IIHM – EHCI

Ingénierie de l'Interaction Homme-Machine
Engineering Human-Computer Interaction

Scientific leader: Laurence Nigay
Reporting Period: 1st January 2014 to 30th June 2019
Web site: <http://iihm.imag.fr/en/>
Parent Organizations: CNRS, Grenoble INP (G-INP), Université Grenoble Alpes (UGA)

The IIHM research group is primarily concerned with concepts, models and software tools / artifacts for interaction techniques and interactive systems. The core scientific activity focuses on the theoretical and technical foundations of interaction for Human-Computer Interaction. Human-Computer Interaction (HCI) is a discipline examining the relation between humans / human societies and interactive systems. On the one hand humans and human societies change. On the other hand technologies of interactive systems change. One is influenced by the other.

In this evolving world, the scientific project of the IIHM group involves concepts, models and software tools for designing, implementing and evaluating interaction techniques and systems and embraces this evolution by focusing on five main research themes:

1. Novel Interaction Techniques for GUI
2. Multimodal Interaction
3. Plasticity and End-User Programming
4. Mixed Reality Interaction
5. Mobile Interaction

Although the IIHM group activities are presented along five main themes (some of them having dedicated conferences and journals in the HCI community), our research studies span several themes. The themes enable us to present the main research activities of the IIHM group but do not in any way define five sub-groups. The collaboration between the group members guarantees a strong scientific consistency of the IIHM group in covering significant issues in HCI.

IIHM adopts a research approach that fruitfully combines conceptual (or analytical) and empirical studies. IIHM is pivotal in establishing conceptual problem / design spaces and taxonomies for a particular problem (e.g., [9, 17, 21]). IIHM also adopts an empirical research approach by conducting both controlled laboratory experiments (e.g., [25, 17]) and in-field evaluations (e.g., [8, 7, 55]) to study interaction. The approach thus involves the interplay of deduction and induction that feed on each other. Both conceptual / fundamental work with practical / empirical work is combined. The feedback loop of deduction / induction relies on the development of interaction techniques. Such interaction techniques have been drivers of transfer to industrial partners during the reporting period through CIFRE doctoral studies.

1.1 Scientific Policy

We received two recommendations related to the previous reporting period.

1. The first recommendation is to study how to better concentrate the forces on a set of research subjects. During the reporting period we built and conducted research projects drawing from the complementary expertise of the group members. We conducted research projects with a large number of group members. For instance the project PIA Connexion whose application domain is the nuclear power plant control system, involved 4 group members and relied on the group expertise on plasticity, multi-user interaction, formal approaches for UI and model-based engineering. Another example is the project ANR ISAR on Spatial Augmented Reality that involved 4 members and relied on the group expertise on deformable UI, 3D UI, projection-based UI and touch-based interaction. This approach also applies to very recent projects including HUMID (THALES Man-Machine Teaming) and future projects that we plan to submit. Since the

group is tightly coupled, this is a naturally emerging approach that is not forced by governance rules that would obviously not work.

2. The second recommendation was to continue the publication effort, in particular to target the best conferences that are general to HCI. We organized ourselves to create a dynamics for stimulating submissions to ACM CHI (the flagship conference of HCI, Core 2018: A*) and currently less intensively to ACM UIST: writing / reviewing workshops and discussion on potential submissions in June to foster a group-wide emulation. This was quite successful. About the ACM CHI conference only:

- We submitted 7 papers in September 2018.
- During the reporting period we published 9 papers (for comparison, 4 CHI papers during the previous reporting period). Moreover 3 of them received an Honorable Mention award (top 5% of the 2300+ submissions in 2016, of 2400+ submissions in 2017, 2500+ submissions in 2018).

The activity profile of the IIHM group is based on the activity profile of each of its permanent members considering only the research activities and ignoring the administration and teaching activities.

proportion (%)	average	lowest	highest
Production of knowledge / Academic research	57.7	50	75
Interaction with the socio-economic environment	9.6	0	40
Research community service	14.6	10	25
Training through research	18.1	0	30

1.2 Key Achievements

Amongst the group's key achievements, we selected some with a scientific, a social and an industrial impact. We cannot describe all of them in one page.

1.3 Scientific achievements

The main achievement of the team is the produced scientific results. These results have been recognized by the HCI community through 46 publications in HCI conferences and journals ranked A* and A. Four of them received an award (CHI and PacificVis).

39 long publications in international conferences (**A***, A): **CHI (9)**, **UIST (1)**, AVI (5), EICS (7), ICMI (2), INTERACT (6), ITS (2), ISS(2), IUI (1), MOBILEHCI (1), PacificVIS (2), VR (1).
7 articles in international journals: ACM CSUR (1), ACM PACMHCI (1), ACM TACCESS (1), ACM ToCHI (2), ACM TIIS(1), IEEE Pervasive computing (1).

We also published several articles in related domains including Software Engineering, Information Systems, Network and Signal Processing. We are particularly proud of the two demonstrations at the conference ISMAR (A*), one on mobile augmented reality [58] and one on spatial augmented reality [5]. The latter entitled "A low-latency, high-precision handheld perspective corrected display" received the award of the best demonstration.

1.4 Social impact

As part of their pluridisciplinary work on visualization techniques for computational social choices [60], Renaud Blanch, Sylvain Bouveret of the LIG-Steamer team and other colleagues have run a voting experiment during the 2017 French presidential election. The collected data are available at <https://vote.imag.fr/>. This work has been widely covered by the media (articles, radio and TV). Following this work, Cédric Villani presented a report on the different voting systems at the French law Commission on 12 September 2018. This report includes the

study performed by Renaud Blanch and Sylvain Bouveret on the voting systems for the 2017 French parliamentary election. This study was requested by Cédric Villani who was president of OPECST (The Parliamentary Office For Scientific and Technological Assessment).
<http://videos.assemblee-nationale.fr/video.6564573_5b98c56d8683a>

1.5 International Visibility and awards

We are particularly proud that Joëlle Coutaz is one of the key HCI personalities described in Ben Schneiderman's project: The Human-Computer Pioneers Project (a web site in 2016 <https://hcipioneers.wordpress.com> and a book in 2019). *"Joëlle Coutaz is widely recognized for her thoughtful leadership for CHI in France ... She had impact through her international efforts to promote the notion of 'plasticity' in user interfaces ..."* — Ben Shneiderman

Céline Coutrix was awarded the 2017 CNRS Bronze Medal.

Laurence Nigay has been elected senior member of the "Institut Universitaire de France" (2019-2024).

1.6 Valorization / Transfer

A particular effort has been devoted to mature a software platform that supports plasticity of user interfaces. Two SATT projects have been conducted to mature the platform and to make it usable by developers in large software projects. A new approach whose architecture has been patented in 2015 relies on cross-fertilisation between Responsive Web Design and Model-Driven Engineering.

Our work on distant pointing techniques based on target-expansion [17] has been transferred to the Aesculap company as part of a CIFRE doctoral study. One of our target-expansion techniques is included in the Aesculap Implant System for Computer-assisted surgery. It is a rewarding experience.

2.1 Team members

Permanent Members			
Name	*Institution*	*Grade*	*Date*
Bérard François	G-INP	Associate Professor	Jan. 01–
Blanch Renaud	UGA	Associate Professor	Sep. 06–
Caffiau Sybille	UGA	Associate Professor	July 12–
Calvary Gaëlle	G-INP	Professor	Jan. 00–
Céret Eric	UGA	Associate Professor	Sep. 15–
Coutaz Joëlle	UGA	Professor Emeritus	Sep. 73–
Coutrix Céline	CNRS	Researcher	Sep. 10–
Demeure Alexandre	UGA	Associate Professor	Feb. 16– (Sep. 08–Jan.16: Ass. Prof. LIG / Pervasive)
Dupuy-Chessa Sophie	UGA	Professor	Sep. 02– (Sep. 08–: 50% IIHM, 50% SIGMA)
Goguey Alix	UGA	Associate Professor	Sep. 18–
Laurillau Yann	UGA	Associate Professor	Sep. 07–
Nigay Laurence	UGA	Professor	Sep. 94–
Ortega Michael	CNRS	Research Engineer, part time	Sep. 10–
Tarpin-Bernard Franck	UGA	Professor	Sep. 09–Sep. 16 (Sep. 13–Sep. 16: delegation at SBT SA, Lyon)

Non Permanent Members		
Name	*Status*	*Date*
Parisa Eslambolchilar	Visiting Professor (Senior Lecturer, Cardiff University)	Jan. 16–Feb. 16
Jean Vanderdonckt	Visiting Professor (Professor, Université Catholique de Louvain)	Feb. 16–April 16
Eléna Elias	Visiting Researcher	Jan. 17–
Nikolaos Karanikolas	Postdoctoral Fellow	Oct. 14–Oct. 15
Nicolas Hili	Postdoctoral Fellow	Feb. 15–Jan. 16
Sébastien Pelurson	Postdoctoral Fellow	June 16–May 17
David Furio	Postdoctoral Fellow	Jan. 17–March 18
Mira Sarkis	Postdoctoral Fellow	March 17–Sept. 18
Fatoumata Camara	Postdoctoral Fellow	Sept. 17–April 19
Ivan Logre	Postdoctoral Fellow	Oct. 17–Sept. 18
Jérémy Wambecke	Postdoctoral Fellow	Dec. 18–
Camille Lenoir	Engineer	Jan. 13–Feb. 15
Thomas Jansoone	Engineer	Feb. 13–July 14
Morgan Bidois	Engineer	Sept. 14–June 15 April 16–Nov. 16
Phi Bang Nguyen	Engineer	Jul. 13–Jul. 15
Carole Plasson	Engineer	Feb. 16–Sept. 17
Thibault Louis	Engineer	April 16–Sept. 17

