch devices: tabletop, tablet, and smartphone. Qualitative and quantitative studies conducted on a tabletop

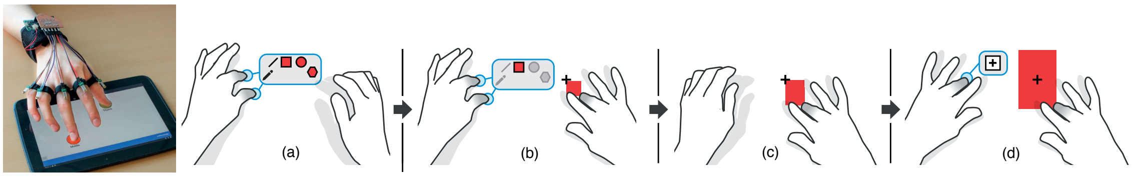

Figure 3. (left) WhichFingers wireless device prototype. (right) Example of how FingerCuts merges command selection with direct manipulation of command parameters with feed-forward: (a) specific finger chords with non-dominant hand displays possible commands; (b) dominant hand selects command using specific corresponding finger, e.g. middle finger triggers "start drawing rectangle"; (c) dominant hand movement provides continuous control of command parameters, e.g. size of the rectangle; (d) other specific fingers with non-dominant hand further tunes the command parameters, e.g. middle finger change mode to "draw rectangle from the center".

suggest that with some practice, FingerCuts is expressive, easy to use, and increases a sense of continuous interaction flow. Interaction with FingerCuts was found as fast or faster than using a graphical user interface. A theoretical analysis of FingerCuts using the Fingerstroke-Level Model (FLM) [43] matches our quantitative study results, justifying our use of FLM to analyze and estimate the performance for other device form factors.

7.4.2. Force-based autoscroll

Autoscroll, also known as edge-scrolling, is a common interaction technique in graphical interfaces that allows users to scroll a viewport while in dragging mode: once in dragging mode, the user moves the pointer near the viewport's edge to trigger an "automatic" scrolling. In spite of their wide use, existing autoscroll methods suffer from several limitations [39]. First, most autoscroll methods over-rely on the size of the control area, that is, the larger it is, the faster scrolling rate can be. Therefore, the level of control depends on the available distance between the viewport and the edge of the display, which can be limited. This is for example the case with small displays or when the view is maximized. Second, depending on the task, the users' intention can be ambiguous (e.g. dragging and dropping a file is ambiguous as the user's target may be located within the initial viewport or in a different one on the same display). To reduce this ambiguity, the size of the control area is drastically smaller for drag-and-drop operations which consequently also affects scrolling rate control as the user has a limited input area to control the scrolling speed.

We presented a conceptual framework of factors influencing the design of edge-scrolling techniques [12]. We then analyzed 33 different desktop implementations by reverse-engineering their behavior, and demonstrated substantial variance in their design approaches. Results of an interactive survey with 214 participants show that edge-scrolling is widely used and valued, but also that users encounter problems with control and with behavioral inconsistencies. Finally, we reported results of a controlled experiment comparing four different implementations of edge-scrolling, which highlight factors from the design space that contribute to substantial differences in performance, overshooting, and perceived workload.

We also explored how force-sensing input, which is now available on several commercial devices, can be used to overcome the limitations of autoscroll. Indeed, force-sensing is an interesting candidate because: 1) users are often already applying a (relatively soft) force on the input device when using autoscroll and 2) varying force on the input device does not require to move the pointer, thus making it possible to offer control to the user while using a small and consistent control area regardless of the task and the device. We designed *ForceEdge*, a novel interaction technique mapping the force applied on a trackpad to the autoscrolling rate [18]. We implemented a software interface that can be used to design different transfer functions that map the force to autoscrolling rate and test these mappings for text selection and drag-and-drop tasks. The results of three controlled experiments suggest that it improves over MacOS and iOS systems baselines for top-to-bottom select and move tasks.

7.4.3. Free-space gestural interaction

7.4.3.1. Exploring at-your-side gestural interaction for ubiquitous environments

Free-space or in-air gestural systems are faced with two major issues: a lack of subtlety due to explicit mid-air arm movements, and the highly effortful nature of such interactions. The lack of subtlety can influence whether gestures are used; specifically, if gestures require large-scale movement, social embarrassment can restrict their use to private contexts. Similarly, large-scale movements are tiring, further limiting gestural input to short-term tasks by physically health users.

We believe that, to promote gestural input, lower-effort and more socially acceptable interaction paradigms are essential. To address this need, we explored at-one's-side gestural input, where the user gestures with their arm down at their side in order to issue commands to external displays. Within this space, we presented the results of two studies that investigate the use of side-gesture input for interaction [35]. First, we investigated end-user preference through a gesture elicitation study, presented a gesture set, and validated the need for dynamic, diverse, and variable-length gestures. We then explored the feasibility of designing such a gesture recognition system, dubbed *WatchTrace*, which supports alphanumeric gestures of up to length three with an average accuracy of up to 82%, providing a rich, dynamic, and feasible gestural vocabulary.

