IN PARTNERSHIP WITH:
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Institut polytechnique de Grenoble

Université de Grenoble Alpes

Activity Report 2018

Project-Team PERVASIVE

Pervasive interaction with smart objects and environments

IN COLLABORATION WITH: Laboratoire d'Informatique de Grenoble (LIG)

RESEARCH CENTER
Grenoble - Rhône-Alpes

THEME
Robotics and Smart environments

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Project-Team PERVASIVE

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Keywords:

Computer Science and Digital Science:

A1.4. - Ubiquitous Systems
A1.6. - Green Computing
A3.4.5. - Bayesian methods
A3.4.6. - Neural networks
A3.4.8. - Deep learning
A3.5.2. - Recommendation systems
A5.1.7. - Multimodal interfaces
A5.1.9. - User and perceptual studies
A5.4. - Computer vision
A5.6. - Virtual reality, augmented reality
A5.7. - Audio modeling and processing
A5.10.2. - Perception
A5.10.3. - Planning
A5.10.4. - Robot control
A5.10.5. - Robot interaction (with the environment, humans, other robots)
A5.11. - Smart spaces
A9. - Artificial intelligence

Other Research Topics and Application Domains:

B1.2.2. - Cognitive science
B2.1. - Well being
B2.5.3. - Assistance for elderly
B6.4. - Internet of things
B6.6. - Embedded systems
B8.1. - Smart building/home
B8.1.1. - Energy for smart buildings
B8.1.2. - Sensor networks for smart buildings
B9.1.1. - E-learning, MOOC

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2. Overall Objectives

2.1. Overall Objectives

Pervasive Interaction develops theories and models for context aware, sociable interaction with systems and services that are dynamically composed from collections of interconnected smart objects. The project uses of situation models as a technological foundation for situated behavior for smart objects and services.

The research program for Pervasive Interaction is designed to respond to the following four research questions:

- Q1: What are the most appropriate computational techniques for acquiring and using situation models for situated behavior by smart objects?
- Q2: What perception and action techniques are most appropriate for situated interaction with smart objects?
- Q3: Can we use situation modelling as a foundation for sociable interaction with smart objects?
- Q4: Can we use situated smart objects as a form of immersive media?

The Pervasive Interaction team was initially formed as a provisional project team of the Inria Grenoble Rhone-Alpes Research Center in April 2016. In November 2017, Pervasive Interaction has been officially designated as an Inria project team. For technical reasons, some publications and results from November and December 2017 are excluded from this report.

3. Research Program

3.1. Situation Models

Situation Modelling, Situation Awareness, Probabilistic Description Logistics

The objectives of this research area are to develop and refine new computational techniques that improve the reliability and performance of situation models, extend the range of possible application domains, and reduce the cost of developing and maintaining situation models. Important research challenges include developing machine-learning techniques to automatically acquire and adapt situation models through interaction, development of techniques to reason and learn about appropriate behaviors, and the development of new algorithms and data structures for representing situation models.

Pervasive Interaction will address the following research challenges:

Techniques for learning and adapting situation models: Hand crafting of situation models is currently an expensive process requiring extensive trial and error. We will investigate combination of interactive design tools coupled with supervised and semi-supervised learning techniques for constructing initial, simplified prototype situation models in the laboratory. One possible approach is to explore developmental learning to enrich and adapt the range of situations and behaviors through interaction with users.

Reasoning about actions and behaviors: Constructing systems for reasoning about actions and their consequences is an important open challenge. We will explore integration of planning techniques for operationalizing actions sequences within behaviors, and for constructing new action sequences when faced with unexpected difficulties. We will also investigate reasoning techniques within the situation modeling process for anticipating the consequences of actions, events and phenomena.

Algorithms and data structures for situation models: In recent years, we have experimented with an architecture for situated interaction inspired by work in human factors. This model organises perception and interaction as a cyclic process in which directed perception is used to detect and track entities, verify relations between entities, detect trends, anticipate consequences and plan actions. Each phase of this process raises interesting challenges questions algorithms and programming techniques. We will experiment alternative programming techniques representing and reasoning about situation models both in terms of difficulty of specification and development and in terms of efficiency of the resulting implementation. We will also investigate the use of probabilistic graph models as a means to better accommodate uncertain and unreliable information. In particular, we will experiment with using probabilistic predicates for defining situations, and maintaining likelihood scores over multiple situations within a context. Finally, we will investigate the use of simulation as technique for reasoning about consequences of actions and phenomena.

Probabilistic Description Logics: In our work, we will explore the use of probabilistic predicates for representing relations within situation models. As with our earlier work, entities and roles will be recognized using multi-modal perceptual processes constructed with supervised and semi-supervised learning [Brdiczka 07], [Barraquand 12]. However, relations will be expressed with probabilistic predicates. We will explore learning based techniques to probabilistic values for elementary predicates, and propagate these through probabilistic representation for axioms using Probabilistic Graphical Models and/or Bayesian Networks.

The challenges in this research area will be addressed through three specific research actions covering situation modelling in homes, learning on mobile devices, and reasoning in critical situations.

3.1.1. Learning Routine patterns of activity in the home.

The objective of this research action is to develop a scalable approach to learning routine patterns of activity in a home using situation models. Information about user actions is used to construct situation models in which key elements are semantic representations of time, place, social role and actions. Activities are encoded as sequences of situations. Recurrent activities are detected as sequences of activities that occur at a specific time and place each day. Recurrent activities provide routines what can be used to predict future actions and anticipate needs and services. An early demonstration has been to construct an intelligent assistant that can respond to and filter communications.

This research action is carried out as part of the doctoral research of Julien Cumin in cooperation with researchers at Orange labs, Meylan. Results are to be published at Ubicomp, Ambient intelligence, Intelligent Environments and IEEE Transactions on System Man and Cybernetics. Julien Cumin will complete and defend his doctoral thesis in 2018.

3.1.2. Learning Patterns of Activity with Mobile Devices

The objective of this research action is to develop techniques to observe and learn recurrent patterns of activity using the full suite of sensors available on mobile devices such as tablets and smart phones. Most mobile devices include seven or more sensors organized in 4 groups: Positioning Sensors, Environmental Sensors, Communications Subsystems, and Sensors for Human-Computer Interaction. Taken together, these sensors can provide a very rich source of information about individual activity.

In this area we explore techniques to observe activity with mobiles devices in order to learn daily patterns of activity. We will explore supervised and semi-supervised learning to construct systems to recognize places and relevant activities. Location and place information, semantic time of day, communication activities, interpersonal interactions, and travel activities (walking, driving, riding public transportation, etc.) are recognized as probabilistic predicates and used to construct situation models. Recurrent sequences of situations will be detected and recorded to provide an ability to predict upcoming situations and anticipate needs for information and services.

Our goal is to develop a theory for building context aware services that can be deployed as part of the mobile applications that companies such as SNCF and RATP use to interact with clients. For example, a current project concerns systems that observe daily travel routines for the Paris region RATP metro and SNCF commuter trains. This system learns individual travel routines on the mobile device without the need to divulge information about personal travel to a cloud based system. The resulting service will consult train and metro schedules to assure that planned travel is feasible and to suggest alternatives in the case of travel disruptions. Similar applications are under discussion for the SNCF inter-city travel and Air France for air travel.

This research action is conducted in collaboration with the Inria Startup Situ8ed. The current objective is to deploy and evaluate a first prototype App during 2017. Techniques will be used commercially by Situ8ed for products to be deployed as early as 2019.

3.1.3. Bibliography

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3.2. Perception of People, Activities and Emotions

Machine perception is fundamental for situated behavior. Work in this area will concern construction of perceptual components using computer vision, acoustic perception, accelerometers and other embedded sensors. These include low-cost accelerometers [Bao 04], gyroscopic sensors and magnetometers, vibration sensors, electromagnetic spectrum and signal strength (wifi, bluetooth, GSM), infrared presence detectors, and bolometric imagers, as well as microphones and cameras. With electrical usage monitoring, every power switch can be used as a sensor [Fogarty 06], [Coutaz 16]. We will develop perceptual components for integrated vision systems that combine a low-cost imaging sensors with on-board image processing and wireless communications in a small, low-cost package. Such devices are increasingly available, with the enabling manufacturing technologies driven by the market for integrated imaging sensors on mobile devices. Such technology enables the use of embedded computer vision as a practical sensor for smart objects.

Research challenges to be addressed in this area include development of practical techniques that can be deployed on smart objects for perception of people and their activities in real world environments, integration and fusion of information from a variety of sensor modalities with different response times and levels of abstraction, and perception of human attention, engagement, and emotion using visual and acoustic sensors.

Work in this research area will focus on three specific Research Actions

3.2.1. Multi-modal perception and modeling of activities

The objective of this research action is to develop techniques for observing and scripting activities for common household tasks such as cooking and cleaning. An important part of this project involves acquiring annotated multi-modal datasets of activity using an extensive suite of visual, acoustic and other sensors. We are interested in real-time on-line techniques that capture and model full body movements, head motion and manipulation actions as 3D articulated motion sequences decorated with semantic labels for individual actions and activities with multiple RGB and RGB-D cameras.