Non Permanent Members (cont.)		
Name	*Status*	*Date*
Dimitri Masson	Doctoral Student	Sept. 10–Sept. 14
Eric Céret	Doctoral Student	Nov. 10–July 14
William Delamare	Doctoral Student	Oct. 10–Nov. 15
Laure Martins-Baltar	Doctoral Student	Oct. 11–Sept 14
Thomas Vincent	Doctoral Student	Oct. 11–Sept. 14
Rémi Brouet	Doctoral Student	Oct. 11–March 15
Wafa Johal	Doctoral Student	Sept. 12–Oct. 15
Nataliya Kos'myna	Doctoral Student	Oct.12–Oct. 15
Raquel Oliveira	Doctoral Student	Oct. 12–Dec. 15
Maxime Guillon	Doctoral Student	Feb. 13–Nov. 17
Elisabeth Rousset	Doctoral Student	May 13–Feb. 16
Sébastien Pelurson	Doctoral Student	Sept. 13–Sept. 16
Anthony Foulonneau	Doctoral Student	Nov. 13–Dec. 17
Rémy Dautriche	Doctoral Student	Nov. 13–Oct. 16
Sara Bouzit	Doctoral Student	Dec. 13–June 17
Elie Cattan	Doctoral Student	Oct. 14–Sept. 17
Ali Jabbari	Doctoral Student	April 15–July 18
Jérémy Wambecke	Doctoral Student	Oct. 15–Oct. 18
Neila Chettaoui	Doctoral Student (stopped: co-tutelle financial support not renewed)	April 16–Nov. 18
Miranda Baez	Doctoral Student	Oct. 14–Dec. 18
Juan Rosso Pirela	Doctoral Student	Oct. 15–Dec. 18
Julián André Galindo	Doctoral Student	Sept. 15–
Hyunyoung Kim	Doctoral Student	Oct. 15–
Van Bao Nguyen	Doctoral Student	Nov. 15–
Marine Lamare	Doctoral Student	Jan. 16–
Alessandro Fenicio	Doctoral Student	Sept. 16–
Hayet Hammami	Doctoral Student	Sept. 16–
Tanguy Giuffrida	Doctoral Student	Oct. 16–
Patrick Perea	Doctoral Student	Nov. 16
Charles Bailly	Doctoral Student	Oct. 17–
Thibault Louis	Doctoral Student	Oct. 17–
Carole Plasson	Doctoral Student	Oct. 17–
Mina Alipour	Doctoral Student	Oct. 18–
Aurélie Peillon	Doctoral Student	Oct. 18–

The composition of the IIHM research group has changed during the reporting period as follows, in chronological order:

- Franck Tarpin-Bernard was on leave (delegation at Scientific Brain Training - SBT SA) from September 2013 until September 2016. He decided to pursue his work as part of SBT SA and not to come back to academic research. He is now a managing director of SBT SA.
- Renaud Blanch was on leave (delegation at CNRS) from September 2013 until September 2014. He was a Visiting Scientist at École Supérieure de Technologie (Montréal, Canada) in March 2014.
- Yann Laurillau defended his Habilitation thesis on November 2014.
- Michael Ortega was a visiting scientist at Simon Fraser University, Vancouver (Pr Wolfgang Stuerzlinger) between 17 August 2015 and 11 September 2015.
- Eric Céret joined in September 2015 as an Associate Professor.
- Parisa Eslambolchilar (Senior Lecturer, Cardiff University) was a Visiting Professor in the IIHM group between 18 January 2016 and 18 February 2016.

- Céline Coutrix was on leave from January 2016 until August 2018 (CNRS long-term mission). She was a visiting researcher in the human-computer interaction research group at the University of Stuttgart, working on shape-changing UI. During her stay she was awarded the Humboldt Research Fellowship for Experienced Researchers.
- Alexandre Demeure who has been Associate Professor in the LIG Pervasive group since September 2008, joined our IIHM group in February 2016 with a research program centered on end-user development.
- Jean Vanderdonckt (Professor, Université Catholique de Louvain) was a Visiting Professor in the IIHM group between 1 February 2016 and 30 April 2016.
- Alix Goguey joined in September 2018 as an Associate Professor.
- Sophie Dupuy-Chessa obtained a ½ CRCT leave of absence from February 2019 until July 2019. During this period she will spend a month as a visiting scientist at the LIST institute in Luxembourg working on information systems. She is also the president of the IHM 2019 conference that will take place in Grenoble and is driving its organization.
- Renaud Blanch will be on leave (½ CRCT) during the second semester of the academic year 2019–2020. He will be a visiting scientist at Edinburgh University and will collaborate with B. Bach (Lecturer) on interactive visualization.

2.2 Team organization and scientific animation

For scientific animation we organize three meetings per month (called "lunch équipe") in addition to meetings between permanent faculty members (lunch). The three group meetings per month take different forms: meeting with presentations by visitors, masters / doctoral students and permanent members on a specific topic, meeting to demonstrate a tool and writing workshops where we all comment on abstracts / articles being written. Moreover articles are exchanged and commented by the group members (if enough time before the deadline).

The governance of the IIHM group is based on the principles of the "reasonable person", on scientific mutual respect and freedom, and encourages initiatives and hard work. The group leader informs the permanent members of each call for projects: local calls (Labex, Idex) and national / international calls. Finding resources for conducting research studies involving several members is an important activity of the group leader who also encourages initiatives of each member. The contribution and collaboration between the group members on different themes guarantees a strong scientific consistency of the IIHM group in covering significant issues in HCI. Every new permanent group member receives the financial support from the group that is necessary to start her / his research (travel, students gratification, equipment). Every student is enrolled within a research contract and is offered to attend reference conferences in the field (even without publication) to become acquainted with the mechanisms of research.

With regard to the everyday life of the group, several social activities contribute to the group cohesion: we routinely have lunch all together (permanent and non-permanent members). Every Friday morning, we have croissants, a gathering organized by the doctoral students. We organize a two-day workshop outside Grenoble every two years (next one in May 2019 in the mountains), a picnic during the summer and a "cake" gathering to celebrate each accepted article, the first author bringing a home-made cake.

2.3 Financial ressources

Contracts and grants		
Source of funding	*Projects Acronym (in bold, on going projects)*	*Budget managed by IIHM (€)*
European projects	AppsGate (CATRENE), Leonardo da Vinci (Education)	991 491
ANR	AMIE (Blanc Int., Coord.), SYSEO, ISAR **ANATOMY2020, AP2, PHYFLEX**	1 128 919
Investment for the Future *"Investissement d'avenir"*	CONNEXION (BGLE), BIG DATA (NANO) Labex Persyval-lab (budget of 6 projects without including the PhD and Post-Doc grants) Idex UGA CDP **Eco-Sesa**, CDP **RISK**	590 793 65 127
FUI	3DCI, DELIGHT	513 700
French Defense Agency	FENICS (AERO)	22 500
CNRS	PEPS S2IH	10 000
Internal Funding	6 projects	73 400
Contracts with Industry	**AESCULAP**, CORYS T.E.S.S, ORANGE, BRECHERCHES, **EASY MOUNTAIN**, MOBILE SERVICE SA, **SCHNEIDER ELECTRIC**, **THALES**	394 578
Industrial Transfer	Flexilab, MIAM-MIAM	52 803
	Total funding (€)	**3 843 311**

The table above summarizes the contracts and grants of IIHM during the reporting period. The table only includes the projects whose budgets were / are managed by IIHM. We were involved in other projects whose budgets are managed by another Grenoble team including the three ANR projects INVOLVED (165 k€), MOCA (177 k€), VocADom (300 k€), PIA IKATS (620 k€) as well as several Labex Persyval-lab projects (with several PhD / Post-Doc grants).

The on-going projects cover several themes of the IIHM group including Augmented Reality / 3D interaction (ANR-ANATOMY, ANR-AP2, the two industrial contracts with Aesculap and Schneider Electric), shape-changing UI (ANR-PHYFLEX), plasticity / persuasion (industrial contract Easy Mountain, Idex Grenoble-Alpes funding CDP Eco-Sesa), multi-user and multimodal interaction (Idex Grenoble-Alpes funding CDP RISK, industrial contract THALES).

2.4 Ethics

Parity. The IIHM group is exemplary for the parity among its members. The permanent members consist of 6 women and 7 men. The parity also applies to doctoral students. 7 female and 13 male doctoral students defended their PhD thesis over the reporting period. The IIHM group currently includes 6 female and 7 male doctoral students.

Environmental impacts. As a joint activity of the group, we are organizing the conference IHM 2019 in Grenoble. As stated on the web site <https://ihm2019.afihm.org/>, we have decided to put a particular effort on taking into account environmental impacts of such conferences. For instance we plan to compensate for the carbon emission of participants' transportation by planting trees.

In research we study persuasive interactive techniques and interactive visualization techniques applied to energy consumption (ANR INVOLVED project (2015–18) and the IDEX-UGA CDP EcoSesa cross-disciplinary project (2017–2021)). Results include a multi-slider interaction technique for decision-making tasks [56], the development of a nature-inspired ambient display complemented with visually augmented light switches to promote energy consumption awareness in public areas of office buildings [55], as well as a "What if" approach to eco-feedback in domestic environments [61].

Scientific integrity. For each published contribution, we aim at sharing the study materials. Sharing study material as much as possible greatly facilitates replication of research[1].

[1] Transparent Statistics in Human–Computer Interaction, <https://transparentstatistics.org/>.

For instance:

- The code of the article [34] is available under the GPLv3.0 license at:
  <http://iihm.imag.fr/blanch/projects/dendrogramix/src/>.
- The code of the study on distractors for comparing pointing techniques is available under the GPLv3.0 license at:
  <http://iihm.imag.fr/blanch/projects/distractors/src/>.
  This code has been reused in the study on distant pointing techniques [17] (defended thesis of Maxime Guillon [14]).
- The anonymous data and the analysis code associated with the conducted experiments described in [44] (best paper at the conference IHM 2016) are published at:
  <http://iihm.imag.fr/coutrix/studies-files/SizeOrientation.html>.