7.4.3.2. Effect of motion-gesture recognizer error pattern on user workload and behavior

In free-space gesture recognition, the system receiving gesture input needs to interpret input as the correct gesture. We measure a system's ability to do this using two measures: precision, or the number of gestures classified correctly versus the number of gestures misclassified; and recall, or the overall number of gestures of a given class that are classified. To promote precision, systems frequently require gestures to be performed more accurately, and systems then reject less careful gesture as input, forcing the user to retry the action. To promote this accuracy, the system sets a threshold, a criterion value, that describes how accurately the gesture must be performed. If we tighten this threshold, we increase the precision of the system, but this, in turn, results in more rejected gestures, negatively impacting recall.

Bi-level thresholding is a motion gesture recognition technique that mediates between precision and recall using two threshold levels: a tighter threshold that limits recognition errors or boost precision, and a looser threshold that promotes higher recall. These two thresholds accomplish this goal by analyzing movements in sequence and treating two less-precise gestures the same as a single more precise gesture, i.e. two near-miss gestures is interpreted the same as a single accurately performed gesture. We explored the effects of bi-level thresholding on the workload and acceptance of end-users [28]. Using a wizard-of-Oz recognizer, we held recognition rates constant and adjusted for fixed versus bi-level thresholding. Given identical recognition rates, we showed that systems using bi-level thresholding result in significant lower workload scores (on the NASA-TLX) and significantly lower accelerometer variance.

7.4.3.3. Rapid interaction with interface controls in mid-air

Freehand interactions with large displays often rely on a "point & select" paradigm. However, constant hand movement in air for pointer navigation quickly leads to arm and hand fatigue. We introduced *summon & select*, a new model for freehand interaction where, instead of navigating to the control, the user summons it into focus and then manipulates it [27]. Summon & select solves the problems of constant pointer navigation, need for precise selection, and out-of-bounds gestures that plague point & select. We conducted two studies to evaluate the design and compare it against point & select in a multi-button selection study. Results suggest that summon & select helps performing faster and has less physical and mental demand than point & select.

7.4.4. Using toolbar button icons to communicate keyboard shortcuts

Toolbar buttons are frequently-used widgets for selecting commands. They are designed to occupy little screen real estate, yet they convey a lot of information to users: the icon is directly tied to the meaning of the command, the color of the button informs whether the command is available or not, and the overall shape and shadow effect together afford a point & click interaction to execute the command. Most commands attached to toolbars can also be selected by using an associated keyboard shortcut. Keyboard shortcuts enable users to reach higher performance than selecting a command through pointing and clicking, especially for frequent actions such as repeated “Copy/Paste” operations. However, keyboard shortcuts suffer from a poor accessibility. We proposed a novel perspective on the design of toolbar buttons that aims to increase keyboard shortcut accessibility [25]. *IconHK* implements this perspective by blending visual cues that convey keyboard shortcut information into toolbar buttons without denaturing the pictorial representation of their command (see Fig. 4). We introduced three design strategies to embed the hotkey, a visual encoding to convey the modifiers, and a magnification factor that determines the blending ratio between the pictogram of the button and the visual representation of the hotkey. Two studies explored the benefits of IconHK for end-users and provided insights from professional designers on its practicality for creating iconsets. Based on these insights, we built a tool to assist designers in applying the IconHK design principles.

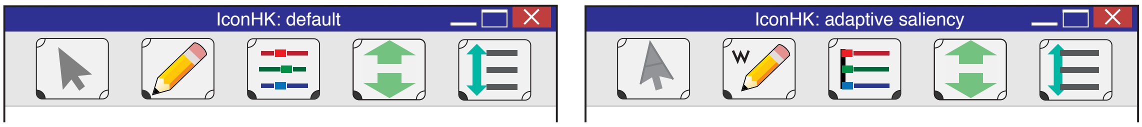

Figure 4. A toolbar using IconHK. (left) By default, the magnification of all buttons is at the default level and the hotkey symbol is not emphasized. (right) The magnification level of each button reflects user’s command selection habits: the more frequently a command is selected by clicking, the more the hotkey symbol is emphasized.

7.5. Novel interactive technologies

Participants: Géry Casiez, Fanny Chevalier, Stéphane Huot [correspondent], Sylvain Malacria, Thomas Pietrzak, Sébastien Poulmane, Thibault Raffaillac, Nicolas Roussel, Marcelo Wanderley.