We will explore the integration of 3D articulated models with appearance based recognition approaches and statistical learning for modeling behaviors. Such techniques provide an important enabling technology for context aware services in smart environments [Coutaz 05], [Crowley 15], investigated by Pervasive Interaction team, as well as research on automatic cinematography and film editing investigated by the Imagine team [Gandhi 13] [Gandhi 14] [Ronfard 14] [Galvane 15]. An important challenge is to determine which techniques are most appropriate for detecting, modeling and recognizing a large vocabulary of actions and activities under different observational conditions.

We will explore representations of behavior that encodes both temporal-spatial structure and motion at multiple levels of abstraction. We will further propose parameters to encode temporal constraints between actions in the activity classification model using a combination of higher-level action grammars [Pirsiavash 14] and episodic reasoning [Santofimia 14] [Edwards 14].

Our method will be evaluated using long-term recorded dataset that contains recordings of activities in home environments. This work is carried out in the doctoral research of Nachwa Abou Bakr in cooperation with Remi Ronfard of the Imagine Team of Inria.

3.2.2. *Perception with low-cost integrated sensors*

In this research action, we will continue work on low-cost integrated sensors using visible light, infrared, and acoustic perception. We will continue development of integrated visual sensors that combine micro-cameras and embedded image processing for detecting and recognizing objects in storage areas. We will combine visual and acoustic sensors to monitor activity at work-surfaces. Low cost real-time image analysis procedures will be designed that acquire and process images directly as they are acquired by the sensor.

Bolometric image sensors measure the Far Infrared emissions of surfaces in order to provide an image in which each pixel is an estimate of surface temperature. Within the European MIRTIC project, Grenoble startup, ULIS has created a relatively low-cost Bolometric image sensor (Retina) that provides small images of 80 by 80 pixels taken from the Far-infrared spectrum. Each pixel provides an estimate of surface temperature. Working with Schneider Electric, engineers in the Pervasive Interaction team had developed a small, integrated sensor that combines the MIRTIC Bolometric imager with a microprocessor for on-board image processing. The package has been equipped with a fish-eye lens so that an overhead sensor mounted at a height of 3 meters has a field of view of approximately 5 by 5 meters. Real-time algorithms have been demonstrated for detecting, tracking and counting people, estimating their trajectories and work areas, and estimating posture.

Many of the applications scenarios for Bolometric sensors proposed by Schneider Electric assume a scene model that assigns pixels to surfaces of the floor, walls, windows, desks or other items of furniture. The high cost of providing such models for each installation of the sensor would prohibit most practical applications. We have recently developed a novel automatic calibration algorithm that determines the nature of the surface under each pixel of the sensor.

Work in this area will continue to develop low-cost real time infrared image sensing, as well as explore combinations of far-infrared images with RGB and RGBD images.

3.2.3. *Observing and Modelling Competence and Awareness from Eye-gaze and Emotion*

Humans display awareness and emotions through a variety of non-verbal channels. It is increasingly possible to record and interpret such information with available technology. Publicly available software can be used to efficiently detect and track face orientation using web cameras. Concentration can be inferred from changes in pupil size [Kahneman 66]. Observation of Facial Action Units [Ekman 71] can be used to detect both sustained and instantaneous (micro-expressions) displays of valence and excitation. Heart rate can be measured from the Blood Volume Pulse as observed from facial skin color [Poh 11]. Body posture and gesture can be obtained from low-cost RGB sensors with depth information (RGB+D) [Shotton 13] or directly from images using detectors learned using deep learning [Ramakrishna 14]. Awareness and attention can be inferred from eye-gaze (scan path) and fixation using eye-tracking glasses as well as remote eye tracking devices [Holmqvist 11]. Such recordings can be used to reveal awareness of the current situation and to predict ability to respond effectively to opportunities and threats.

This work is supported by the ANR project CEEGE in cooperation with the department of NeuroCognition of Univ. Bielefeld. Work in this area includes the Doctoral research of Thomas Guntz to be defended in 2019.

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3.3. Sociable Interaction with Smart Objects

Reeves and Nass argue that a social interface may be the truly universal interface [Reeves 98]. Current systems lack ability for social interaction because they are unable to perceive and understand humans or to learn from interaction with humans. One of the goals of the research to be performed in Pervasive Interaction is to provide such abilities.

Work in research area RA3 will demonstrate the use of situation models for sociable interaction with smart objects and companion robots. We will explore the use of situation models as a representation for sociable interaction. Our goal in this research is to develop methods to endow an artificial agent with the ability to acquire social common sense using the implicit feedback obtained from interaction with people. We believe that such methods can provide a foundation for socially polite man-machine interaction, and ultimately for other forms of cognitive abilities. We propose to capture social common sense by training the appropriateness of behaviors in social situations. A key challenge is to employ an adequate representation for social situations.

Knowledge for sociable interaction will be encoded as a network of situations that capture both linguistic and non-verbal interaction cues and proper behavioral responses. Stereotypical social interactions will be represented as trajectories through the situation graph. We will explore methods that start from simple stereotypical situation models and extending a situation graph through the addition of new situations and the splitting of existing situations. An important aspect of social common sense is the ability to act appropriately in social situations. We propose to learn the association between behaviors and social situation using reinforcement learning. Situation models will be used as a structure for learning appropriateness of actions and behaviors that may be chosen in each situation, using reinforcement learning to determine a score for appropriateness based on feedback obtained by observing partners during interaction.

Work in this research area will focus on four specific Research Actions

3.3.1. Moving with people

Our objective in this area is to establish the foundations for robot motions that are aware of human social situation that move in a manner that complies with the social context, social expectations, social conventions and cognitive abilities of humans. Appropriate and socially compliant interactions require the ability for real time perception of the identity, social role, actions, activities and intents of humans. Such perception can be used to dynamically model the current situation in order to understand the situation and to compute the appropriate course of action for the robot depending on the task at hand.

To reach this objective, we propose to investigate three interacting research areas:

- Modeling the context and situation of human activities for motion planning
- Planning and acting in a social context.
- Identifying and modeling interaction behaviors.

In particular, we will investigate techniques that allow a tele-presence robot, such as the BEAM system, to autonomously navigate in crowds of people as may be found at the entry to a conference room, or in the hallway of a scientific meeting.

3.3.2. Understanding and communicating intentions from motion

This research area concerns the communication through motion. When two or more people move as a group, their motion is regulated by implicit rules that signal a shared sense of social conventions and social roles. For example, moving towards someone while looking directly at them signals an intention for engagement. In certain cultures, subtle rules dictate who passes through a door first or last. When humans move in groups, they implicitly communicate intentions with motion. In this research area, we will explore the scientific literature on proxemics and the social sciences on such movements, in order to encode and evaluate techniques for socially appropriate motion by robots.

3.3.3. Socially aware interaction

This research area concerns socially aware man-machine interaction. Appropriate and socially compliant interaction requires the ability for real time perception of the identity, social role, actions, activities and intents of humans. Such perception can be used to dynamically model the current situation in order to understand the context and to compute the appropriate course of action for the task at hand. Performing such interactions in manner that respects and complies with human social norms and conventions requires models for social roles and norms of behavior as well as the ability to adapt to local social conventions and individual user preferences. In this research area, we will complement research area 3.2 with other forms of communication and interaction, including expression with stylistic face expressions rendered on a tablet, facial gestures, body motions and speech synthesis. We will experiment with use of commercially available tool for spoken language interaction in conjunction with expressive gestures.

3.3.4. Stimulating affection and persuasion with affective devices.

This research area concerns technologies that can stimulate affection and engagement, as well as induce changes in behavior. When acting as a coach or cooking advisor, smart objects must be credible and persuasive. One way to achieve this goal is to express affective feedbacks while interacting. This can be done using sound, light and/or complex moves when the system is composed of actuators.

Research in this area will address 3 questions:

1. How do human perceive affective signals expressed by smart objects (including robots)?
2. How does physical embodiment effect perception of affect by humans?
3. What are the most effective models and tools for animation of affective expression?

Both the physical form and the range of motion have important impact on the ability of a system to inspire affection. We will create new models to propose a generic animation model, and explore the effectiveness of different forms of motion in stimulating affect.

3.3.5. Bibliography

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3.4. Interaction with Pervasive Smart Objects and Displays

Currently, the most effective technologies for new media for sensing, perception and experience are provided by virtual and augmented realities [Van Krevelen 2010]. At the same time, the most effective means to augment human cognitive abilities are provided by access to information spaces such as the world-wide-web using graphical user interfaces. A current challenge is to bring these two media together.

Display technologies continue to decrease exponentially, driven largely by investment in consumer electronics as well as the overall decrease in cost of microelectronics. A consequence has been an increasing deployment of digital displays in both public and private spaces. This trend is likely to accelerate, as new technologies and growth in available communications bandwidth enable ubiquitous low-cost access to information and communications.

The arrival of pervasive displays raises a number of interesting challenges for situated multi-modal interaction. For example:

1. Can we use perception to detect user engagement and identify users in public spaces?
2. Can we replace traditional pointing hardware with gaze and gesture based interaction?
3. Can we tailor information and interaction for truly situated interaction, providing the right information at the right time using the right interaction modality?
4. How can we avoid information overload and unnecessary distraction with pervasive displays?

It is increasingly possible to embed sensors and displays in clothing and ordinary devices, leading to new forms of tangible and wearable interaction with information. This raises challenges such as

1. What are the tradeoffs between large-scale environmental displays and wearable displays using technologies such as e-textiles and pico-projector?
2. How can we manage the tradeoffs between implicit and explicit interaction with both tangible and wearable interaction?
3. How can we determine the appropriate modalities for interaction?
4. How can we make users aware of interaction possibilities without creating distraction?