As future work we aim at making this process even more comprehensive as we did not publish the related study materials for all our papers. For each published contribution, we aim at establishing a framework to help publish the code, the models and other study materials available as well as the anonymous data and the analysis code associated with the conducted experiment described in the paper[1]. The internal team mechanism to further promote publication of materials for transparency and replication of our results will be discussed at the team retreat in May 2019.

3) Scientific and technological results

The main results are concepts, models, methods, interaction techniques and tools. We present them along our five themes: novel interaction techniques for GUI, multimodal interaction/deformable interaction device, user interface plasticity / end-user development, mixed reality interaction, mobile interaction.

On the one hand, the five themes we address correspond to sub-domains in HCI with dedicated journals and conferences. This enables us to position ourselves within the HCI community. On the other hand, the themes correspond either to a particular context of use (mobile interaction) or to interaction paradigms (graphical interaction, multimodality, augmented reality) or to engineering approaches to interaction (plasticity, persuasion, end-user programming). It is then unavoidable that our research studies very often span several themes. We present the main results classified along the five themes by considering the initial research question that was addressed.

3.1 Novel Interaction Techniques for GUI

Contributors	
Permanent members:	F. Bérard, R. Blanch, S. Dupuy-Chessa, L. Nigay, M. Ortega
Doctoral students:	—
Defended theses:	R. Brouet, É. Cattan, R. Dautriche, M. Guillon, A. Jabbari, É. Rousset, J. Wambecke
Publications	
Conferences:	CHI 14 [15], CHI 15 [16, 17], CHI 17 [25], UIST 15 [18], AVI 14 [32, 31], AVI 16 [41], ITS 15 [39, 38], ISS 16 [45], PacificVIS 15 [34], PacificVIS 18 [28], VR 18 [51]
Journals:	ACM CSUR 17 [9]
Awarded publications:	CHI 17 [25], PacificVIS 15 [34]

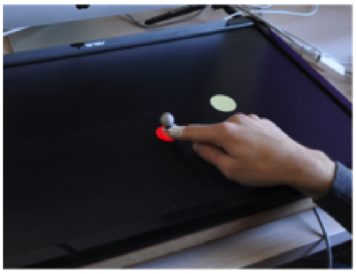

Figure 3.1: Latency: The finger is localized by optical tracking using a marker. Users touch the red circle to bring it into the white target.

Figure 3.2: Direct Drawing on 3D Shapes with Automated Camera Control (ACCD). With ACCD, the small radius of a torus can be drawn in a single continuous curve.

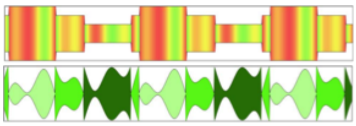

Figure 3.3: Examples of a composite visual mapping: Top: Size-Hue Bottom: Saturation-Size.

This theme focuses on interaction techniques that improve **Graphical User Interface** (GUI) interaction. We delimit this theme by considering studies of fundamental knowledge of interaction as well as studies of interaction for basic and generic graphical tasks including target acquisition, viewpoint manipulation, visual menu and exploration of large information spaces. We have worked at two levels of abstraction: device / sensory-motor phenomenon level and interaction technique level.

This work improved the fundamental knowledge of the effect of **latency** on the interaction, and more precisely on touch interaction on large interactive surfaces (Fig. 3.1). Our contributions include the implementation of a large interactive surface with very low latency (17ms), and the use of this system to: measure the performance degradation of users' pointing with latency, evaluate the benefit of using prediction on users' performances, and demonstrating users' ability to compensate for latency in tracking tasks.

Focusing on the basic task of pointing, we further extend our previous studies by considering target expansion techniques for **distant pointing**. The context of augmented surgery (collaboration with Aesculap-Bbraun company) provides a concrete real world context for interacting at a distance with a GUI. Focusing on feedforward mechanisms for target expansion, we proposed a design space for describing, classifying and designing target expansion techniques. Based on this design space, several target expansion techniques have been designed and experimentally compared.

Nowadays, displaying 3D content is common. Efficiently **interacting with 3D content** and navigating in and around 3D content are crucial for both novice and expert users. We further developed this research axis and introduced new forms of interaction with 3D virtual scenes. We demonstrated the performance benefit of a novel multi-touch rotation technique and we studied intuitive, and easy-to-learn viewpoint manipulation (Fig. 3.2).

Finally we have continued our work on **interactive visualization**. In particular we have explored (1) the concept of hybrid visualizations that merge efficiently various encodings (e.g., with Dendrogramix) (2) the concept of composite mappings that use several graphical channels to encode a single data attribute (e.g., Fig. 3.3), thus maximizing the throughput while satisfying space constraints.

3.2 Multimodal interaction / Deformable interaction device

Contributors	
Permanent members:	S. Caffiau, C. Coutrix, A. Goguey, Y. Laurillau, L. Nigay, F. Tarpin-Bernard
Doctoral students:	K. Hyunyoung
Defended theses:	N. Kos'myna, W. Delamare, S. Pelurson
Publications	
Conferences:	CHI 18 [29, 30], AVI 16 [40], EICS 15 [33], ICMI 15 [37], ICMI 16 [46], INTERACT 15 [20, 36], INTERACT 19 [4]
Journals:	ACM TACCESS 15 [7], ACM ToCHI 15 [11], ACM ToCHI 15 [6]
Awarded publications:	CHI 18 [30]

Figure 3.4: Brain-computer interaction: in-game training.

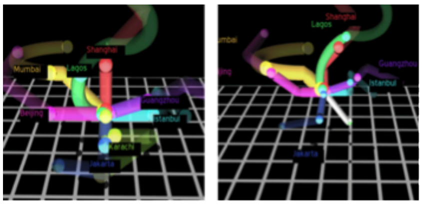

Figure 3.5: OctoPocus3D: 3D Gesture Guidance. User starts following the gesture toward the direction up-left. Radius of unlikely recognized gestures (on the right of the scene) have decreased.

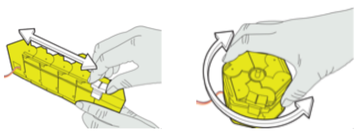

Figure 3.6: KnobSlider is a shape-changing device that changes between a rotational knob and a linear slider.

This theme is one of the foundational research areas of the group. During the reporting period we focused on input multimodal interaction (from user to interactive system). The IIHM group had three complementary research avenues during the reporting period.

First we studied particular input modalities or combinations of modalities. We pursued our work on brain-computer interaction and muscle-computer interaction. Our goal was to reduce the need for training and calibration (e.g., in-game training, Fig. 3.4) as well as to improve the accuracy by combining modalities. We also focused on speech as an input modality for controlling a smart home: the conducted experiment with seniors and people with visual impairment showed the need to better adapt the speech recognizer to the user and the environment. To control smart homes, we also focused on 3D in-air gestures. We designed OctoPocus3D (Fig. 3.5) a technique to guide novice users to perform 3D in-air gestures and we built a design space for gesture guiding systems.

A second avenue of research is reconfigurable input interfaces. Physical deformation of controls defines a novel form of sequential multimodality through physical shape and size changes. Key results include 1) the design of KnobSlider (Fig. 3.6), a device that can be reconfigured either by the user or by the system, and that can switch between a rotary knob and a slider; 2) a revision of existing taxonomies of reconfigurable UIs. Other reconfigurable controls have been designed for mobile interaction (see Section 3.5).

Figure 3.7: (Left) Bifocal display on mobile devices. (Right) 3-phase modeling of the navigation task: Focus-targeting phase (fast navigation); transition phase; and cursor pointing phase (precise navigation).

A third avenue of research focused on transition between modalities. Multimodal interaction for a given task is geared towards improving performance by using the most adequate modality for a given sub-task. The transition between modalities must then be the shortest one, else the time saved by using a suitable modality will be lost by the time needed for transitioning to another modality. In a study of a selection task in bifocal view (Fig. 3.7) on mobile devices, we experimentally studied several combinations of modalities by focusing on transition time. We have adopted a multimodal approach to solve the problem of fast and accurate navigation.

3.3 User Interface Plasticity / End-User Development

Contributors	
Permanent members:	S. Caffiau, É. Céret, J. Coutaz, G. Calvary, A. Demeure, S. Dupuy-Chessa, Y. Laurillau
Doctoral students:	M. Alipour, A. Fenicio, J. Galindo, T. Giuffrida, H. Hammami, M. Lamare, V. B. Nguyen, A. Peillon
Defended theses:	M. Baez, S. Bouzit, É. Céret, A. Foulonneau, W. Johal, L. Martins-Baltar, D. Masson, R. Oliveira
Publications	
Conferences:	EICS 15 [35], EICS 16 [21, 42, 23], EICS 17 [47], EICS 18 [54], INTERACT 15 [19], INTERACT 17 [50], IUI 18 [27]
Journals:	IEEE Perv. Comp. 16 [8], ACM PACMHCI 17 [10], ACM TIIS 19 [2]
Awarded publications:	—

Plasticity. Plasticity refers to the capacity of UIs to withstand variations of the context of use (user, platform, environment) while preserving human-centered values. IIHM initiated this theme twenty years ago with the publication of a research agenda at Interact 99. Since then, we have attained a leading position in this area, especially by the promotion of Model Driven Engineering (MDE) and more specifically of models at runtime for plasticity.