7.5.1. Technologies for prototyping, tuning and studying interactive systems

7.5.1.1. Measure, characterization and compensation of end-to-end latency

We developed a low-cost method to measure and characterize the end-to-end latency when using a touch system (tap latency) or an input device equipped with a physical button [22]. Our method relies on a vibration sensor attached to a finger and a photo-diode to detect the screen response (see Fig. 5). Both are connected to a micro-controller connected to a host computer using a low-latency USB communication protocol in order to combine software and hardware probes to help determine where the latency comes from. We presented the operating principle of our method and investigated the main sources of latency in several systems. We showed that most of the latency originates from the display side. Our method can help application designers characterize and troubleshoot latency on a wide range of interactive systems.

When there is no other way to reduce latency (e.g. hardware improvements or software optimization), we have to rely on latency compensation methods. In direct interaction, this problem is considered and formulated as a trajectory prediction problem, i.e. where should the active position be without latency? We addressed this problem by constructing a frequency-domain approximation of the non-casual ideal predictor [19]. This approximation can be computed analytically, or obtained as an optimization task. We also proposed an adaptive modification of the algorithm taking into account possible variations in user behavior, and we empirically illustrated its applicability.

7.5.1.2. Turning function calls into animations

Animated transitions are an integral part of modern interaction frameworks. While early systems would animate a few properties, such as position or color, with different functions for each, modern systems contain too many properties to scale this way. To cope with this increasing numbers of properties to animate, most frameworks rely on naming strategies to refer to properties – like “position” or “color” – instead of having one specific function for each. This improves flexibility for choosing animated properties at runtime and reduces

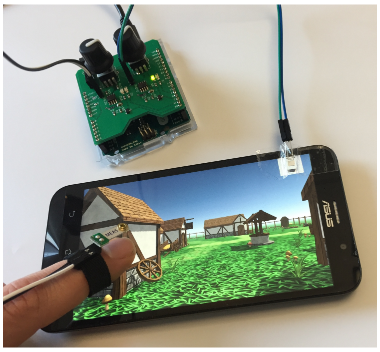

Figure 5. The hardware of our latency measuring method comprises a vibration sensor mounted on the finger to measure when a surface is touched or when a physical button is pressed, and a photo-diode to determine when the screen is updated.

API size. It also gives an implicit contract that any property can animate. This flexibility has a price though. The animation of custom properties and types requires frameworks to provide an advanced API that exposes low-level details of their animation systems (e.g., timers and threads). This results in larger APIs and cumbersome syntaxes owing to the complex underlying mechanisms. It also creates a steep learning curve from basic to advanced APIs, which is likely to force programmers to stick to existing animatable properties whenever possible.

We have studied better ways for animating all objects in the system, independently of any frameworks, and aimed for a syntax reusing as much as possible the existing lexical elements [33]. This resulted in a delay operator appended to function calls – `object.setProperty(target)` *`during 2s`* – that turns setters into animations. It offers a coherent way to express animations across frameworks, and facilitates the animation of new properties. Our proof-of-concept implementation has been done in the Smalltalk language and tested with three popular interaction frameworks for the Pharo platform. In the future, this prototype should contribute to measuring the effect of animation syntax on programmers' ease in prototyping.

7.5.1.3. Interactive tuning of parameters without code recompilation

We developed *libParamTuner*, a cross-platform library that allows interactive tuning of parameters in applications written in C++ or Java, without the need to re-compile [20]. libParamTuner provides a lightweight syntax to bind some variables of an application to parameters defined in an XML file. Each modification of the XML file updates in real time the associated parameters in the application. A graphical interface allows editing the XML file, using interactive controls dynamically created for each parameter.

7.5.2. Technologies for creative applications

7.5.2.1. Leveraging flexion input for pen interaction

For artists, digital media offers some advantages over physical media, such as non-destructive editing, automation, and potential novel effects. However, conveying artistic intent to a computer system can be problematic. An artist working in traditional media, such as a painter or pastellist, can subtly manipulate their artistic tool to create different effects, while a digital artist working with a non-augmented stylus is only able to indicate a path, shape, or point on the surface of the tablet. Augmented styluses help solve this problem by using physical inputs such as pressure or tilt to function as parametric controls. We designed and developed *FlexStylus*, a flexible stylus that detects deformation of the barrel as a vector with both a rotational and an absolute value [24]. It provides two additional degrees of freedom with the goal of improving the expressiveness of digital art using a stylus device. The prototype uses a cluster of four fiber-optic-based deformation sensors. We also proposed interaction techniques using the FlexStylus to improve menu navigation and tool selection (see Fig. 6). Finally, we conducted a study comparing users' ability to match a changing target value using a commercial pressure stylus and the FlexStylus' absolute deformation. When using the FlexStylus, users had higher accuracy overall, suggesting that deformation may be a useful input method for future work considering stylus augmentation.