In addition to display and communications, the continued decrease in microelectronics has also driven an exponential decrease in cost of sensors, actuators, and computing resulting in an exponential growth in the number of smart objects in human environments. Current models for systems organization are based on centralized control, in which a controller or local hub, orchestrates smart objects, generally in connection with cloud computing. This model creates problems with privacy and ownership of information. An alternative is to organize local collections of smart objects to provide distributed services without the use of a centralized controller. The science of ecology can provide an architectural model for such organization.

This approach raises a number of interesting research challenges for pervasive interaction:

1. Can we devise distributed models for multi-modal fusion and interaction with information on heterogeneous devices?
2. Can we devise models for distributed interaction that migrates over available devices as the user changes location and task?
3. Can we manage migration of interaction over devices in a manner that provides seamless immersive interaction with information, services and media?
4. Can we provide models of distributed interaction that conserve the interaction context as services migrate?

Research Actions for Interaction with Pervasive Smart Objects for the period 2017 - 2020 include

3.4.1. Situated interaction with pervasive displays

The emergence of low-cost interactive displays will enable a confluence of virtual and physical environments. Our goal in this area is to go beyond simple graphical user interfaces in such environments to provide immersive multi-sensorial interaction and communication. A primary concern will be interaction technologies that blend visual with haptic/tactile feedback and 3D interaction and computer vision. We will investigate the use of visual-tactile feedback as well as vibratory signals to augment multi-sensorial interaction and communication. The focus will be on the phenomena of immersive interaction in real worlds that can be made possible by the blending of physical and virtual in ordinary environments.

3.4.2. Wearable and tangible interaction with smart textiles and wearable projectors

Opportunities in this area result from the emergence of new forms of interactive media using smart objects. We will explore the use of smart objects as tangible interfaces that make it possible to experience and interact with information and services by grasping and manipulating objects. We will explore the use of sensors and actuators in clothing and wearable devices such as gloves, hats and wrist bands both as a means of unobtrusively sensing human intentions and emotional states and as a means of stimulating human senses through vibration and sound. We will explore the new forms of interaction and immersion made possible by deploying interactive displays over large areas of an environment.

3.4.3. Pervasive interaction with ecologies of smart objects in the home

In this research area, we will explore and evaluate interaction with ecologies of smart objects in home environments. We will explore development of a range of smart objects that provide information services, such as devices for Episodic Memory for work surfaces and storage areas, devices to provide energy efficient control of environmental conditions, and interactive media that collect and display information. We propose to develop a new class of socially aware managers that coordinate smart objects and manage logistics in functional areas such as the kitchen, living rooms, closets, bedrooms, bathroom or office.

3.4.4. Bibliography

[Van Krevelen 10] D. W. F. Van Krevelen and R. Poelman, A survey of augmented reality technologies, applications and limitations. International Journal of Virtual Reality, 9(2), 1, 2010

4. Application Domains

4.1. Smart Energy Systems

Participants: Amr Alyafi, Amine Awada, Patrick Reignier Partners: UMR G-SCOP, UMR LIG (Persuasive Interaction, IIHM), CEA Liten, PACTE, Vesta Systems and Elithis.

Work in this area explores techniques for a user centric energy management system, where user needs and tacit knowledge drive the search of solutions. These are calculated using a flexible energy model of the living areas. The system is personified by energy consultants with which building actors such as building owners, building managers, technical operators but also occupants, can interact in order to co-define energy strategies, benefiting of both assets: tacit knowledge of human actors, and measurement with computation capabilities of calculators. Putting actors in the loop, i.e. making energy not only visible but also controllable is the needed step before large deployment of energy management solutions. It is proposed to develop interactive energy consultants for all the actors, which are energy management aided systems embedding models in order to support the decision making processes. MIRROR (interactive monitoring), WHAT-IF (interactive quantitative simulation), EXPLAIN (interactive qualitative simulation), SUGGEST-AND-ADJUST (interactive management) and RECOMMEND (interactive diagnosis) functionalities will be developed.

4.2. E-Textile

Participant: Sabine Coquillart

Partner: LIMSI

Collaboration with the HAPCO team from LIMSI on e-textiles. A patent application has been filed related to this work:

- F. Bimbard, M. Bobin, M. Ammi, S. Coquillart "Procédé de conception d'un capteur de flexion textile piézorésistif à partir de fils fonctionnels", Patent Application, 2017.

4.3. Interaction with Pervasive Media

Participants: Sabine Coquillart, Jingtao Chen

Partners: Inria GRA, GIPSA, G-SCOP

Pseudo-haptic feedback is a technique aiming to simulate haptic sensations without active haptic feedback devices. Peudo-haptic techniques have been used to simulate various haptic feedbacks such as stiffness, torques, and mass. In the framework of Jingtao Chen PhD thesis, a novel pseudo-haptic experiment has been set up. The aim of this experiment is to study the EMG signals during a pseudo-haptic task. A stiffness discrimination task similar to the one published in Lecuyer's PhD thesis has been chosen. The experimental set-up has been developed, as well as the software controlling the experiment. Pre-tests are under way. They will be followed by the tests with subjects.

4.4. Bayesian Reasoning

Participants: Emmanuel Mazer, Raphael Frisch, Augustin Lux, Didier Piau, Marvin Faix, Jeremy Belot

The development of modern computers is mainly based on increase of performances and decrease of size and energy consumption, with no notable modification of the basic principles of computation. In particular, all the components perform deterministic and exact operations on sets of binary signals. These constraints obviously impede further sizable progresses in terms of speed, miniaturization and power consumption. The main goal of the project MicroBayes is to investigate a radically different approach, using stochastic bit streams to perform computations. The aim of this project is to show that stochastic architectures can outperform standard computers to solve complex inference problems both in terms of execution speed and of power consumption. We will demonstrate the feasibility on two applications involving low level information processing from sensor signals, namely sound source localization and separation.

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

James Crowley has received the ICMI Sustained Achievements award at the 2018 International Conference on Multimodal Interaction at Boulder Colorado in Oct. 2018.

6. New Software and Platforms

6.1. Platforms

The AmiQual4Home Innovation Factory is an open research facility for innovation and experimentation with human-centered services based on the use of large-scale deployment of interconnected digital devices capable of perception, action, interaction and communication. The Innovation Factory is composed of a collection of workshops for rapid creation of prototypes, surrounded by a collection of living labs and supported by an industrial innovation and transfer service. Creation of the Innovation Factory has been made possible by a grant from French National programme Investissement d'avenir, together with substantial contributions of resources by Grenoble INP, Univ Joseph Fourier, UPMF, CNRS, Schneider Electric and the Communaute de Communes of Montbonnot. The objective is to provide the academic and industrial communities with an open platform to enable research on design, integration and evaluation of systems and services for smart habitats.

The AmiQual4Home Innovation Factory is a unique combination of three different innovation instruments:

1. Workshops for rapid prototyping of devices that embed perception, action, interaction and communication in ordinary objects based on the MIT FabLab model,
2. Facilities for real-world test and evaluation of devices and services organized as open Living Labs,
3. Resources for assisting students, researchers, entrepreneurs and industrial partners in creating new economic activities.

The AmiQual4Home Innovation Factory works with the Inovallee TARMAC technology incubator as well as the SAT Linksium to proved innovation and transfer services to enable students, researchers and local entrepreneurs to create and grow new commercial activities based on smart objects and services.

7. New Results

7.1. Using Attention to Address Human-Robot Motion

Participants: Thierry Fraichard, Rémi Paulin, Patrick Reignier.

To capture the specificity of robot motion among people, we choose the term **Human-Robot Motion** (HRM) [1], to denote the study of how robots should move among people. HRM is about designing robots whose motions are deemed socially **acceptable** from a human point of view while remaining **safe**.

After 15 years of research on HRM, the main concept that has emerged is that of *social spaces*, *i.e.* regions of the environment that people consider as psychologically theirs [33], any intrusion in their social space will be a source of discomfort. Such social spaces are characterized by the position of the person, *i.e.* "Personal Space", or the activity they are currently engaged in, *i.e.* "Interaction Space" and "Activity Space". The most common approach in HRM is to define costmaps on such social spaces: the higher the cost, the less desirable it is to be there. The costmaps are then used for navigation purposes, *e.g.* [37] and [36].

[1] In reference to Human-Robot Interaction (HRI), *i.e.* the study of the interactions, in the broad sense of the word, between people and robots.

Social spaces are of course relevant to HRM but they have limitations. First, it is not straightforward to define them; what is their shape or size, especially in cluttered environments? Second, it seems obvious that there is more to acceptability than geometry only: the appearance of a robot and its velocity will also influence the way it is perceived by people. Finally, social spaces can be conflicting because when a robot needs to interact with a person, it is very likely that it will have to penetrate a social space.

To complement social spaces, we have started to explore whether human attention could be useful to address HRM vis-à-vis the acceptability aspect. Why attention? The answer is straightforward: the acceptability of a robot motion is directly related to the way it is perceived by a person hence our interest in human attention. For a person, attention is a cognitive mechanism for filtering the person's sensory information (to avoid an overwhelming amount of information) [35]. It controls where and to what the person's attentional resources are allocated.