Going one step further, during the reporting period, we addressed the issue of the complexity of MDE for plasticity which limits its adoption by engineers. The development of techniques and tools for software engineers has been studied from three perspectives. First, considering the large number of models required for using a model-based approach, we proposed tools for editing models and for visualizing and exploring models (Fig. 3.8). Second, to address the problem of the high threshold of the model-based approach, we developed a new approach (whose architecture was patented in 2015) that relies on cross-fertilisation between Responsive Web Design and Model-Driven Engineering. The principle is to define "variants" —different versions of a UI— each of them being dedicated to a specific and predefined subset of the characteristics in the context of use, e.g., a specific window size —as this is done in Responsive Web Design. Thirdly, we proposed an approach to verify interactive systems considering the adaptation capability of the UIs. The approach applies the model checking formal technique to the verification of properties over the system model, and the equivalence checking formal technique to compare different versions of a UI.

Beyond the MDE approach and from the end users' point of view: 1) We enlarged the elements of context of use by considering users' model and personalization. Considering users' characteristics requires to address the problem of data uncertainty and of the large number of rules for adaptation. To address these problems, we proposed an adaptation engine based on fuzzy logic. A fuzzy inference engine is used to automatically handle the combination of rules and to consider uncertainty. 2) We started to focus on how emotions can be used as relevant measures to trigger adaptation. We studied the categorization of emotions depending on users' age and gender and two user experience dimensions, namely aesthetics and usability.

Figure 3.8: Overview of FlexiLab: one editing area per type of model (e.g., task and domain models).

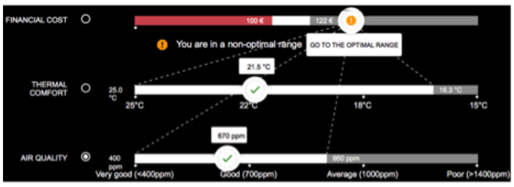

Figure 3.9: TOP-Slider with three criteria: financial cost, thermal comfort, and air quality.

Beyond plasticity: Persuasive interaction techniques. We explored proactive plasticity (anticipating users' needs with recommendations) together with persuasive technology. Persuasive interactive systems are designed in order to induce behaviour change in full awareness, desired and without coercion, and to support the user throughout the behaviour change process. Salient results are conceptual frameworks for the design of engineering of persuasive systems, a novel multi-slider interaction technique for decision-making tasks performed by general audience for optimization problems (Fig. 3.9) and a new concept of persuasive UI applied to an e-coach for energy saving.

Beyond plasticity: End-User Development (EUD). To put the power in the users' hands, we explored the potential of End-User Development (EUD for smart homes. Several LIG experimental platforms are available for conducting in-field experiments, in particular the Equipex Amiqual4Home platform. One focus was on the languages to enable inhabitants to express automations while preventing well-known pitfalls. Main results are: 1) a field study on smart homes: programming and maintaining smart homes; 2) a new programming language that promotes the notion of context as well as the use of pseudo-natural language; 3) a fully deployed system (AppsGate) in real world conditions (5 families for 1 month, followed by 1 family – one of the authors'home for more than 3 years to promote first person experience as an approach to longitudinal system evaluations).

3.4 Mixed Reality Interaction

Contributors	
Permanent members:	F. Bérard, C. Coutrix, L. Nigay, Y. Laurillau, M. Ortega
Doctoral students:	C. Bailly, P. Perea, C. Plasson, T. Louis
Defended theses:	T. Vincent
Publications	
Conferences:	CHI 17 [24], INTERACT 19 [3], ISS 17 [26]
Awarded publications:	ISMAR 18 demonstration [5]

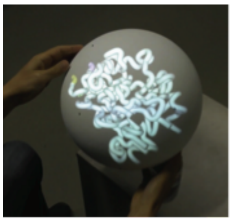

Figure 3.10: HPCD - A display-fixed scene: a spaghetti puzzle.

Figure 3.11: Head-Controlled Cursor: head-based movement of a cursor towards a menu.

Mixed Reality (MR) interactive systems seek to smoothly merge physical and digital worlds. As for multimodal interaction, this theme is one of the foundational research areas of the group. Examples include tangible user interfaces (TUI), augmented reality (AR), augmented virtuality (AV), physical interfaces and embodied interfaces. Several interaction paradigms therefore fall into MR. In a paper published at Interact 99, we clarified this area by making a distinction between augmented virtuality and augmented reality. During the reporting period, our efforts in this theme cover the steps of our research approach, from concepts, to effective interaction techniques and evaluation. Major results fall into two categories. First, based on spatial augmented reality, we created the first un-tethered Handheld Perspective Corrected Display (HPCD) (Fig. 3.10) that demonstrates its superiority for 6 degrees of freedom object placement (best demonstration at ISMAR 2018). Second, we have focused on interaction techniques for handheld AR and more recently for HMD-based AR (Fig. 3.11). The conducted studies are dedicated to pointing tasks at visible and off-screen objects as well as to menu techniques. For HMD-based menu techniques, we have developed a design space structured according to the following factors: the element controlled by the user (Head-Controlled Cursor or Head-Controlled Menu) and the presence (or absence) of physical anchors at the location of the virtual targets (i.e. mixed targets). We have designed and evaluated interaction techniques by performing both in-laboratory and in-field experiments.

3.5 Mobile Interaction

Contributors	
Permanent members:	C. Coutrix, A. Goguey, L. Nigay, M. Ortega
Doctoral students:	P. Perea
Defended theses:	S. Pelurson, J. Rosso, T. Vincent
Publications	
Conferences:	CHI 16 [22], CHI 19 [1], AVI 18 [52], MobileHCI 17 [49]
Awarded publications:	CHI 16 [22], IHM 16 [44]

Handheld touch-screen devices are routinely used but are raising unprecedented challenges for interaction design. This theme is fully orthogonal to the themes presented above: for instance as part of previous themes, we have presented contributions on multimodal interaction on mobile devices (Fig. 3.7), adaptive menu on mobile devices and handheld AR.

In this section, we present interaction techniques that address challenges specific to mobile devices: limited screen size, eyes-free interaction and one-handed interaction. The IIHM group extended its work on mobile interaction by adopting two complementary approaches both based on reconfigurable UIs. First, we introduced the concept of Emergeables, a concept of tangible widgets that can emerge from the surface of a mobile phone. The user study quantifies the benefits that the concept can bring to interaction in the future. As examples of emergeables, we focused on deformable tangible sliders (Fig. 3.12) that offer the benefit of eyes-free and one-handed interaction. Second, we studied solutions for creating expandable interaction devices, in one, two or three dimensions. The goal is then to study both new interaction techniques and new visualization techniques. A first prototype of a Handheld expandable device (Fig. 3.13) has been used for a very first experiment on menu selection. Extending the modular implementation of our handheld expendable device, we started to study a fully re-configurable device concept composed of cells. It explores physical reconfiguration and interdevice connectivity to break the mould of rigid screens, challenging and disrupting the notion of personal device.

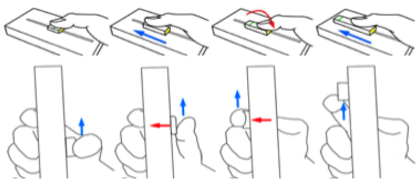

Figure 3.12: Morphing of the slider's knob to help the user reach a target on a mobile device.

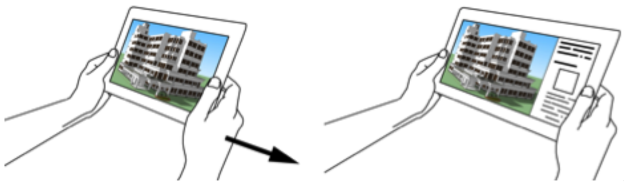

Figure 3.13: Changing the shape of the display to fit the size of the window.

Strengths. Beyond the strong group cohesion, two strengths specific to IIHM are (1) its ability to conduct both analytical and empirical HCI research studies and to fruitfully combine them, and (2) its unique capability to conduct research both on interaction techniques and on concepts & tools for HCI. As demonstrated by our projects as well as by the innovative nature of the conducted research in each theme including new successful research axes such as shape-changing UI, the group is particularly open to novel ideas and to stimulating collaborations with both the academic community and industry. As an integral part of the culture of the group, we establish collaborations, when relevant for a given problem, with other specialties in Computer Science and beyond Computer Science (CERAG/Marketing, GIPSA-Lab/Cognitive Sciences and Signal Processing, ESAD-Valence/Design&Art). In Computer Science, the numerous collaborations of IIHM with different LIG teams and other labs (e.g. TIMC-Grenoble, IRIT-Toulouse, Inria-Bordeaux, Swansea Univ., AIST-Tsukuba, Simon Fraser Univ., Univ. of Bristol, Univ. Catholique de Louvain) reflect this. Complementary to fertile national and international academic collaborations, the group is also attentive to the requirements of industry (e.g. Avionics, Industry 4.0, Smart Building, Surgery), which provides our research agenda with hard, real world problems, and enables IIHM to conduct in-field experimental evaluations. Another important strength is the attractiveness and dynamicity of the group. During the reporting period, twenty students have defended their PhD thesis successfully. Eleven of them are working in industry, and seven of them have academic positions as lecturers (ESTIA, Grenoble, Toulouse) and as non-permanent members (EPFL, Koshi Univ, MIT). The dissemination of our former PhD students increases the IIHM visibility and contributes to developing our close network of academic and industrial collaborations.

Weaknessess. Ten permanent members are faculty members who are fully engaged in teaching, research and administration. The faculty members are deeply involved in teaching (with a total number of teaching hours per year that increased, over 220 hours) assuming important teaching responsibilities that are very time-consuming. Moreover, the faculty members are intensely involved in the local community (LIG direction, LIG axis responsibility, EQUIPEX vice-president, LABEX axis responsibility, IDEX research committee, Grenoble INP vice-president for Technology Transfer) as well as national (CNU, INRIA, National Strategy) and European committees (ERC): While this demonstrates the increasing visibility of the HCI domain, these activities are time-consuming. To reinforce the research capability of the group, we need to encourage the faculty members to apply for sabbatical leaves as done by S. Dupuy-Chessa (2018-19) and R. Blanch (2019-20) and to intensify our efforts to recruit CNRS researchers.