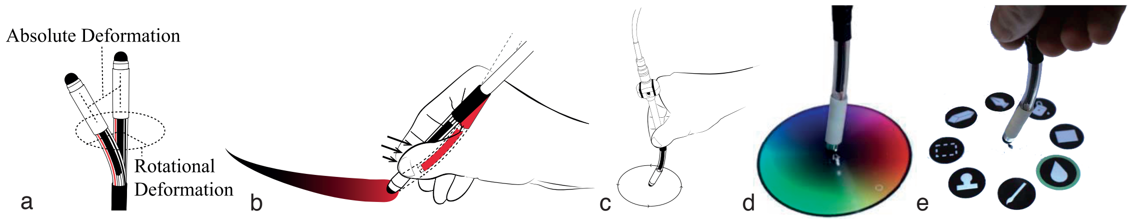

Figure 6. Flexstylus measures absolute and rotational deformation (a). Examples of interaction techniques leveraging bending input: (b) controlling stroke width, (c) performing circle gesture, (d) using color-picker, (e) using a radial menu.

7.5.2.2. Versioning and annotation support for collaborative mapping design

A crucial component of the digital musical instrument (DMI) building process involves the mapping of sensor or gesture input signals from the musician to relevant synthesis parameters. While there are many different approaches to the design and implementation of DMI mapping, for many designers, a common part of the process involves the use of graphical user interfaces where the connection of signals can be observed and manipulated visually. In that context, and especially during collaborative design, being able to effectively store, preview, and reload previous configurations can reduce risks, encourage exploration, and improve the management of configuration files. We developed a new mapping tool for the libmapper library, a well-used system for connecting signals employed for the design and implementation of DMIs, that deeply integrate graphical versioning and comparison tool, and rich annotation features that go beyond the text-based tagging commonly employed by existing versioning systems [36]. We plan to further extend this approach with richer annotation capabilities (e.g. media files or examples of use) and query features, and with additional visualizations of the mappings and their changes over time.

7.5.2.3. Probatio: a method and toolkit for generating ideas and prototypes

We have investigated aspects of DMI design by focusing on the complexity of the design space and the importance of prototyping cycles. In particular, we focused on how to provide an initial path for generating DMI ideas and how to reduce the time and effort required to build functional DMI prototypes. We proposed a new methodology and an associated physical prototyping toolkit, *Probatio* (see Fig. 7), which has building blocks inspired by existing instruments [13]. A preliminary user study with musicians and DMI designers revealed a strong potential for its use in the development of DMIs. It also highlighted possible improvements such as more ergonomic shapes for the building blocks and better sound mapping possibilities.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

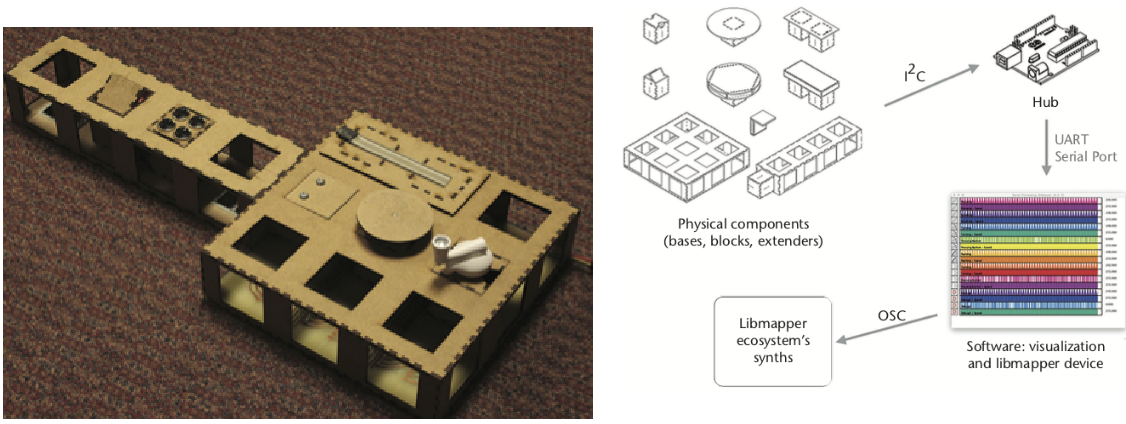

Figure 7. (left) Example of a DMI prototype using Probatio. (right) Overview of Probatio architecture. The blocks are attached to the base, which is connected to an Arduino via I2C. The Arduino is also connected to the computer via serial port. The computer runs an interactive application where each block connected to the base has its value graphed in real time with a unique color, allowing the user to see their activity.

- **Mock-up of a tool for dynamic media pre-production:** we did work with the HCOP holding company on the design of new tools for the pre-production of dynamic media such as videos, e-learning animations, etc. This work involved interviews of professional video producers, the identification of opportunities for tools that could help them, and the production of descriptions and mock-ups of these tools.

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Mjolnir/UCLIC associate team (Inria Lille, 2015-2017)

Participants: Sylvain Malacria [correspondent], Nicolas Roussel.