In 2014, we introduced the concept of **attention field**, *i.e.* a predictor of the amount of attention that a person allocates to the robot when the robot is in a given state. In [32], the attention field was computed thanks to a computational model of attention proposed in [34] in the context of ambient applications and pervasive systems. In this model, attentional resources are focused on a single specific area of the person's visual space (as per the zoom lens model [31]). Later studies have demonstrated that the situation is more complex and that attentional resources can be distributed over multiple objects in the visual space [35].

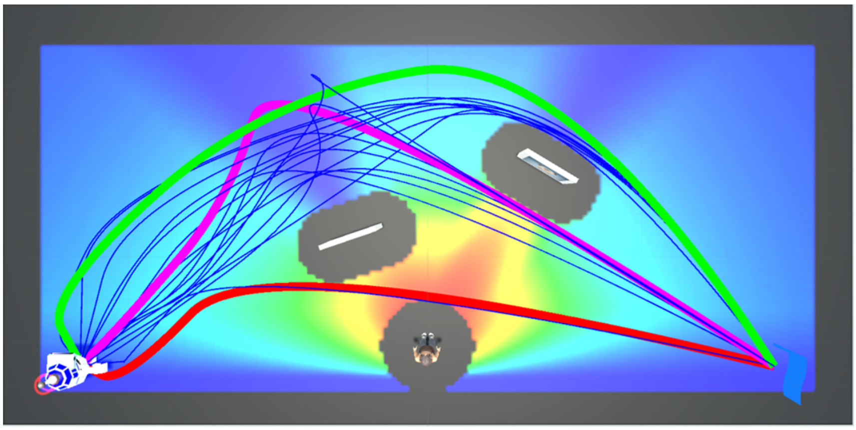


Figure 1. Motions with different attentional properties in a scenario featuring a person watching at paintings in a museum and a robot which is to travel from left to right: less distracting (green) vs. shortest (red) motions are depicted. The purple motion is a trade-off solution.

In 2018, we have developed a novel **computational model of attention** that takes this property into account. This model is used to compute the attention field for a robot. The attention field is then used to define different **attentional properties** for the robot's motions such as distraction or surprise. The relevance of the attentional properties for HRM have been demonstrated on a proof-of-concept **acceptable motion planner** on various case studies where a robot is assigned different tasks. The multi-criteria nature of motion planning in the context of HRM led to the design of an acceptable motion planner based upon a state-of-the-art many-objective optimization algorithm. It shows how to compute acceptable motions that are non-distracting and non-surprising, but also motions that convey the robot's intention to interact with a person. All these contributions have been presented in the PhD of Rémi Paulin [6] and the conference article [26].

7.2. Simulating Haptic Sensations

Participants: Jingtao Chen, Sabine Coquillart

Partners: Inria GRA, LIG, GIPSA, G-SCOP

Pseudo-haptic feedback is a technique aiming to simulate haptic sensations without active haptic feedback devices. Peudo-haptic techniques have been used to simulate various haptic feedbacks such as stiffness, torques, and mass. In the framework of the Persyval project, a novel pseudo-haptic experiment has been set up. The aim of this experiment is to study the force and EMG signals during a pseudo-haptic task. A stiffness discrimination task similar to the one published in Lecuyer's PhD thesis has been chosen. The experimental set-up has been developed, as well as the software controlling the experiment. Pre-tests have been conducted. They have been followed by formal tests with subjects.

7.3. Observing and Modeling Awareness and Expertise During Problem Solving

Participants: Thomas Guntz, Dominique Vaufreydaz, James Crowley, Philippe Dessus, Raffaella Balzarini

7.3.1. Observing and Modelling Competence and Awareness from Eye-gaze and Emotion

We have constructed an instrument for capturing and interpreting multimodal signals of humans engaged in solving challenging problems. Our instrument captures eye gaze, fixations, body postures, and facial expressions signals from humans engaged in interactive tasks on a touch screen. We use a 23 inch Touch-Screen computer, a Kinect 2.0 mounted 35 cm above the screen to observe the subject, a 1080p Webcam for a frontal view, a Tobii Eye-Tracking bar (Pro X2-60 screen-based) and two adjustable USB-LED for lighting condition control. A wooden structure is used to rigidly mount the measuring equipment in order to assure identical sensor placement and orientation for all recordings.

As a pilot study, we observed expert chess players engaged in solving problems of increasing difficulty [Guntz et al 18a]. Our initial hypothesis was that we could directly detect awareness of significant configurations of chess pieces (chunks) from eye-scan and physiological measurements of emotion in reaction to game situation. The pilot experiment demonstrated that this initial hypothesis was overly simplistic.

In order to better understand the phenomena observed in our pilot experiment, we have constructed a model of the cognitive processes involved, using theories from cognitive science and classic (symbolic) artificial intelligence. This model is a very partial description that allows us to ask questions and make predictions to guide future experiments. Our model posits that experts reason with a situation model that is strongly constrained by limits to the number of entities and relations that may be considered at a time. This limitation forces subjects to construct abstract concepts (chunks) to describe game play, in order to explore alternative moves. Expert players retain associations of situations with emotions in long-term memory. The rapid changes in emotion correspond to recognition of previously encountered situations during exploration of the game tree. Recalled emotions guide selection of situation models for reasoning. This hypothesis is in accordance with Damasio's Somatic Marker hypothesis, which posits that emotions guide behavior, particularly when cognitive processes are overloaded [Damasio 91].

Our hypothesis is that the subject uses the evoked emotions to select from the many possible situations for reasoning about moves during orientation and exploration. With this interpretation, the player rapidly considers partial descriptions as situations composed of a limited number of perceived chunks. Recognition of situations from experience evokes emotions that are displayed as face expressions and body posture.

With this hypothesis, valence, arousal and dominance are learned from experience and associated with chess situations in long-term memory to guide reasoning in chess. Dominance corresponds to the degree of experience with the recognized situation. As players gain experience with alternate outcomes for a situation, they become more assured in their ability to spot opportunities and avoid dangers. Valence corresponds to whether the situation is recognized as favorable (providing opportunities) or unfavorable (creating threats). Arousal corresponds to the imminence of a threat or opportunity. A defensive player will give priority to reasoning about unfavorable situations and associated dangers. An aggressive player will seek out high valence situations. All players will give priority to situations that evoke strong arousal. The amount of effort that player will expend exploring a situation can determined by dominance.

In 2019 we will conduct an additional experiment designed confirm and explore this hypothesis. Results will be reported in a journal paper (under preparation) as well as in the doctoral thesis of Thomas Guntz, to be defended in late 2019.

7.3.2. Bibliography

[Damasio 91] Damasio, A., Somatic Markers and the Guidance of Behavior. New York: Oxford University Press. pp. 217–299, 1991.

[Guntz et al. 18a] T. Guntz, R. Balzarini, D. Vaufreydaz, and J.L. Crowley, "Multimodal Observation and Classification of People Engaged in Problem Solving: Application to Chess Players". Multimodal Technologies and Interaction, Vol 2 No. 2, p11, 2018.

[Guntz et al. 18b] T. Guntz, J.L. Crowley, D. Vaufreydaz, R. Balzarini, P. Dessus, The Role of Emotion in Problem Solving: first results from observing chess, Workshop on Modeling Cognitive Processes from Multimodal Data, at the 2018 ACM International Conference on Multimodal Interaction, ICMI 2018, Oct 2018.

7.4. Learning Routine Patterns of Activity in the Home

Participants: Julien Cumin, James Crowley

Other Partners: Fano Ramparany, Greg Lefevre (Orange Labs)

During the month of February 2017, we have collected 4 weeks of data on daily activities within the Amiqual4Home Smart Home Living lab apartment. This dataset was presented at the international Conference on Ubiquitous Computing and Ambient Intelligence, UCAmI 2017, at Bethlehem PA, in Nov 2017 and is currently available for download from the Amiqual4Home web server (http://amiqual4home.inria.fr/en/orange4home/)

The objective of this research action is to develop a scalable approach to learning routine patterns of activity in a home using situation models. Information about user actions is used to construct situation models in which key elements are semantic time, place, social role, and actions. Activities are encoded as sequences of situations. Recurrent activities are detected as sequences of activities that occur at a specific time and place each day. Recurrent activities provide routines that can be used to predict future actions and anticipate needs and services. An early demonstration has been to construct an intelligent assistant that can respond to and filter inter-personal communications.

7.5. Bayesian Reasoning

Participants: Emmanuel Mazer, Raphael Frisch, Marvin Faix, Augustin Lux, Didier Piau, Jeremy Belot.

To overcome the ever growing needs in computing power, alternative computing paradigms have been developed such as stochastic architectures. These latter have found substantial interests for energy efficient implementations in artificial intelligence. In particular, mixing stochastic computing with Bayesian models makes a promising paradigm for non-conventional computational architectures dedicated to Bayesian inference. The ability to deal with uncertainty and adapt its computational accuracy is some of the advantages of these computing approaches.

During 2018 we have designed a first hardware prototype to localize a sound source with a stochastic machine. The goal of this project was to provide a proof of concept of stochastic machines by implementing an autonomous platform of sound source localization. It includes an sound acquisition module, a pre-processing circuit, and the stochastic machine. The platform has been implemented on an Altera Cyclone V FPGA and validated functionally with digital simulations. Several optimization to improve size and power consumption have been proposed. Results in terms of computation time, power and used FPGA resources allowed to assess their impact on future design. The same architecture of stochastic machine was also analyzed in simulation to provide design guidelines for our next design [25].