Threats. Getting contracts and grants is more and more difficult. This has an impact on our research agenda. Moreover the various solicitations from industrial partners and multidisciplinary consortiums lead to several collaborative projects in diverse application domains (e.g. 7 CIFRE doctoral students). We have to maintain a right balance between industrial/collaborative projects on specific application domains and HCI research projects. While maintaining a strong link with real-world scenarios, we could try to increase the number of research projects (ANR 'blanc', JCJC and ERC) and the number of PhD students with a Ministers research fellowship.

Opportunities. The continuous integration of informatics into all aspects of human society provide new opportunities for users while defining challenges for the design of the corresponding interactive systems. HCI thus has high visibility in both the academic and industrial worlds. This provides a great opportunity for IIHM to advance its group research. Moreover the theme "AI human beings and the environment" of the MIAI (Multidisciplinary Institute in Artificial Intelligence) project defines opportunities for IIHM to study how to combine natural and artificial intelligence to design usable intelligent interaction techniques. From a more practical point of view and beyond improving the quality of the work environment (number of offices), the new building, IMAG, is an opportunity to further strengthen the group cohesion and to enable us to perform laboratory studies in our new dedicated room "playground", always seeking to improve.

5.1 Strategy and research approach

The continued exponential growth in the number of interconnected devices with embedded sensing and actuation define a wide and ever-increasing variety of interaction techniques and very diverse settings for human-computer interaction. In this context the IIHM research group is primarily concerned with interactive techniques and systems that match users' needs and capabilities. Fully aligned with the strategic plan of the LIG and its "Interactive and Cognitive Systems" theme, the IIHM scientific project is to elaborate new concepts, models and software tools / artifacts for designing, implementing, and evaluating interaction techniques that are easy to learn and provide for efficient use in various situations (usability dimensions) as well as to enhance users' experience (aesthetic and affective dimensions). The expected impact is on nearly every social, economic and cultural domain where informatics is used. The designed interaction techniques have been and will be drivers of transfer to our partners and to the general public.

5.1.1 Research approach

Over the years, we have devised a research approach that serves as a systematic structured framework for each of the themes developed in the group. The approach fruitfully combines conceptual (or analytical) and empirical studies:

1. IIHM is pivotal in establishing conceptual problem spaces and taxonomies for a particular problem.
2. IIHM also adopts an empirical research approach by conducting both controlled laboratory experiments and in-field evaluations to study interaction.

The approach thus involves the interplay of deduction and induction that feed on each other: Conceptual/fundamental work is combined with practical/empirical work.

Integrity. As explained in the report of the past period, we have started to discuss within the group and study how to share the study materials (replication of research). For each published contribution, we aim to encourage the publication of the code, the models and other study materials available as well as the anonymous data and the analysis code associated with the conducted experiment.

5.1.2 Members and resources.

As of July 2019 the IIHM group is composed of: 12 permanent members and a CNRS engineer part time (section 3.1 of the report), 12 doctoral students (1 student defended his thesis in June 2019), 1 postdoctoral fellow, 1 invited researcher and 1 visiting professor (July 2019-July 2020, Univ. of Manitoba, Canada).

The core group brings a strong expertise in Human-Computer Interaction (HCI). During the next five years, Joëlle Coutaz who is Professor Emeritus since 2012 will stop her research activities as part of the group.

In terms of resources, the on-going projects include 3 ANR projects, 2 IDEX multidisciplinary projects and 4 industrial contracts. Laurence Nigay will be a senior member of IUF starting in September 2019: the associated financial support will be used for the group. One ANR-JST CREST project on symbiotic interaction has been recently submitted by LIG-ADELE group and includes IIHM. IIHM is also part of a chair of the recently accepted Institute for AI entitled "MIAI Grenoble Alpes" (Multidisciplinary Institute in Artificial Intelligence Grenoble Alpes). As part of MIAI, IIHM will contribute to the theme "AI human beings and the environment". We also plan to submit new ANR projects in Autumn 2019 dedicated to our research directions. Stated as a threat in the previous section, our goal is not to be opportunistic i.e., initiating study challenges that are currently "in the air": we aim rather to submit projects that will help us to conduct the research as defined in the following section.

5.2 Research directions

During the reporting period, the five themes that structured the IIHM research were: 1) Novel Interaction Techniques for GUI 2) Multimodal Interaction 3) Plasticity and End-User Programming 4) Mixed Reality Interaction 5) Mobile Interaction. Those five research themes will be sustained by focusing on specific research lines within a theme. Conferences are dedicated to these themes. Moreover these themes are concrete for presenting the group to industrial partners with focused activities such as mobile augmented reality. However since our past and future research studies span several themes, we present the on-going and future IIHM research activities by highlighting the two main general research themes:

1. **Interaction Techniques**
2. **Concepts & Tools for HCI**

These two themes enable us to present the main future research activities of the IIHM group but do not define two sub-groups. Indeed all the group members are conducting studies in both themes that mutually enrich each other.

Interaction techniques. We will deepen initiated research lines that we address at different levels of abstraction or granularity. While the focus will be on interaction techniques, the studies will also contribute to our second theme on concepts & tools for HCI by defining design spaces and prototyping / development tools.

First, we will continue to work on the scalability problem of interactive visualisation, especially focusing on progressive visualisations (i.e. visualisations that are refined concurrently with the user interaction and navigation). We also work on the visualisation of voting systems to make them easier to understand for the laymen.

Second, touch interaction has been studied for many years in the group: effect of latency on interaction and multimodal interaction including touch modality on mobile phones. This axis has been reinforced with the arrival of A. Goguey in 2018. We will explore ways to enrich the interaction vocabulary for touch modality, for instance using pressure. Our objective is to support the long-term use of pressure-based interactions by demonstrating its benefits through: 1) the crafting of design guidelines informed by human factor studies, to guide the implementation of interaction techniques. 2) the exploration and implementation of context-appropriate interaction techniques instantiating these recommendations.

Third, the group will further develop the research area of shape-changing interfaces, whose physical shape can be adapted by the user or can adapt to the context. The aim is to provide users with shape-changing tangible interfaces (i.e., controllers). There is a need for theories, prototypes and user studies, as well as tools for the prototyping of these interfaces.

Fourth, the group will continue to study augmented reality (AR). Several research challenges of AR systems have been centred on the output part where advanced computer vision and computer graphics techniques have been developed to ensure an effective mapping between the real and the digital worlds. We adopt a complementary approach by focusing on interaction with augmented physical objects. We will study interaction in the context of spatial AR and of Head-Mounted Display based AR.

We also identify two transverse research axes that are complementary: 1) *transition between modalities* and 2) *interaction techniques with non-flat non-rectangular surfaces*.
1) Living in an increasingly interactive pervasive computing environment, we are using a variety of interaction modalities in one day. Users switch between modalities and systems adapt modalities to changing situations. In this context, the proposed research builds upon a key concept: transition between modalities. We plan to study transitions in multimodal interaction:

at three novel levels of analysis: micro – physical actions, meso – one task, macro – multiple tasks; for a large subset of interaction styles: mobile, physical, augmented reality and deformable interaction. In the light of transition between modalities and to empower the users by a true co-adaptation by adopting a machine-in-the-loop approach, one research avenue is to thoroughly study intelligent interaction techniques at the three above levels of abstraction (micro/meso/macro) and promisingly study the links between the three levels.
2) Going beyond the flat squared surface defined by current displays, we will study interaction with non-flat non-rectangular surfaces for 2D/3D contents. This research axis relies on complementary expertise in the group and will encompass studies on 3D visualization and interaction, deformable devices, multimodal interaction and augmented reality. We intend to further develop our untethered Handheld Perspective Corrected Display (HPCD) prototype and its application in order to better understand usage context that most benefit from it. We will also study interaction and visualisation techniques of 3D contents on expandable devices as well as further explore fully reconfigurable devices that allow physical reconfiguration, functional reconfiguration and easy inter-device connectivity to break the mould of rigid screens. We started to study the programming of interactive applications on PickCells, a physically reconfigurable cell-composed touchscreen. This research line directly contributes to our second theme on Concepts & Tools for HCI and illustrates the tight coupling between the two themes of the group.

Concepts & Tools for HCI. We have two main research axes primarily focused on concepts & tools for HCI: 1) *design spaces and software platforms for adaptive and persuasive user interfaces* and 2) *a programming language and platform for end-user development*. We have addressed these research axes during the previous period and we plan to further extend them. In particular persuasive user interfaces define a recent topic for the group that we started to study during the previous period.

1. Focusing on adaptation of user interfaces we will further study both (a) plasticity consisting of repairing UIs to recover from variations of the context of use, called reactive plasticity, and (b) plasticity responsible for anticipating user needs with recommendations, called proactive plasticity.

   Reactive plasticity: First, we will continue to mature a software platform that supports plasticity. Second, we aim at refining the adaptation capacities of our approach, by (a) integrating a complete feedback loop based on users' emotions, (b) defining UI variants at UI components levels, for easing reuse and (c) extending our architecture to new context of use characteristics (user's cognitive behaviour, tasks variability, etc.). We will study UI adaptation to emotions in the context of natural risks (IDEX project CDP Risk). Beyond adaptive user interfaces, we will extend our work on user's emotions for user interfaces evaluation: detecting usability and / or aesthetics problems based on emotions.

   Proactive plasticity: We will further extend our work on exploring plasticity together with persuasive technology with the challenge of in-context recommendations.This will include an in-depth investigation of Artificial Intelligence based recommender systems. For the development of persuasive interactive systems we will focus on: (1) software operationalisation of a behaviour change process model and (2) composition of existing generic software bricks implementing persuasive functions to be integrated into a toolkit.