The goal of this project, whose funding ends 2017, is the design and implementation of novel cross-device systems and interaction techniques. Thanks to this funding, the Mjolnir group and UCLIC are currently working on two scientific research projects. The first one investigates the design of notification systems for smart watches, smartphones, and in distributed computing environments based on device proximity, location, and time. A group of three Computer Science students from UCL is currently designing and implementing the first prototype of this system. The second project studies the influence of the shape and color of icons on visual search, on smartphones and smartwatches. In addition, UCLIC and the Mjolnir group also collaborate on the design and implementation of a software tool for helping HCI researchers to create non-photorealistic figures aimed at illustrating interaction techniques.

Partner: University College London Interaction Centre (United Kingdom).

9.2. National Initiatives

9.2.1. Turbotouch (ANR, 2014-2019)

Participants: Géry Casiez [correspondent], Sylvain Malacria, Mathieu Nancel, Thomas Pietrzak, Sébastien Poulmane, Nicolas Roussel.

Touch-based interactions with computing systems are greatly affected by two interrelated factors: the transfer functions applied on finger movements, and latency. This project aims at transforming the design of touch transfer functions from black art to science to support high-performance interactions. We are working on the precise characterization of the functions used and the latency observed in current touch systems. We are developing a testbed environment to support multidisciplinary research on touch transfer functions and 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.

Web site: http://mjolnir.lille.inria.fr/turbotouch/

Related publications: [22], [18], [12], [19]

9.2.2. ParkEvolution (Carnot Inria - Carnot STAR, 2015-2018)

Participants: Géry Casiez [correspondent], Sébastien Poulmane.

This project studies the fine motor control of patients with Parkinson disease in an ecological environment, at home, without the presence of experimenters. Through longitudinal studies, we collect raw information from pointing devices to create a large database of pointing behavior data. From the analysis of this big dataset, the project aims at inferring the individual's disease progression and influence of treatments.

Partners: the "Perceptual-motor behavior group" from the Institute of Movement Sciences and Hôpital de la Timone.

Web site: http://parkevolution.org/

9.2.3. BCI-LIFT (Inria Project Lab, 2015-2019)

Participants: Géry Casiez [correspondent], Nicolas Roussel.

The goal of this large-scale initiative is to design a new generation of non-invasive Brain-Computer Interfaces (BCI) that are easier to appropriate, more efficient, and suited for a larger number of people.

Partners: Inria's ATHENA, NEUROSYS, POTIOC, HYBRID & DEMAR teams, *Centre de Recherche en Neurosciences de Lyon* (INSERM) and INSA Rouen.

Web site: https://bci-lift.inria.fr/

Related publications: [23], [34]

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

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

Participants: Julien Decaudin, Christian Frisson, Thomas Pietrzak [correspondent], Nicolas Roussel.

The main objective of this project is to develop and evaluate new types of haptic actuators printed on advanced Thin, Organic and Large Area Electronics (TOLAE) technologies for use in car dashboards. These actuators are embedded in plastic molded dashboard parts. The expected outcome is a marketable solution for haptic feedback on curved interactive surfaces.

In this project, Inria is responsible for WP2: Human Factors and Interaction Design, as well as the software development of the project main demo. A first version of this demo was showcased at the Geneva Motor Show 2017. We developed the dashboard software of the Mojave concept car, built by the Sbarro school.

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

Web site: http://happiness-project.eu/

Related publications: [27], [37]

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners

Andy Cockburn, University of Canterbury, Christchurch, NZ [12]

Daniel Vogel, University of Waterloo, Waterloo, CA [14]

Nathalie Henry Riche, Microsoft Research, Seattle, USA [17]

Audrey Girouard, Carleton University, Ottawa, CA [24]

Daniel Wigdor, University of Toronto, Toronto, CA [26]

Ravin Balakrishnan, University of Toronto, Toronto, CA [27]

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Ed Lank, Associate Professor at the University of Waterloo, has already spent one year in our team until Aug. 2017 (funded by Région Hauts-de-France and Université Lille 1). His stay was extended until Feb. 2018, funded by Inria.

Marcelo Wanderley, Professor at McGill University, who has been awarded an Inria International Chair in our team in 2016, spent 2 months in our group this year (June to July).

9.5.1.1. Internships

Shaishav Siddhpuria, Master student, Univ of Waterloo, from Feb. to Apr. 2017

Keiko Katsuragawa, Postdoc, Univ of Waterloo, Mar. 2017

Rina Wehbe, PhD student, Univ of Waterloo, Mar. 2017

Jeff Avery, PhD student, Univ of Waterloo, from Jun. to Aug. 2017

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. Scientific Events Organisation

10.1.1.1. General Chair, Scientific Chair

- ICMI (ACM): Edward Lank (General co-Chair)
- Rencontres Jeunes Chercheurs (AFIHM): Sylvain Malacria (co-Chair)
  RJCs is a biyearly summer school organized by the French-speaking HCI association with courses and seminars targeting 1st and 2nd year PhD students (about 20 participants).