Further, we have proposed a way to reduce the memory needs of our architecture by sharing a memory between the processing units (in collaboration with TIMA and C2M -Université Paris Sud). This optimization reduces the area and the cost of our architecture. However, its impact on power consumption is not obvious. Therefore, we designed an integrated circuit (ASIC) with our original and optimized proposals. We synthesized the VHDL description of the circuit in the FDSOI 28nm technology from STMicroelectronics. Notice that the memory has been implemented thanks to a SRAM memory compiler. The results highlight that the optimized machine significantly reduces both the circuit area (by 30%) and the power consumption (by 35%). Nevertheless, the simulations showed that, in the optimized version, the memory represents nearly 60 % of our circuit area and more than 55% of the power consumption. According to the latest literature, the Magnetic Random Access Memory (MRAM) technology provides some promising features and would approximately reduce by a factor of 20 the memory area. Moreover, this feature should drastically impact the power consumption. Thus, our future works will focus on the implementation of Bayesian machines using MRAM instead of SRAM. A poster describing this work was presented at the International Conference on rebooting Computing.

We have proposed (in collaboration with ISIR - Université Paris Sorbonne)a new way to localize several sound sources using a Bayesian model. This multi-source localization algorithm is fast and can readily be implemented on our stochastic machine (Paper submitted at ICASSP 2019). The Figure 2 shows the location of the source and of the microphones in the simulated environment. The Figure 3 shows the posterior distribution of the location of one source using a short frame and the Figure 4 shows the result using fifty frames. As the frame are very short the localization of the two sources is readily obtained and it is used as a bootstrap for the source separation algorithm .

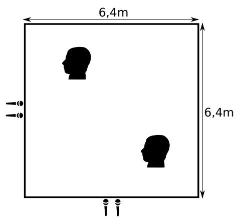
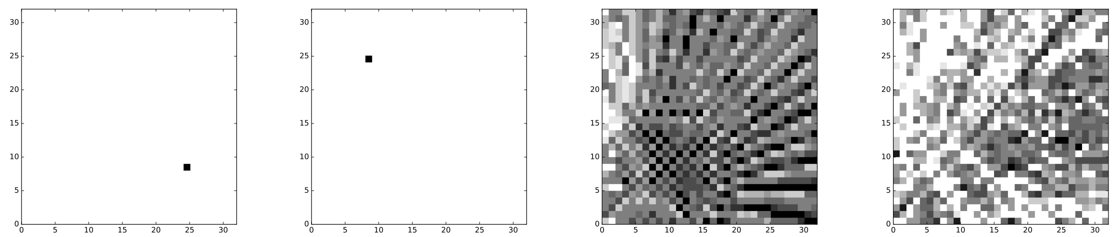


Figure 2. Simulated room setup.



(a) Frame 1 (b) Frame 3 (c) Frame 29 (d) Frame 46

Figure 3. Posterior distribution maps for a single source obtained for 4 very short time-frames of a given 50-frame bloc.

We devised and successfully tested a Bayesian model for the source separation problem. The model assumes the localization of the sources are known. The inference - retrieving the sound emitted by each source from the

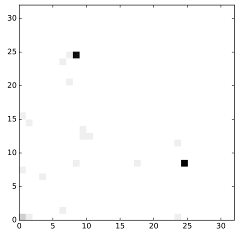


Figure 4. Final distribution map after fusion over 50 frames. The two black squares correspond to the actual positions of the two sources.

mixed signals obtained with several microphones - takes place in a very high dimensional space. Nevertheless, the Gibbs algorithm is well suited to solve the problem when the location of the sources are known. A very efficient implementation of this algorithm was tested with a realistic sound simulator using human voices. The algorithm can be implemented on a sampling machine and the corresponding stochastic architecture has been devised. It is currently implemented on an FPGA.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Pervasive has a contract with Orange Labs, Meylan, for supervision of the doctoral research of Julien Cumin for Learning daily routines by observing activity in a smart home

Members of the Pervasive interaction team are work with Orange Labs on techniques for observing activity and learning routines in a smart home. Activity is observed by monitoring use of electrical appliances and Communications media (Telephone, Television, Internet). Activities are described using Bayesian Situation Modeling techniques demonstrated in earlier projects. A log of daily activities is used to discover daily routines expressed as temporal sequences of contexts, where each context is expressed as a network of situations. Experiments will be performed using the Smart home living lab that has been constructed as part of the EquipEx Amiqual4home.

8.1.1. Toutilo project

Participants: Stan Borkoswki, Dominique Vaufreydaz, Joelle Coutaz, James Crowley, Giovanni Balestrieri, Anthony Chavoutier
Partners: Inria, Touti Terre

Touti Terre is a pioneer startup in the use of agricultural robotics for market gardening, developing innovative solutions to make working the land easier and farms sustainable. The Toutirobo-2 Inria innovation lab proposes the design of on overall IT solution for their cobot solution: the Toutilo robot. This project aims at providing significant time and productivity gains for its users. Thanks to the support of the experimentation and prototyping platform Amiqual4Home, members of the Pervasive team contribute to this project on several innovation topics: farm and vehicle management, autonomous guidance, navigation and planning, and interaction systems adapted to farm jobs. boisi

8.1.2. IRT Silver Economy

Participants: James Crowley, Maxime Belgodere

Partners: CEA, Schneider Electric.

Members of the Pervasive Interaction team are working with the CEA and Schneider Electric to develop environmental sensors that can detect when a hospital patient or elderly person has fallen and is unable to get up. The project uses an infrared Bolometric image sensor to observe human activity. Image processing and fall detection logic are to be performed by an embedded image processor on board.

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. LabEx Persyval, Project RHUM, "Robots in Human Environments"

Participants: Thierry Fraichard, Rémi Paulin, Patrick Reignier.

Partners: GIPSA, Inria, LIG, LJK and TIMC.
Dates:*[Sep. 15-Dec. 19].*

The RHUM project from the LabEx Persyval (ANR-11-LABX-0025-01) brings together ten teams from different labs from the Grenoble academic scene: GIPSA, Inria, LIG, LJK and TIMC. Its goal is to tackle scientific problems related to active perception, navigation in human environments, learning and adaptation of robots behaviors for social interaction. PERVASIVE contributes to the navigation in human environments aspects.

9.1.2. ANR Project Involved

Participants: Amr Al-Zhouri Al-Yafi, Patrick Reignier.

Other Partners: UMR G-SCOP, UMR LIG (Persuasive Interaction, IIHM, Getalp), CEA Liten, PACTE, Vesta Systems and Elithis.

Dates: Jan 2015 to Dec 2018

The ANR project Involved focuses on bringing solutions to building actors for upcoming challenges in energy management in residential buildings. The project explores a user centric energy management system, where user needs and tacit knowledge drive the search of solutions. These are calculated using a flexible energy model of the living areas. The system is personified by energy consultants with which building actors such as building owners, building managers, technical operators but also occupants, can interact with in order to co-define energy strategies, benefiting of both assets: tacit knowledge of human actors, and measurement with computation capabilities of calculators. Putting actors in the loop, i.e. making energy not only visible but also controllable is the needed step before large deployment of energy management solutions.

The project will develop interactive energy consultants for all the actors, providing energy management aided systems embedding models in order to support the decision making processes. MIRROR (interactive monitoring), WHAT-IF (interactive quantitative simulation), EXPLAIN (interactive qualitative simulation), SUGGEST- AND-ADJUST (interactive management) and RECOMMEND (interactive diagnosis) functionalities will be developed.

9.1.3. ANR Project CEEGE: Chess Expertise from Eye Gaze and Emotion

Participants: James Crowley, Dominique Vaufreydaz, Rafaellea Balzarini, Thomas Guntz

Other Partners: Dept of NeuroCognition, CITEN, Bielefeld University

Dates: Jan 2016 to Dec 2019

CEEGE is a multidisciplinary scientific research project conducted by the Inria PRIMA team in cooperation with the Dept of Cognitive Neuroscience at the University of Bielefeld. The primary impacts will be improved scientific understanding in the disciplines of Computer Science and Cognitive NeuroScience. The aim of this project is to experimentally evaluate and compare current theories for mental modelling for problem solving and attention, as well as to refine and evaluate techniques for observing the physiological reactions of humans to situation that inspire pleasure, displeasure, arousal, dominance and fear.

In this project, we will observe the visual attention, physiological responses and mental states of subject with different levels of expertise solving classic chess problems, and participating in chess matches. We will observe chess players using eye-tracking, sustained and instantaneous face-expressions (micro-expressions), skin conductivity, blood flow (BVP), respiration, posture and other information extracted from audio-visual recordings and sensor readings of players. We will use the recorded information to estimate the mental constructs with which the players understand the game situation. Information from visual attention as well as physiological reactions will be used to determine and model the degree to which a player understands the game situation in terms of abstract configurations of chess pieces. This will provide a structured environment that we will use for experimental evaluation of current theories of mental modeling and emotional response during problem solving and social interaction.