2. We will extend our work on end-user development (EUD) for smart homes by further developing our programming language CCBL that promotes the notion of context and its platform.

   First, we will focus on how to present the language to end-users and how to help end-users to express a correct behaviour. Such a research avenue will involve evaluation with end-users. Second, we will study how CCBL can take into account the concurrent access to and the scheduling of resources in smart homes. And last, we will extend the CCBL platform in order to define an IDE for end-user developers integrating test and verification methods of home behaviors.

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EVALUATION CAMPAIGN 2019-2020
VAGUE A

Name of the team: IIHM
Acronym: IIHM

Head of the team for the current contract: Laurence Nigay
Head of the team for the next contract: Laurence Nigay

A.1 Production of knowledge and activities contributing to the influence and scientific attractiveness of the unit

A.1.1 Journal Articles

Scientific articles in English

Top 20%

[J1] Nataliya Kos'myna, Franck Tarpin-Bernard, and Bertrand Rivet. Adding human learning in brain computer interfaces (BCIs): Towards a practical control modality. *ACM Trans. Comput.-Hum. Interact. (TOCHI) 22, 3, Article 12 (May 2015), 37 pages.*, 22(3):1–37, 2015.

[J2] Michel Vacher, Sybille Caffiau, François Portet, Brigitte Meillon, Camille Roux, Elena Elias, Benjamin Lecouteux, and Pedro Chahuara. Evaluation of a context-aware voice interface for ambient assisted living: qualitative user study vs. quantitative system evaluation. *ACM Transactions on Accessible Computing*, 7(2):1–36, 2015.

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[J11] Sirinee Thongpanja, Angkoon Phinyomark, Franck Quaine, Yann Laurillau, Chusak Limsakul, and Pornchai Phukpattaranont. Probability density functions of stationary surface EMG signals in noisy environments. *IEEE Transactions on Instrumentation and Measurement*, 65(7):1547–1557, 2016.

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[J13] Amr Alzhouri Alyafi, Van Bao Nguyen, Yann Laurillau, Patrick Reignier, Stéphane Ploix, Gaëlle Calvary, Joëlle Coutaz, Monalisa Pal, and Jean-Philippe Guilbaud. From usable to incentive-building energy management systems. *Modeling and Using Context*, 18(1):1–30, 2018.

Other articles (professional journals, etc.)

Top 20%

[OA1] Grégory Cano, Yann Laurillau, and Gaëlle Calvary. Persuasion technologique et energie : revue critique de l'état de l'art. *Journal d'Interaction Personne-Système (JIPS) - Numéro spécial Technologies persuasives*, 4(1):48–68, 2015.

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[OA7] Anthony Foulonneau, Gaëlle Calvary, and Eric Villain. Etat de l'art en conception de systèmes persuasifs. *Journal d'Interaction Personne-Système (JIPS) - Numéro spécial Technologies persuasives*, 4(1):19–47, 2015.

[OA8] Nataliya Kos'myna, Franck Tarpin-Bernard, and Bertrand Rivet. Brains, computers, and drones: think and control!, 2015.

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A.1.2 Books

Management and coordination of scientific books / Scientific book edition Management and coordination of scientific books / Scientific book edition in English or another foreign language

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Book chapters in English or another foreign language

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[Ch1] Renaud Blanch. *Visualisation interactive d'information*, pages 211–238. Eyrolles, 2018.

[Ch2] Laure Martins-Baltar, Yann Laurillau, and Gaëlle Calvary. *Pearly UIs for Cloud Computing: First Experience in Health Care IT*, chapter 12, pages 303–324. Chapman and Hall/CRC, UK, 2014.

[Ch3] Angkoon Phinyomark, Franck Quaine, and Yann Laurillau. *The Relationship between Anthropometric Variables and Features of Electromyography Signal for Human-Computer Interface*, chapter 15, pages 325–357. IGI Global, Autralia, 2014.

Edited theses

Top 20%

[PhD1] Yann Laurillau. Ingénierie de la fluidité interactionnelle : vers des systèmes symbiotiques, 2014. HDR.

[PhD2] William Delamare. *Interaction à distance en environnement physique augmenté*. PhD thesis, 2015.

[PhD3] Élie Cattan. *Analyse de la latence et de sa compensation pour l'interaction au toucher direct : aspects techniques et humains*. PhD thesis, 2017.

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[PhD5] Dimitri Masson. *Inspirez ! Explorez ! Soutien à la créativité en conception d'interfaces homme-machine*. PhD thesis, 2014.

[PhD6] Laure Martins-Baltar. *Plasticité des interfaces homme-machine : concilier variabilité du contexte et stabilité de l'interface à travers le concept de perle*. PhD thesis, FR, 2014.

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[PhD13] Sarah Bouzit. *Plasticité de l'Interaction Homme-Machine : présentation à l'utilisateur, une question de compromis*. PhD thesis, 2017.

[PhD14] Maxime Guillon. *Expansion de cibles pour le pointage et la sélection : Application à l'interaction à distance en chirurgie augmentée*. PhD thesis, 2017.

[PhD15] Anthony Foulonneau. *Pour l'adaptation de la persuasion : modèles et démonstration sur l'usage du téléphone*. PhD thesis, 2017. Version temporaire.

[PhD16] Ali Jabbari. *Composite Visual Mapping for Time Series Visualization*. PhD thesis, 2018.

[PhD17] Jérémy Wambecke. *Visualisation de données temporelles personnelles*. PhD thesis, 2018.

[PhD18] Belén A. Baez Miranda. *Génération de récits à partir de données ambiantes*. PhD thesis, 2018.

[PhD19] Juan Pablo Rosso Pirela. *Malleable Interactive Surfaces for Distant Mobile Tangible Interaction*. PhD thesis, 2018.

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[C5] Fatoumata Camara and Gaëlle Calvary. Worth-centered design in practice: Lessons from experience and research agenda. In *Proc. INTERACT 2015*, pages 123–139, Bamberg, Germany, 2015. Springer.

[C6] Céline Coutrix and Cédric Masclet. Shape-change for zoomable TUIs: Opportunities and limits of a resizable slider. In *Proceedings of the 15th IFIP TC13 Conference on Human-Computer Interaction (INTERACT'15)*, pages 349–366, Bamberg, Germany, 2015. Springer.

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[C8] Simon Robinson, Céline Coutrix, Jennifer Pearson, Juan Pablo Rosso Pirela, Matheus Torquato, Laurence Nigay, and Matt Jones. Emergeables: Deformable displays for continuous eyes-free mobile interaction. In *Proceedings of the 34th international conference on Human factors in computing systems (CHI 2016), San Jose, CA, USA, May 7-12, 2016*, page 13, Santa Clara, USA, 2016.

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[C13] Jean Vanderdonckt, Sarah Bouzit, Gaëlle Calvary, and Denis Chene. Cloud menus, a circular adaptive menu for small screens. In *IUI'18: 23rd International Conference on Intelligent User Interfaces Proceedings*, pages 317–328. ACM, 2018.

[C14] Ali Jabbari, Renaud Blanch, and Sophie Dupuy-Chessa. Composite visual mapping for time series visualization. In *Proceedings of the 11th IEEE Pacific Visualization Symposium (PacificVis 2018)*, pages 116–124, Kobe, Japon, 2018.

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[C18] Yoann Gabillon, Gaëlle Calvary, and Humbert Fiorino. PLACID: a planner for dynamically composing user interfaces services. In *Proceedings of the ACM conference on Engineering Computing Interactive Systems (EICS 2014)*, pages 223–228, Rome, Italie, 2014. ACM.

[C19] Maxime Guillon, François Leitner, and Laurence Nigay. Static voronoi-based target expansion technique for distant pointing. In *Proceedings of the International Working Conference on Advanced Visual Interfaces (AVI 2014)*, pages 41–48, Como, Italy, 2014. ACM.

[C20] Élisabeth Rousset, François Bérard, and Michael Ortega. Two-finger 3D rotations for novice users: Surjective and integral interactions. In *Conference Proceedings of ACM-Advanced Visual Interfaces (AVI 2014)*, pages 217–224, Como, Italy, 2014. ACM.

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[C23] Wafa Johal, Sylvie Pesty, and Gaëlle Calvary. Toward companion robots behaving with style. In *Proceedings of the 2014 IEEE International Symposium on Robot and Human Interactive Communication (ROMAN)*, pages 1063–1068, Edinburgh, United Kingdom, 2014.

[C24] Joëlle Coutaz, Sybille Caffiau, Alexandre Demeure, and James Crowley. Early lessons from the development of SPOK, an end-user development environment for smart homes. In *Ubicomp’2014 adjunct Proceedings, HomeSys 2014*, pages 895–902, Seattle, USA, 2014. ACM publ.

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[C26] Koji Makita, Thomas Vincent, Soichi Ebisuno, Masakatsu Kourogi, Tomoya Ishikawa, Takashi Okuma, Minoru Yoshida, Laurence Nigay, and Takeshi Kurata. Mixed reality navigation on a tablet computer for supporting machine maintenance in wide-area indoor environment. In *Conference Proceedings of ICServ2014, the 2nd International Conference on Serviceology*, pages 41–47, Yokohama, Japan, 2014. Springer.

[C27] Yoann Gabillon, Gaëlle Calvary, and Humbert Fiorino. PLACID : un planificateur pour composer dynamiquement des services IHM - formalisation du problème et algorithme solution. In *26e conférence francophone sur l’Interaction Homme-Machine*, pages 123–129, Lille, France, 2014. ACM.

[C28] Sarah Bouzit, Denis Chene, and Gaëlle Calvary. From appearing to disappearing ephemeral adaptation for small screens. In *Proc. ACM OzCHI 2014 international conference*, pages 41–48, Sydney, Australia, 2014. ACM. Sydney, December 2014.