10.1.1.2. Member of the Organizing Committees

- VIS (IEEE): Fanny Chevalier (Meetups co-Chair)

10.1.2. Scientific Events Selection

10.1.2.1. Member of the Conference Program Committees

- ICMI (ACM): Thomas Pietrzak
- Infovis (IEEE): Fanny Chevalier, Sylvain Malacria
- CHI (ACM): Fanny Chevalier (sub-committee co-chair), Sylvain Malacria (associate chair), Mathieu Nancel (associate chair)
- IHM (AFIHM): Géry Casiez

10.1.2.2. Reviewer

- CHI (ACM): Géry Casiez, Thomas Pietrzak
- UIST (ACM): Géry Casiez, Fanny Chevalier, Thomas Pietrzak, Sylvain Malacria, Mathieu Nancel
- MobileHCI (ACM): Sylvain Malacria
- ICMI (ACM): Christian Frisson, Mathieu Nancel
- ISS (ACM): Mathieu Nancel
- DIS (ACM): Mathieu Nancel
- Interact (IFIP): Géry Casiez, Fanny Chevalier, Stéphane Huot, Sylvain Malacria
- World Haptics (IEEE): Thomas Pietrzak
- Eurovis (IEEE): Fanny Chevalier
- IHM (AFIHM): Christian Frisson
- DAFx: Christian Frisson
- OzCHI: Amira Chalbi

10.1.3. Journal

10.1.3.1. Member of the Editorial Boards

- Computer Music Journal Editorial Advisory Board: Marcelo Wanderley

10.1.3.2. Reviewer - Reviewing Activities

- Intl. Journal of Human-Computer Studies (Elsevier): Thomas Pietrzak
- Transactions on Visualization and Computer Graphics (IEEE): Fanny Chevalier
- Transactions on Computer-Human Interaction (ACM): Fanny Chevalier
- Intl. Journal of Human–Computer Interaction (Taylor & Francis): Thomas Pietrzak

10.1.4. Invited Talks

- *Left Brain, Right Brain: Designing Interaction for Visual Analytics and Creativity*, Segal Seminar Series, Northwestern University: Fanny Chevalier
- *Designing Interaction for Visual Analytics and Creativity*, giCenter, City University of London: Fanny Chevalier
- *Direct Spacetime Sketching and Editing of Visual Media*, University College London: Fanny Chevalier
- *Static and Dynamic Network Visualization*, Université Catholique de Lille: Fanny Chevalier
- *Concevoir des systèmes interactifs pour tous*, European Commission in Luxembourg: Thomas Pietrzak
- *Advanced Interaction Techniques to Favor the Transition from Novice to Expert Behavior*, International Symposium on User Expertise and Interactive Systems (UEIS): Sylvain Malacria

10.1.5. Leadership within the Scientific Community

Association Francophone d'Interaction Homme-Machine (AFIHM):

- Géry Casiez: president until Sept. 2017
- Stéphane Huot: board member until Sept. 2017, scientific council member
- Thomas Pietrzak: board member, webmaster

10.1.6. Scientific Expertise

- Natural Sciences and Engineering Research Council (NSERC) Discovery grants: Géry Casiez (reviewer), Fanny Chevalier (reviewer)
- CN35 AFNOR normalization committee about normalizing the French keyboard, in collaboration with Aalto University and the Max Planck Institute: Mathieu Nancel
- Research Foundation - Flanders (FWO), evaluate doctoral fellowships strategic basic research applications: Mathieu Nancel

10.1.7. Research Administration

For Inria:

- Evaluation committee: Nicolas Roussel (member until July 2017)
- Gender equity and equality committee: Nicolas Roussel (member)
- Strategic orientation committee for the information system (COSS scientifique): Nicolas Roussel (member)
- International relations working group (COST-GTRI): Stéphane Huot (member)

For Inria Lille – Nord Europe:

- Scientific officer (délégué scientifique): Nicolas Roussel (until July 2017)
- “Bureau du comité des équipes projets” (BCEP): Stéphane Huot (member since Sept. 2017)
- Research jobs committee (CER): Fanny Chevalier (member), Nicolas Roussel (member until July 2017)
- Technical development committee (CDT): Nicolas Roussel (member until July 2017)
- Consultative committee (Comité de centre): Fanny Chevalier (member)
- Operational legal and ethical risk assessment committee (COERLE): Stéphane Huot (local correspondent)
- Support to researchers (accompagnement des chercheurs): Stéphane Huot (adviser)
- Activity reports (RAweb): Nicolas Roussel (local correspondent until July 2017)

For the CRIStAL lab of Univ. Lille 1 & CNRS:

- Laboratory council: Géry Casiez (elected member)
- Computer Science PhD recruiting committee: Géry Casiez (member)

For the Univ. Lille 1:

- Coordinator for internships at IUT A: Géry Casiez

10.1.8. Hiring committees

- Inria’s eligibility jury for Junior Researcher Positions (CR2) in Lille: Stéphane Huot (president)
- University of Lille hiring committee for two Computer Science Assistant Professor positions: Thomas Pietrzak (vice-president)
- University of Nice Sophia Antipolis hiring committee for a Computer Science Full Professor position: Stéphane Huot (member)
- Université Paris-Saclay hiring committee for a Computer Science Assistant Professor position: Géry Casiez (member) and Fanny Chevalier (member)

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

DUT Informatique: Géry Casiez (72h), Stéphane Huot (28h), *IHM*, 1^{st} year, IUT A de Lille - Univ. Lille 1

DUT Informatique: Géry Casiez, *Algorithmique*, 80 h, 1st year, IUT A de Lille - Univ. Lille 1

DUT Informatique: Géry Casiez, *Modélisation mathématique*, 14 h, 2nd year, IUT A de Lille - Univ. Lille 1

DUT Informatique: Géry Casiez, *Projets*, 18 h, 2nd year, IUT A de Lille - Univ. Lille 1

Licence Informatique: Thomas Pietrzak, *Logique*, 52.5h, L3, Univ. Lille 1

Licence Informatique: Thomas Pietrzak, *Automates et Langages*, 36h, L3, Univ. Lille 1

Licence Sciences pour l'Ingénieur (SPI): Sylvain Malacria, *Introduction à l'Interaction Homme Machine*, 30h, L3, Institut Villebon Georges Charpak

Master Informatique: Thomas Pietrzak (18h), Géry Casiez (11h), Fanny Chevalier (13.5h), *NIHM*, M2, Univ. Lille 1

Master Informatique: Géry Casiez, *RVI*, 4 h, M2, Univ. Lille 1

Master Informatique: Géry Casiez, *Multi-Touch Interaction*, 10 h, M1, Univ. Lille 1

Master Informatique: Géry Casiez (4h), Thomas Pietrzak (4h), *Projets*, M2, Univ. Lille 1

Master Informatique: Thomas Pietrzak (55.5h), Sylvain Malacria (31.5), Nicolas Roussel (6h), *IHM*, M1, Univ. Lille 1

Master Informatique: Mathieu Nancel, *Information Visualization*, 9h, M2, Univ. Lille 3

Master: Géry Casiez (6h), Thomas Pietrzak (10.5h), *3DETech : 3D Digital Entertainment Technologies*, M2, IMT Lille Douai

Master: Thomas Pietrzak, *IHM et interfaces à gestes*, 12h, M2, Polytech Lille

Master Sciences Humaines et Sociales – Réseaux Sociaux Numériques (RSN): Fanny Chevalier, *Statistiques et visualisation de données*, 8h, M2, Univ. Lille 1

Master Sciences Humaines et Sociales – Réseaux Sociaux Numériques (RSN): Fanny Chevalier, *Outils et pratiques numériques*, 6h, M1, Univ. Lille 1

Doctorat: Géry Casiez, *Workshop on statistics for HCI*, AFIHM RJC IHM 2017

10.2.2. Supervision

PhD: Justin Mathew, *A Design Framework for User Interfaces of 3D Audio Production Tools*, defended in Oct. 2017 [11], advised by Stéphane Huot & Brian Katz

PhD in progress: Axel Antoine, *Helping Users with Interactive Strategies*, started Oct. 2017, advised by Géry Casiez & Sylvain Malacria

PhD in progress: Nicole Ke Chen Pong, *Understanding and Improving Users Interactive Vocabulary*, started Oct. 2016, advised by Nicolas Roussel, Sylvain Malacria & Stéphane Huot

PhD in progress: Thibault Raffaillac, *Languages and System Infrastructure for Interaction*, started Oct. 2015, advised by Stéphane Huot & Stéphane Ducasse

PhD in progress: Amira Chalbi-Neffati, *Understanding and Designing Animations in the User Interfaces*, started Oct. 2014, advised by Nicolas Roussel & Fanny Chevalier

PhD in progress: Hakim Si Mohammed, *Improving Interaction Based on a Brain-Computer Interface*, started Oct. 2016, advised by Anatole Lecuyer, Ferran Argelaguet, Géry Casiez & Nicolas Roussel (in Rennes)

PhD in progress: Hrim Mehta, *Data Narratives*, started Oct. 2016, advised by Christopher Collins & Fanny Chevalier (at University of Ontario)

PhD in progress: Nicole Barbosa Sultanum, *Visualization of Medical Narratives*, started Sept. 2015, advised by Michael Brudno, Daniel Wigdor & Fanny Chevalier (at University of Toronto)

PhD in progress: Alexandre Kouyoumdjian, *Multimodal Selection of Numerous Moving Targets in Large Visualization Platforms: Application to Interactive Molecular Simulation*, started Oct. 2013, advised by Stéphane Huot, Patrick Bourdot & Nicolas Ferey (in Saclay)