The project is organized in three phases. During the first phase, we will observe individual players of different levels of chess expertise solving known chess problems. We will correlate scan-path from eye tracking and other information about visual attention to established configurations of pieces and known solutions to chess problems. This will allow us to construct a labeled corpus of chess play that can be used to evaluate competing techniques for estimating mental models and physiological responses. In a second phase, we will observe the attention and face expressions of pairs of players of different levels of chess ability during game play. In particular, we will seek to annotate and segment recordings with respect to the difficulty of the game situation as well as situations that elicit particularly strong physiological reactions. In the final phase, we will use these recordings to evaluate the effectiveness of competing techniques for mental modeling and observation of emotions in terms of their abilities to predict the chess abilities of players, game outcomes and individual moves and player self reports. Results of our work will be published in scientific conferences and journals concerned with cognitive science and cognitive neuroscience as well as computer vision, multimodal interaction, affective computing and pervasive computing. Possible applications include construction of systems that can monitor the cognitive abilities and emotional reactions of users of interactive systems to provide assistance that is appropriate but not excessive, companion systems that can aid with active healthy ageing, and tutoring systems that can assist users in developing skills in a variety of domains including chess.

9.1.4. CDP EcoSesa - Cross Disciplinary Project of the ComUE UGA

Participants: James Crowley, Patrick Reignier, Rafaellea Balzarini Dates: Jan 2017 to Dec 2020

Cities and their energy systems are undergoing profound transformations. Electric Power networks are being transformed from centralized, high capacity, generating plants, dimensioned to meet peak loads to decentralized, local, production based on intermittent renewable sources. This transformation is made possible by integration of information and energy technologies, new energy materials and components, and the rapid spread of pervasive computing. The result is a change in the socio-economics of energy distribution, and a change in the role of users from passive consumers to active participants in a dynamically fluctuating energy market. Many cities worldwide have initiated research projects and experiments to accelerate the spread of clean technologies. However, these initiatives generally focus on a specific issue that depends on the priorities and preferences of the local decision makers and stakeholders. At the same time, academic research has generally been confined to specialized silos in energy materials and management systems, in Social Sciences as well as in Information and Communication Technologies (ICT), resulting in piecemeal knowledge.

The vision of Eco-SESA is to address the problems resulting from the transition to clean decentralized energy production based on renewable sources with a holistic integrated humansystem approach. The project will address the development of Safe, Efficient, Sustainable and Accessible energy systems, from the individual end-user to dynamic communities of stakeholders at the district and grid levels.

Pervasive is involved in two research front of the project :

- Interactive systems to involve occupants of buildings
- Emerging behaviors from individual to communities

9.1.5. ANR VALET

Participant: Dominique Vaufreydaz.

Partners: Inria (Pervasive and Chroma teams for Inria Rhône-Alpes, RITS in Paris), Ircyyn (Nantes), AKKA (Paris)
Dates:*[2016-2018].*

The ANR VALET project investigates two aspects of car sharing. In the first one, a novel approach for solving vehicle redistribution problem is proposed by managing an autonomous platoons guided by professional drivers. The second aspect concerns autonomous parking of shared cars when they arrived at their destination parking lot. In this project, our researches address the prediction of pedestrians' behaviors during urban fleet movements and during parking phases. The PhD student (Pavan Vashista) recruited in this project focus on integrating models of human behaviors to evaluate the risk that surrounding pedestrians encounter the trajectory of the VALET vehicles. His PhD thesis started in February 2016 is co-supervised by Anne Spalanzani (Chroma team) and Dominique Vaufreydaz.

9.1.6. ANR HIANIC

Participant: Dominique Vaufreydaz.

Partners: ARMEN and PACCE teams from LS2N laboratory (Nantes), Inria (Pervasive and Chroma teams for Inria Rhône-Alpes, RITS in Paris), MAGMA from LIG laboratory (Grenoble).
Dates:*[2018-2021].*

The HIANIC project proposes to endow autonomous vehicles with smart behaviors (cooperation, negotiation, socially acceptable movements) to address problems that arise when autonomous cars are mixed with pedestrians in urban shared environment. It aims at developing new technologies in term of autonomous navigation in dense and human populated traffic. In order to contribute to urban safety and intelligent mobility, the HIANIC project also explores the complex problem of sociable interactions between pedestrians and cars while sharing the same urban environment.

In this project, Dominique Vaufreydaz works jointly with the Chroma team on perceiving pedestrians and their behaviors around autonomous cars and on interaction between autonomous vehicles and pedestrians.

9.1.7. LabEx Persyval - Project MicroBayes: Probabilistic Machines for Low-level Sensor Interpretation

Participants: Emmanuel Mazer, Raphael Frisch Other Partners: Laurent Girin (GIPSA Lab), Didier Piau (L'Institut Fourier)

Dates: Nov 2016 to Nov 2019

The project MicroBayes builds on results of the recently completed EC FET Open project BAMBI to explore a new technique for Blind source separation and acoustic signal location using a new form of Bayesian Computer. The techniques have recently been demonstrated using a software simulation. Current plans are to implement and demonstrate the Bayesian computer using an FPGA. By the end of the project we expect to produce a hardware implementation suitable for use in low-cost low-power applications.

9.1.8. Competitivity Clusters

James Crowley is on the scientific committee for the Minalogic Competitivity Cluster. Minalogic is the global innovation cluster for digital technologies serving France's Auvergne-Rhône-Alpes region. The Scientific Committee advises the pole of strategy, advises local industry in proposal preparation, reviews FUI project proposals, and makes recommendations about labelling and support of project proposals.

9.2. European Initiatives

9.2.1. H2020 Project AI4EU - ICT-26-2018 Artificial Intelligence

From February 2018 to Sept 2018, James Crowley has participated in the core writing team for the H2020 proposal AI4EU submitted to the call ICT-26-2018 Artificial Intelligence. The project proposal was submitted in April 2018. The consortium has been notified in September 2018 that the project has been accepted for funding, and will begin on 1 January 2019.

AI4EU will bring together European researchers, educators, entrepreneurs and socio-economic innovators around a shared, crowd-sourced, innovation ecosystem that lowers barriers for education, research and innovation through AI. This ecosystem will be constructed by federating existing national innovation platforms and their user communities wherever possible, and by completing this federation with new components, new services and new enabling technologies that respond to opportunities for innovation.

9.2.2. H2020 FET Flagship Humane AI

James Crowley has participated as part of the core team for the proposal to create a FET Flagship named Humane AI. The Humane AI Flagship will develop the scientific and technological foundations needed to shape the AI revolution in a direction that is beneficial to humans on both individual and social level and strictly adheres to European ethical values and social norms. The core concept is that of AI systems that understand and adapt to complex dynamic environments and social settings in order enhance human capabilities and empower people as individuals and the society as whole.

Following a successful 1st stage proposal submitted in 2017, the consortium was invited to submit a 2nd stage proposal in Sept. 2018. We have been notified in November that this 2nd stage proposal has been accepted for funding. The project is start date is proposed for March 2019.

9.3. International Initiatives

9.3.1. Participation in Other International Programs

Vietnam

International partnership with **HUST** (Hanoi University of Science and Technology), Vietnam Joint lab unit between Grenoble INP and HUST, with the support of CNRS: **International Research Institute MICA** (Multimedia, Information, Communication and Applications) – UMI 2954 of CNRS from January 2006 to March 2018.

- Eric Castelli: French director of UMI 2954 “MICA Institute”, Vietnam, from 01 September 2001 to 5 February 2018
- Eric Castelli: now Adjunct Member of International Research Institute MICA, Vietnam (from June 2018)
- Eric Castelli: Responsible (and co-founder) of the International MASTER degree ACMI (Ambient Computing, Multimedia & Interactions), Hanoi University of Science and Technology (from January 2014 to June 2018)
- Eric Castelli: International scientific expert for the Vietnamese agency for research development NAFOSTED (National Foundation for Science and Technology Development), Ministry of Science and Technology, Vietnam (from 2015 to now)
- Eric Castelli: active participant to the bilateral French-Vietnam program PFIEV (Programme de Formation d’Ingénieurs d’Excellence au Vietnam), Grenoble INP is one of the main French partners.

Cambodia

International partnership with **ITC** (Institut de Technologie du Cambodge), Phnom Penh, Cambodia

- Eric Castelli: Member of the International Consortium of "Institut de Technologie du Cambodge (ITC)", Phnom Penh, Cambodia, representative of Hanoi University of Science and Technology (from 2008 to March 2018)
- Eric Castelli: Elected Member, representative of the International Consortium at the Administration Council of the "Institut de Technologie du Cambodge" (ITC), Phnom Penh, Cambodia (from 2014 to March 2018)

International partnership with **NIPTICT** (National Institute of Post and Telecoms, and Information Communication Technologies), Phnom Penh, Cambodia. NIPTICT Institute is under the authority of the Ministry of Posts and Telecommunications of Cambodia

- Eric Castelli: Scientific advisor for the Ministry of Posts and Telecommunications of Cambodia, for the creation of the research center CSSD (Computer Sciences for Social Development, a new research lab of NIPTICT)
- Eric Castelli: cowriter of the MELISSA international project, submitted to French AFD Agency (with NIPTICT (leader), NUOL, and HUST partners) in 2018 (1st submission) and 2019 (2nd submission)

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. Scientific Events Organisation

10.1.1.1. General Chair, Scientific Chair

- Sabine Coquillart was Conference co-chair for ICAT-EGVE 2018, Cyprus, Nov. 7-9, 2018.