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[C34] Nataliya Kos'myna, Franck Tarpin-Bernard, and Bertrand Rivet. Operationalization of conceptual imagery for BCIs. In *European Signal Processing Conference (EUSIPCO'2015)*, pages 2726–2730, Nice, France, 2015.

[C35] Nataliya Kos'myna, Franck Tarpin-Bernard, and Bertrand Rivet. Towards brain computer interfaces for recreational activities: Piloting a drone. In *Proceedings of the 15th IFIP TC13 Conference on Human-Computer Interaction (INTERACT'15)*, pages 506–522, Bamberg, Germany, 2015. Springer.

[C36] Élisabeth Rousset, François Bérard, and Michael Ortega. Study of the effect of the directness of the interaction on novice users when drawing straight lines. In *IHM'15*, pages 14:1–14:7, Toulouse, France, 2015.

[C37] Wafa Johal, Gaëlle Calvary, and Sylvie Pesty. Non-verbal signals in HRI: Interference in human perception. In *Proceedings of The International Conference on Social Robotics 2015 (ICSR'15)*, pages 275–284, Paris, France, 2015. Springer.

[C38] Sébastien Pelurson and Laurence Nigay. Visualisation bifocale sur supports mobiles : une étude empirique / bifocal display on mobile devices: Empirical investigation. In *Actes 27e conférence francophone sur l'Interaction Homme-Machine (IHM 2015)*, page No 20, Toulouse, France, 2015. ACM.

[C39] Alessandro Fenicio and Gaëlle Calvary. Persuasion through an ambient device: proof of concept and early evaluation of CRegrette, a smoking cessation system. In *Proceedings of the European Conference on Ambient Intelligence (AmI 2015)*, pages 252–267, Athens, Greece, 2015.

[C40] Sébastien Pelurson and Laurence Nigay. Multimodal interaction with a bifocal view on mobile devices. In *Conference ACM ICMI 2015, 17th ACM International Conference on Multimodal Interaction, Seattle, November 9-13, 2015 (ICMI 2015)*, pages 191–198, Seattle, USA, 2015. ACM.

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[W8] Wafa Johal, Sylvie Pesty, and Gaëlle Calvary. Expressing parenting styles with companion robots. 2014.

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A.1.4 Tools and products

Softwares

The IIHM group produces several types of software from generic services to software platforms / frameworks and interaction techniques. To concisely present the software developments we use the criteria for software self-assessment defined by INRIA[1]. For each criterion, we code the corresponding note by a color. The criteria are:

Audience (A)	1	2	3	4	5	From personal use (1) to wide-audience (5)
Software Originality (SO)	1	2	3	4		From no originality (1) to original ideas (4)
Soft. Maturity (SM)	1	2	3	4	5	From demos work (1) to high-assurance software (5)
Evolution Maintenance (EM)	1	2	3	4		From no plan (1) to well-defined and implemented plan (4)
Soft. Distribution & Licensing (SD)	1	2	3	4	5	From none (1) to distributed product (5)

Software: Type / Name	A	SO	SM	EM	SD	*Description*
Interactive Visualization: Dendrogramix	3	4	2	1	4	Dendrogramix is a hybrid tree-matrix interactive visualization of dendrograms that superimposes the relationship between individual objects onto the hierarchy of clusters. Article: PacificVis 2015 Best paper [34]
Interactive Visualization: TraceViz	4	3	4	4	5	Trace visualization is a software module that allows the interactive exploration of execution traces of multimedia decoding software running on embedded devices. It is integrated with the IDE that STMicroelectronics provides to its customers. Article: IHM 2016 [43] Thesis: [13]
Interaction technique: Pointing techniques	4	2	5	1	5	Software implementing different target expansion techniques. One technique is used in Aesculap's product for augmented surgery. Article: CHI 2015 [17]
Interaction technique: Precise pointing techniques for handheld AR	2	4	1	1	1	Software implementing two techniques that improve accuracy of pointing at physical objects for handheld Augmented Reality (AR): ShiftAR and Relative Pointing. Thesis: [12] Demo at Global Industrie 2019 Eurexpo Lyon

[1] Criteria for Software Self-Assessment, <https://www.inria.fr/medias/recrutement-metiers/pdf/criteria-for-software-self-assessment>.

Software: Type / Name	A	SO	SM	EM	SD	*Description*
Interaction technique: HPCD software (AR on the sphere)	2	4	1	2	2	The HPCD software is used to create a very convincing illusion of the presence of a 3D virtual scene inside a volumetric display. It includes robust, sub-milimeter tracking of rigid constellations of markers with 27ms of latency, sub-millimeter projector calibration, stereo rendering. Best demo ISMAR 2018
Widget: TOP-Sliders	2	4	2	2	1	TOP-Sliders is a multi-slider widget for decision-making tasks performed by general audience for optimization problems. It revisits classical sliders to allow users to explore a set of optimal solutions based on a Pareto-optimal algorithm. Widget used in the project ECO-Sesa. Article: NordiCHI 2018 [56]
System: Electronic Board Inspection	2	4	1	1	1	The electronic board inspection software includes intuitive navigation on a complex 3D scene through multi-touch interaction on a large surface. The software also offers automatic animation and various visualisations that help the operator in inspecting tasks.
Tool: TaskModelReader	4	2	2	3	4	Tool for novice designers: Natural language generation to support the understanding of task models. Code: <https://github.com/SybilleCaffiau/TaskModelReader> Article: IHM 2017 [48]
Service: Tasker Network Event Server	3	1	3	1	2	Tasker Network Event Server is a plugin for Tasker. It enables Tasker to receive network request (via HTTP POST or socketIO) and to process them as events, so Tasker rules can be triggered. This was originally developed in the context of AppsGate project. <https://play.google.com/store/apps/details?id=bidoismorgan.httpevent>
Library: alx-upnp	1	2	2	2	2	Upnp Library for Typescript. <https://github.com/AlexDmr/alx-upnp> Journal: PACM HCI [10]
Service: CCBL interpreter	1	4	2	4	2	Interpreter in Typescript for CCBL programs. <https://github.com/AlexDmr/ccbl-js> Journal: PACM HCI [10]
System: TActHab2 End-user programming in the smart home	1	3	2	4	2	Software for end-user programming in the smart home. It includes the CCBL interpreter, the CCBL editor, upnp controllers and links to other smart home systems such as openhab. <https://github.com/AlexDmr/tacthab2> Journal: PACM HCI [10]
System: AppsGate	3	4	4	2	5	The AppsGate smart home prototype is a dynamic ecosystem of devices and services that can be assembled in a meaningful way by people using a pseudo-natural language. The software deployed in real world conditions (homes) is still in use for longitudinal experiments in a domestic habitat. Article: IEEE Pervasive Computing 2016 [8]
Framework: PlastiLab	1	4	2	2	1	PlastiLab is the first version of a software environment for supporting UI plasticity by model-driven engineering.
Framework: Flexilab	2	4	2	2	1	FlexiLab is a new version of PlastiLab, with a fully flexible architecture making it possible to plug in any component, including models editors and plasticity engines.

Software: Type / Name	A	SO	SM	EM	SD	*Description*
Editor: FlexEd	5	3	3	3	3	FlexEd is a UI multi-model editor for HCI with special attention to massive UI models, multiplicity of models, multiplicity of stakeholders and collaborative editing. The editor is available as a web application. A version has been transferred to ATOS company. The editor has been used for teaching between 2015–17. Article: EICS 2015 [59]
Framework: µPlastiLab	4	3	3	3	1	Framework for adaptive UIs based on patent TPI2015053. µPlastiLab implements a novel approach based on Magnetic Variants, to offer to end-users interfaces with adaptive possibilities while avoiding MDE complexity and overpassing Responsive Web Design limitations. Framework used in valorization for MIAMS with SATT Linksium.
Service: Emotion inferring engine	2	4	1	1	1	The inferring engine detects usability / aesthetics problems based on users' emotions. The engine is implemented in Perso2U, a prototype for dynamically adapting UIs to users' emotions. Article: Int. Conf. on Research Challenges in Information Science 2018 [53]
Service: Fuzzy4U Adaptation engine	2	3	1	1	1	Fuzzy4U is an adaptation engine based on fuzzy logic instead of Boolean logic. The engine is implemented in Perso2U, a prototype for dynamically adapting UIs to user's emotions. Article: IHM 2016 [57]

Databases

Morphees+ <http://phyflex.imag.fr/EverydayObjects.html>
A collection of everyday reconfigurable objects to inspire the design of interaction, as well as the revision of existing taxonomies.
Article: CHI 2018 [30], Honorable Mention Award

Tools for decision making

Design Space for Gesture Guiding Systems <http://iihm.imag.fr/delamare/guidance/>
The tool is dedicated to practitioners to characterize, compare and design gesture guiding systems. The tool can be used to find an example system meeting specific requirements or to start exploring an original research area based on unexplored design options. The motivation for the online tool is the large underlying design space including 35 design axes: the tool therefore helps explore and combine the various design options.
Article presenting the design space: AVI 2016 [40]
Article presenting the tool: EICS 2015 [33]

A.1.5 Instruments and methodology

Prototypes

Numerous prototypes have been developed as part of our research approach that fruitfully combines conceptual and empirical studies. Some developed software prototypes are described above in the section Software.
In addition to software prototypes, we also built several physical prototypes as part of our research on shape-changing interfaces: For instance the KnobSlider (Fig. 3.6), two deformable sliders (Fig. 3.12) and the EXHI-bit mechanical structure (Fig. 3.13).

A.1.6 Other products

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A.1.7 Editorial activities

Participation in editorial committees (books, collections, etc.)

10 including ACM PACM HCI, Springer HCI, IEEE Pervasive Computing special issue.

Collection and series management

1 Journal of Interaction between Persons and Systems (JIPS), The Journal of the French speaking Association on Human-Machine Interaction.