PhD in progress: Jeronimo Barbosa, *Design and Evaluation of Digital Musical Instruments*, McGill University, started in 2013, advised by Marcelo Wanderley & Stéphane Huot (in Montréal)

10.2.3. Juries

Caroline Appert (HDR, Univ. Paris-Saclay): Géry Casiez, examiner

Jessalyn Alvina (PhD, Univ. Paris-Saclay): Géry Casiez, examiner

Élie Cattan (PhD, Univ. Grenoble Alpes): Géry Casiez, reviewer

Martin Cronel (PhD, Univ. de Toulouse): Géry Casiez, examiner

Onur Ferhat (PhD, Univ. Autònoma de Barcelona): Christian Frisson, examiner

Maxime Guillon (PhD, Univ. Grenoble Alpes): Géry Casiez, reviewer

Rafael Morales González (PhD, Univ. Paris-Saclay): Stéphane Huot, examiner

10.2.4. Mid-term evaluation committees

- Olivier Capra (PhD, Univ. Lille 1): Stéphane Huot
- Bruno Fruchard (PhD, Univ. Paris-Saclay): Géry Casiez
- Sarah Ribet (PhD, Univ. Lille 1): Géry Casiez
- Hugo Romat (PhD, Univ. Paris-Saclay): Fanny Chevalier

10.3. Popularization

Dashboard software in the Sbarro car: Mojave at the Geneva Motor Show 2017 in Geneva, Julien Decaudin, Christian Frisson, Thomas Pietrzak.

Projet Happiness : ça roule pour le tactile, interview in the Inria official website, Thomas Pietrzak, Christian Frisson, Julien Decaudin.

Dans la peau d'un robot, article in le blog binaire and in the Inria official website, Amira Chalbi.

Banned From the US? There's a Robot for That, interview in WIRED, Amira Chalbi.

Mon Histoire avec l'Informatique, presentation at "L codent L créent": Amira Chalbi, Nicole Pong.

11. Bibliography

Major publications by the team in recent years

[1] B. ALPER, N. H. RICHE, F. CHEVALIER, J. BOY, M. SEZGON. *Visualization literacy at elementary school*, in "Proceedings of CHI'17", ACM, May 2017, pp. 5485-5497, http://dx.doi.org/10.1145/3025453.3025877

[2] G. BAILLY, T. PIETRZAK, J. DEBER, D. J. WIGDOR. *Metamorphe: augmenting hotkey usage with actuated keys*, in "Proceedings of CHI'13", ACM, April 2013, pp. 563-572, http://dx.doi.org/10.1145/2470654.2470734

[3] F. CALEGARIO, M. WANDERLEY, S. HUOT, G. CABRAL, G. RAMALHO. *A method and toolkit for digital musical instruments: generating ideas and prototypes*, in "IEEE MultiMedia", January 2017, vol. 24, n^{o} 1, pp. 63-71, https://doi.org/10.1109/MMUL.2017.18

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Publications of the year

Doctoral Dissertations and Habilitation Theses

[11] J. D. MATHEW. *A design framework for user interfaces of 3D audio production tools*, Université Paris-Saclay, October 2017, https://tel.archives-ouvertes.fr/tel-01632727

Articles in International Peer-Reviewed Journals

[12] J. ACEITUNO, S. MALACRIA, P. QUINN, N. ROUSSEL, A. COCKBURN, G. CASIEZ. *The design, use, and performance of edge-scrolling techniques*, in "International Journal of Human-Computer Studies", January 2017, vol. 97, pp. 58 - 76 [*DOI :* 10.1016/J.IJHCS.2016.08.001], https://hal.archives-ouvertes.fr/hal-01624625

[13] F. CALEGARIO, S. HUOT, M. M. WANDERLEY, G. CABRAL, G. RAMALHO. *A Method and Toolkit for Digital Musical Instruments: Generating Ideas and Prototypes*, in "IEEE MultiMedia", February 2017, vol. 24, n^{o} 1, 9 p. [*DOI :* 10.1109/MMUL.2017.18], https://hal.inria.fr/hal-01467105

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J. ZHAO, M. GLUECK, P. ISENBERG, F. CHEVALIER, A. KHAN. *Supporting Handoff in Asynchronous Collaborative Sensemaking Using Knowledge-Transfer Graphs*, in "IEEE Transactions on Visualization and Computer Graphics", 2018, vol. 24, n^{o} 1, pp. 340-350 [*DOI :* 10.1109/TVCG.2017.2745279], https://hal.inria.fr/hal-01565560.

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B. ALPER, N. HENRY RICHE, F. CHEVALIER, J. BOY, T. M. SEZGIN. *Visualization Literacy at Elementary School*, in "CHI '17 - Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems", Denver, CO, United States, ACM, May 2017, pp. 5485-5497 [*DOI :* 10.1145/3025453.3025877], https://hal.inria.fr/hal-01558717.

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