10.1.1.2. Chair of Conference Program Committees

- Thierry Fraichard was Program Co-Chair for the IEEE Int. Conf. on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR), Brisbane (AT), *May 2018*.

10.1.1.3. Member of Conference Program Committees

- Patrick Reignier was a member of the Program Committee of Smart Objects 2018 (satellite workshop to CHI 2018, Montreal (CA).
- Eric Castelli: co-organisator and "board member" of the international conference serie STLU'xx (Spoken Language Technologies for Under-resourced languages) since it-s creation. For 2018: participation of SLTU'18 (Gurugam, India) (as reminder: SLTU'16 (Jakarta, Indonesia) - SLTU'14 (St Petersburg, Russia) - SLTU'12 (Cape Town, South Africa) - STLU'10 (Penang, Malaysia) - Organisator and "co-chair" of the first edition STLU'08 (Hanoi, Vietnam))
- Sabine Coquillart was a member of the Program Committee for 3DCVE'18, CENTRIC'18, GRAPP'18, ICGI'18, ICMI'18, IEEE VR'18 Journal Papers, IEEE VR'18 Conference Papers, ICAT-EGVE'18, VRST'18, WSCG'18,

10.1.1.4. Reviewer

- Thierry Fraichard reviewed papers for the IEEE/RSJ IROS conference.
- Patrick Reignier reviewed papers for Smart Objects 2018.
- Dominique Vaufreydaz reviewed articles for IV2018, IUadapt2018, RO-MAN2018, ICARCV2018, AVEC2018, Workshop on Modeling Cognitive Processes from Multimodal Data at ICMI 2018, HRI 2019, MAPR2018.

- Eric Castelli reviewed papers of 14 international conferences and workshops: SPIN 2018 (Noida, Dehly, India) - 3ICT18 (Bahrain) – IALP 2018 (Bandung, Indonesia) – NICS 2018 (Ho Chi Minh City, Vietnam) - SCS 2018 (Bahrain) – SPECOM 2018 (Leipzig, Germany) – SigTelCom 2018 (Ho Chi Minh Citiy, Vietnam) - STLU'18 (Gurugram, India) – ATC 2018 (Ho Chi Minh City, Vietnam) – ICVES 2018 (Madrid, Spain) – SCS 2019 (Bahrain) – SigTelCom 2019 (Hanoi, Vietnam) – ICMSAO 2019 (Bahrain) – SPECOM 2019 (Istanbul, Turkey) – MAPR 2019 (Ho Chi Minh City, Vietnam)
- James Crowley Reviewed papers for ACCV 2018, ICMI 2019, and CVPR 2018.
- Sabine Coquillart Reviewed papers for Eurographics'18, Eurohaptics'18.

10.1.2. Journal

10.1.2.1. Member of the Editorial Boards

- Sabine Coquillart is a member of the Scientific Committee of the Journal of Virtual Reality and Broadcasting.
- Sabine Coquillart is Academic Editor for PeerJ Computer Science Journal.
- Sabine Coquillart is Review Editor for Frontiers in Virtual Environments Journal.
- Sabine Coquillart is Associate Editor for Presence: Teleoperators and Virtual Environments.
- Thierry Fraichard is an Asssociate Editor for IEEE Robotics and Automation Letters (RA-L).
- Patrick Reignier is a member of the editorial board of the Modeling and Using Context Journal.
- Patrick Reignier served as a guest editor for a special issue of the Revue d'Intelligence Artificielle on Smart Homes.
- Dominique Vaufreydaz served as a guest editor for a special issue Special Issue "Human Behavior, Emotion and Representation" of Multimodal Technologies and Interaction.

10.1.2.2. Reviewer - Reviewing Activities

- Thierry Fraichard reviewed articles for IEEE Trans. Intelligent Vehicles (TIV), IEEE Robotics and Automation Letters (RA-L).
- Thierry Fraichard reviewed proposals for the IDEX Université Grenoble Alpes and the Italian Research Agency.
- Thierry Fraichard served as a reviewer for the H2020 ILIAD European project.
- Eric Castelli reviewed article for the "Romanian Human Computer Interaction" Journal (RRIOC)
- Dominique Vaufreydaz reviewed articles for the journal of Interactive Technology and Smart Education

10.1.3. Invited Talks

- Eric Castelli: *The future of scientific international cooperation in ASEAN area*. Seminar of International Research Institute MICA, Hanoi, Vietnam, 9 & 10 July 2018
- James Crowley: *Put That There: 30 Years of Research on Multi-Modal Interaction*, Invited Plenary Presentation, 2018 International Conference on Multimodal Interaction, ICMI 2018, Boulder Co. 16 Oct 2018.
- James Crowley: *Artificial Intelligence*, Invited Plenary Presentation, 2018 Colloque annuel des directeurs des écoles d'ingénieures, Marseilles, 31 May 2018.
- Sabine Coquillart: *Pseudo-haptics : résultats de recherche et perspectives d'applications*, Invited presentation, Séminaire "Sensorimotricité, intersensorialité et réalité virtuelle", Grenoble, 28 janvier 2018.

10.1.4. Leadership within the Scientific Community

- James Crowley is a member of the Steering Committee for the ACM Int. Conf. on Multimodal Interaction.
- Sabine Coquillart is serving as member of the steering committee for the ICAT Int. Conf. on Artificial Reality and Telexistence.
- Sabine Coquillart is chairing the steering committee for the EGVE Working Group – EUROGRAPHICS Working group on Virtual Environments.
- Sabine Coquillart is an elected member of the EUROGRAPHICS Executive Committee.
- Sabine Coquillart is a member of the EUROGRAPHICS Working Group and Workshop board.

10.1.5. Scientific Expertise

- James L. Crowley served on the ANR committee CE 33 Interaction, Robotics.
- Sabine Coquillart served as an expert reviewer for the Austrian Science Fund.
- Thierry Fraichard served as an expert reviewer for the European Commission and the Italian Research Agency.
- Patrick Reignier is a member of the Scientific Council of the Amiqual4Home EquipEx.
- Dominique Vaufreydaz served as an evaluator for Initiatives de Recherche Stratégiques (IRS) call of the Grenoble Idex.
- Dominique Vaufreydaz served as an evaluator for Icelandic Research Fund.
- Eric Castelli served as an international expert for the Vietnamese agency NAFOSTED (National Foundation for Science and Technology Development), Ministry of Science and Technology of Vietnam.
- Eric Castelli served as an international expert for the Cambodian Ministry of Posts and Telecommunications
- Sabine Coquillart served as member for the Best Paper Award Committee for IEEE VR 2018.
- Sabine Coquillart served as a member of the Scientific Committee of "Challenges of IoT in the Digital Tools and Uses Congress", 2018.

10.1.6. Research Administration

- James Crowley is director for the Amiqual4Home Innovation Platform (EquipEx).
- James Crowley serves on the Administrative Committee (Bureau) for the Laboratoire Informatique de Grenoble.
- James Crowley served on the Scientific Committee (CoS) for the CRI Inria Grenoble-Rhone Alpes.
- James Crowley served on the orientation committee for the Competitivety Pole Minalogic
- Patrick Reignier is head of the engineering support group of the Laboratoire d'Informatique de Grenoble (13 members). He is currently supervising the moving of the Domus Living lab to a new site on Campus.
- Patrick Reignier serves on the Administrative Office (Bureau) for the Laboratoire Informatique de Grenoble.
- Patrick Reignier is at the head of the Domus Living Lab
- Patrick Reignier is a member of the Comité Executif of the Amiqual4Home Equipex
- Patrick Reignier is a member of the Comité de pilotage of the MACI (Maison de la Création et l'Innovation)

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

10.2.1.1. James Crowley

James Crowley was co-director of the Master of Science in Informatics at Grenoble (MoSIG) to Sept 2018.

Master : Computer Vision, Course 27h EqTD, M2 year, Master of Science in Informatics at Grenoble

Master 1: Intelligent Systems, Cours 54h EqTD, UFRIM2AG

ENSIMAG 2: Intelligent Systems, Cours 54h EqTD, ENSIMAG

ENSIMAG 3 : Pattern Recognition and Machine Learning, Cours 27h EqTD, ENSIMAG

10.2.1.2. Patrick Reignier

- Patrick Reignier has been elected member of the Conseil des Etudes et de la Vie Universitaire of Grenoble INP
- Patrick Reignier was a member of the consultation group for the proposal of the founding text for the integrated university.
- Patrick Reignier has been nominated as a member of the Conseil de la Formation Continue de Grenoble INP
- Patrick Reignier participated in the editing of a successful Idex Educational program proposal "FromLivingLab".
- Patrick Reignier is co-director of the "formation en apprentissage" of Ensimag (3 years program : 1 year for the Licence and 2 years for the Master)
- Patrick Reignier Supervises the industrial part of the “formation en apprentissage” of the Ensimag engineering school.
- Master: Patrick Reignier, Projet Genie Logiciel, 55h eqTD, M1, Ensimag/Grenoble INP, France.
- Master: Patrick Reignier, Développement d’applications communicantes, 18h eqTD, M2, Ensimag/Grenoble-INP, France
- Master: Patrick Reignier, Introduction aux applications reparties, 18h eqTD, M2, Ensimag/Grenoble-INP, France
- Master: Patrick Reignier, Applications Web et Mobiles , 27h eqTD, M1, Ensimag/Grenoble-INP, France
- Master: Patrick Reignier, Projet Systeme, 12h eq TD, M1, Ensimag/Grenoble-INP, France
- Licence: Patrick Reignier, Projet C, 20h eqTD, L3, Ensimag/Grenoble-INP, France.