A.1.8 Reviewing activities

The IIHM group is deeply involved in the HCI research community at the National, European and International levels.

Reviewing of articles

It is impossible to list all the conferences for which members of the group were reviewers, associate chairs or area chairs. We are involved in international journals such as ACM TOCHI (special issue on Human Building Interaction, special issue on End-User Development) as well as in all HCI major conferences including ACM CHI, ACM UIST, ACM MobileHCI, IEEE VisWeek, INTERACT. A total of **378** articles in conferences and journals have been reviewed by the IIHM group.

Grant evaluation (public or charities)

The IIHM group reviewed **201** research projects. Some IIHM members have been deeply involved in reviewing projects beyond being a reviewer: President of ANR panels, Member of ANR panels and Member of ERC AdG panels.

Reviewing of research institutes

Four members of the IIHM group took part in the evaluation of **4** French laboratories (Hcéres).

Participation in institutional committees and juries (CNRS, Inserm, etc.)

The IIHM group has been involved in **23** committees, in particular hiring committees of lecturers, professors and INRIA researchers.
IIHM group members: president, reviewer or examiner of **50** PhD committees and **6** Habilitation committees.

A.1.9 Academic research grants

The research grants are listed in Section 2.3. These grants cover the five themes of the IIHM group. There are too many grants to be described in detail. The key results of the research conducted as part of these projects are described in Part 3.

European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants - coordination

AMIE Japan-French (JST/ANR) project 2011-2014: Coordinator L. Nigay

European (ERC, H2020, etc.) and international (NSF, JSPS, NIH, World Bank, FAO, etc.) grants - partnership

AppsGate (CATRENE) 2012-2015

Other European grants - partnership

1 UK grant (EPSRC) Breaking the Glass 2015-2019: Multimodal, Malleable Interactive Mobile surfaces for Hands-In Interactions Coordinator: Swansea University

National public grants (ANR, PHRC, FUI, INCA, etc.) - coordination

3 including 1 CNRS PEPS and 2 ANR projects

National public grants (ANR, PHRC, FUI, INCA, etc.) - partnership

12 grants (ANR and FUI)

Local grants (collectivités territoriales) - coordination

2

PIA (labex, equipex etc.) grants - coordination

2

PIA (labex, equipex etc.) grants - partnership

7

A.1.10 Visiting senior scientists and post-doc

Post-docs (total number)

8 (their names and dates are listed in Section 2.1)

Foreign post-docs

2
Nikolaos Karanikolas, University of Patras
David Furio, Politecnica de Valencia

Visiting scientists (total number)

3

Foreign visiting scientists

3
Two visiting scientists are listed in Section 2.1. They visited us in 2016.
Andrea Bunt, Assistant Professor at the University of Manitoba in Canada, will visit us for one year starting in June 2019.

A.1.11 Scientific recognition

Prizes and / or distinctions

- 5 awarded papers: 3 Honorable mention awards at ACM–CHI, best paper at IEEE-PacificVis and at ACM–IHM.
- Best demonstration at IEEE–ISMAR
- J. Coutaz 2015 – Honorary Member of SIF (Société Informatique de France / French Computer Society)
- L. Nigay 2015 – Distinguished Speaker of the ACM
- J. Coutaz 2016 – "Encounters with HCI Pionners" by B. Schneiderman
- C. Coutrix 2017 – CNRS Bronze medal
- C. Coutrix 2017 – Humboldt Research Fellowship for Experienced Researchers

IUF members

- L. Nigay 2019 – Senoir member of "Institut Universitaire de France"

Chair of learned and scientific societies

- The IIHM group is deeply involved in AFIHM, the French-speaking Human-Computer Interaction Association since its creation. Several IIHM members are, or have been members of its governing body and of its steering committee.
- Four members of the group belong to the IFIP WG 2.7 on user interface engineering. G. Calvary is currently the vice-chair of WG 2.7.
- S. Dupuy-Chessa is involved in GDR GPL (Software Engineering) leading a specific action on HCI and Software engineering.

Invitations to meetings and symposia

5
For instance:

- Keynote speaker at the conference ACM-IHM 2016 (Switzerland)
- Invited talk at the bilateral workshop on Cyber-physical Systems and IoT: Kobe University (Japan) and Universty Grenoble Alpes
- Invited talk at Eindhoven University of Technology - TUe (Netherlands)

Members' long-term visits abroad

4
R. Blanch / Canada, C. Coutrix / Germany, S. Dupuy-Chessa / Luxembourg, M. Ortega / Canada

A.1.12 Scientific animation

Organisations of meetings and symposia

5
For instance:
Paper chairs: International conferences ACM-IUI 2019 (USA), ACM-EICS 2015 (Germany) and 2017 (Portugal)
Area chair: International conference IFIP TC13 INTERACT 2019 (Cyprus)

Scientific and steering committees

- R. Blanch is in charge of the Interactive and Cognitive Systems (SIC) area of LIG.
- R. Blanch is member of the scientific committee of the research action "Advanced Data Mining" of the PERSYVAL-Lab (Labex on Pervasive systems and algorithms at the convergence of physical and digital worlds).
- S. Caffiau, S. Dupuy-Chessa and L. Nigay – Elected at the research committee of "Mathematics, Sciences and Technologies of Information and Communication" research department, one of the six departments of ComUE Université Grenoble Alpes IDEX.
- G. Calvary is deputy director of LIG.
- G. Calvary is vice-president for Technology Transfer at Grenoble INP.
- J. Coutaz co-chairs the EquipEx AmiQual4Home and chairs the scientific board of the EquipEx.
- L. Nigay was member (2014) of a group of experts dedicated to challenge 7 "The Information and Communication Society" for the National Research Strategy led by the French Ministry of Higher Education and Research.
- L. Nigay co-chairs one of the four research actions "Authoring Augmented Reality" of the PERSYVAL-Lab (Labex on Pervasive systems and algorithms at the convergence of physical and digital worlds). PERSYVAL-Lab has been recently extended for 5 years.

A.2 Interaction of the unit with the non-academic world, impacts on economy, society, culture or health

A.2.1 Socio-economic interactions / Patents

Invention disclosures

2 on plasticity

Filed patents

1 on plasticity

Accepted patents

1 on plasticity

A.2.2 Socio-economic interactions

Industrial and R&D contracts

10
The list of industrial partners is provided in Section2.3. The on-going projects are in collaboration with AESCULAP, EASY MOUNTAIN, SCHNEIDER ELECTRIC and THALES.

Cifre fellowships

7 including 3 students currently preparing their PhD thesis under CIFRE convention.

A.2.3 Expertise

Consulting

3

Expert and standardization reports

1
R. Blanch contributed to a report on voting systems requested by C. Villani for OPECST (The Parliamentary Office For Scientific and Technological Assessment).

A.2.4 Public outreach

Radio broadcasts, TV shows, magazines and newspaper

4

- Renaud Blanch, Sylvain Bouveret (LIG STEAMER) and colleagues about the conducted voting experiment during the 2017 French presidential election:
  - TV: TV News TéléGrenoble 25 April 2017 <https://www.dailymotion.com/video/x5jndl7>
  - Newspaper: 25 April 2017
  <http://binaire.blog.lemonde.fr/2017/04/27/reformons-lelection-presidentielle/>
- IIHM and Swansea University on their work on shape-changing User Interfaces:
  Online Newspaper: South Wales Evening Post 9 September 2016, our co-author Matt Jones mentionning our ACM CHI 2016 paper "Emergeables: Deformable Displays for Continuous Eyes-Free Mobile Interaction".
- Nataliya Kosmyna about her work on Brain-Computer Interface:
  TV: ARTE Future Mag 9 January 2016 <https://www.youtube.com/watch?v=sHmviVqWOZg>
- Laurence Nigay about her research in Human-Computer Interaction:
  TV: UGA channel 18 April 2014 <https://www.youtube.com/watch?v=VLD_kFXZw-I>

Journal articles, interviews, book edition, videos, other popularization outputs, debates on science and society, etc.

13
For instance:

- Innovatio, a pluridisciplinary magazine on innovation <https://www.echosciences-grenoble.fr/communautes/humagora/articles/innovatio-la-revue-pluridisciplinaire-en-innovation-publication-du-n-5>
- CNRS web site <https://ins2i.cnrs.fr/fr/cnrsinfo/une-forme-qui-sadapte-au-fond>

A.3 Involvement of the unit and of each team in training through research

A.3.1 Educational outputs

E-learning, MOOCs, multimedia lessons, etc.

2
In addition S. Caffiau and S. Dupuy are involved in pedagogical projects/platforms of the Idex UGA. S. Dupuy is currently leading one pedagogical project/plaform of Idex UGA called APACHES 2, a multidisciplinary project on the pedagogical approach of project-based learning. The project targets 220 UGA students and 120 Grenoble-INP students.

A.3.2 Scientific productions (articles, books, etc.) from theses

Scientific productions (articles, books, etc.) from theses

101

Mean number of publications per student (Biology & Science and technology only)

5

A.3.3 Training

Habilitated (HDR) scientists

4

HDR obtained during the period

1

PhD students (total number)

33 (see Section 2.1)

PhD students benefiting from a specific doctoral contract

30

Defended PhDs

20 (see Section 2.1)

Mean PhD duration

40 months

Internships (M1, M2)

51 students

People in charge for a mention or a master's degree course (total number)

3
R. Blanch has been responsible of Polytech Fifth year from 2014 to 2018.
A. Demeure is responsible of License MIAGE.
L. Nigay is in charge of the Master's program in Software Engineering (M2-GI, 49 students this year) since 2005.

People in charge for a mention or a master's degree course with international certification (Erasmus mundus)

2
R. Blanch and L. Nigay are managing the specialized program "Ubiquitous and Interactive Systems" (30 ECTS) of the International Masters of Science in Informatics at Grenoble.