10.2.1.3. Dominique Vaufreydaz

- Co-responsibility of the Graphic, Vision and Robotics track of the MOSIG Master program.
- In charge of the transversal numerical competence courses at the Grenoble Faculty of Economics (Grenoble and Valence campuses)
- Licence: Compétences Numériques, 126h eq TD,L1, Université Grenoble Alpes, France.
- Licence: Informatique appliquée à l’économie et à la gestion, 32 h eq TD, enseignement à distance, Licence, Université Grenoble Alpes, France.
- Licence: Pratique avancée du Tableur, 72 h eq TD, L3, Université Grenoble Alpes, France.
- Licence Professionnelle: Enquêtes et traitement d’enquêtes avec le logiciel Sphinx, 12h eq TD, Licence pro Métiers de l’Emploi et de la Formation, Université Grenoble Alpes, France.
- Licence Professionnelle: Administration en environnement hétérogène, 20h eq TD, Licence pro Administration et Sécurité des Systèmes et des Réseaux, Université Grenoble Alpes, France.
- IUT année spéciale: Programmation C++, 18h eq TD, Année Spéciale IUT Informatique, Université Grenoble Alpes, France.
- Master: Pratique avancée du Tableur, 24 h eq TD, M1 économie internationale et stratégies d’acteurs, Université Grenoble Alpes, France.

- Master: Développement Web Mobile, 24h eq TD, M2 Mathématiques et Informatique Appliquées aux Sciences Humaines et Sociales, Université Grenoble Alpes, France

10.2.1.4. Thierry Fraichard

- Master: Thierry Fraichard, Autonomous Robotics, 22.5h eqTD, M2 MOSIG, Univ. Grenoble Alpes.

10.2.2. Supervision - Doctoral theses completed in 2018

- Rémi Paulin, *Human-Robot Motion: an Attention-Based Approach*, 22 March 2018, Patrick Reignier and Thierry Fraichard.
- Nguyen Dinh Van, *Wireless Sensors Networks for Indoor Mapping and Accurate Localization for Low Speed Navigation in Smart Cities*, 5 December 2018, Fawzi Nashashibi and Eric Castelli

10.2.3. Supervision - Current Doctoral Students

- PhD in progress: Jose Grimaldo Da Silva Filho, "Human-Robot Motion, a Shared Effort Approach", Octobre 2015, Thierry Fraichard.
- PhD in progress: Matteo Ciocca, "Safe Robot Motion", Octobre 2016, Thierry Fraichard and Pierre-Brice Wieber.
- PhD in progress : Romain Bregier, Détection et estimation de pose d'instances d'objet rigide pour la manipulation robotisée, Octobre 2014, Frederic Devernay and James Crowley
- PhD in progress : Etienne Balit, expressive social robot design, Octobre 2014, Patrick Reignier and Dominique Vaufreydaz.
- PhD in progress : Interaction-Aware Tracking and Lane Change Detection in Highway Driving, David Sierra Gonzales, Octobre 2014, Dizan Vasquez and Emmanuel Mazer
- PhD in progress : Minh-khoa Nguyen, Robotics-inspired methods for modeling and simulation of large nanosystems, Octobre 2014, Leaonard Jaillet and Emmanuel Mazer
- PhD in progress : Amr Alyafi, explanatory observation of energy usage, Octobre 2015, Stephane Ploix and Patrick Reignier.
- PhD in progress : Amine Awada, activity recognition for smart energy management, Octobre 2015, Stephane Ploix and Patrick Reignier.
- PhD in progress : Liliya Tsetanova, Social Robotics, Octobre 2015, Veronique Aubergé and Patrick Reignier.
- PhD in progress : Thomas Guntz, Multimodal Observation of Subjects Engaged in Problem Solving, Octobre 2016, James Crowley and Dominique Vaufreydaz
- PhD in progress : Pavan Vashista, Situational Awareness of Autonomous Cars in Urban Areas, February 2016, Dominique Vaufreydaz and Anne Spalanzani (Inria Chroma).
- PhD in progress : Nashwa Abou Bakr, Observation of Kitchen Activities, Octobre 2016, James Crowley and Remi Ronfard
- PhD in progress : Raphael Frisch, conception de machine stochastique pour la localisation et la séparation de source sonor, Octobre 2016, Emmanuel Mazer

10.2.4. Juries

- Thierry Fraichard served as an expert evaluator in the PhD Jury of Florent Altché, Ecole Nat. Sup. des Mines de Paris, *Sep. 18*.
- Patrick Reignier served as a jury member of the Doctoral Jury of Hiary Landy Rajaonarivo (Lab-STICC, Brest)
- Patrick Reignier served as a president of the Doctoral Jury of Nathan Ramoly (Telecom Sud Paris)
- Patrick Reignier served as a president of the Doctoral Jury of Jérémy WAMBECKE (University Grenoble Alps)

- Patrick Reignier served as a president of the Doctoral Jury of Paola Gomez (University Grenoble Alps)
- Patrick Reignier served as a reporter of the Doctoral Jury of Mauricio Gomez Morales (Purdue University and Paris Est Créteil)
- Sabine Coquillart served as reporter for the doctoral jury of A. Costes at INSA Rennes
- Sabine Coquillart served as examiner for the doctoral juty of G. Cortes at Univ. Rennes 1.

11. Bibliography

Major publications by the team in recent years

[1] R. BRÉGIER, F. DEVERNAY, L. LEYRIT, J. CROWLEY. *Defining the Pose of any 3D Rigid Object and an Associated Distance*, in "International Journal of Computer Vision", June 2018, vol. 126, n^{o} 6, pp. 571–596, https://arxiv.org/abs/1612.04631 [*DOI :* 10.1007/s11263-017-1052-4], https://hal.inria.fr/hal-01415027

[2] J. COUTAZ, J. L. CROWLEY. *A First-Person Experience with End-User Development for Smart Homes*, in "IEEE Pervasive Computing", May 2016, vol. 15, pp. 26 - 39 [*DOI :* 10.1109/MPRV.2016.24], https://hal.inria.fr/hal-01422364

[3] T. FRAICHARD, R. PAULIN, P. REIGNIER. *Human-Robot Motion: An Attention-Based Navigation Approach*, in "IEEE RO-MAN", Edinburgh (UK), August 2014, Best Paper Award Nominee [*DOI :* 10.1109/ROMAN.2014.6926332], http://hal.inria.fr/hal-01018471

[4] T. GUNTZ, J. L. CROWLEY, D. VAUFREYDAZ, R. BALZARINI, P. DESSUS. *The Role of Emotion in Problem Solving: First Results from Observing Chess*, in "ICMI 2018 - Workshop at 20th ACM International Conference on Multimodal Interaction", Boulder, Colorado, United States, October 2018, pp. 1-13, https://arxiv.org/abs/1810.11094 , https://hal.inria.fr/hal-01886694

[5] P. VASISHTA, D. VAUFREYDAZ, A. SPALANZANI. *Building Prior Knowledge: A Markov Based Pedestrian Prediction Model Using Urban Environmental Data*, in "ICARCV 2018 - 15th International Conference on Control, Automation, Robotics and Vision", Singapore, Singapore, November 2018, pp. 1-12, Best Student Paper Award, https://hal.inria.fr/hal-01875147

Publications of the year

Doctoral Dissertations and Habilitation Theses

[6] R. PAULIN. *Human-Robot Motion: an Attention-Based Approach*, Université Grenoble Alpes, March 2018, https://tel.archives-ouvertes.fr/tel-01864355

[7] D. VAUFREYDAZ. *Multimodal perception and sociable interaction*, Université Grenoble Alpes (France) ; MSTII, July 2018, Habilitation à diriger des recherches, https://hal.inria.fr/tel-01970420

Articles in International Peer-Reviewed Journals

[8] A. ALZOUHRI ALYAFI, V.-B. NGUYEN, Y. LAURILLAU, P. REIGNIER, S. PLOIX, G. CALVARY, J. COUTAZ, M. PAL, J.-P. GUILBAUD. *From Usable to Incentive Building Energy Management Systems*, in "Modélisation et utilisation du contexte (Modeling and Using Context)", November 2018, vol. 2, n^{o} 1, pp. 1-30 [*DOI :* 10.21494/ISTE.OP.2018.0302], https://hal.inria.fr/hal-01929051

[9] M. BOUGUERRA, T. FRAICHARD, M. FEZARI. *Viability-Based Guaranteed Safe Robot Navigation*, in "Journal of Intelligent and Robotic Systems", November 2018, pp. 1–13 [*DOI :* 10.1007/S10846-018-0955-9], https://hal.inria.fr/hal-01924855

[10] R. BRÉGIER, F. DEVERNAY, L. LEYRIT, J. CROWLEY. *Defining the Pose of any 3D Rigid Object and an Associated Distance*, in "International Journal of Computer Vision", June 2018, vol. 126, n^o 6, pp. 571–596, https://arxiv.org/abs/1612.04631 [*DOI :* 10.1007/S11263-017-1052-4], https://hal.inria.fr/hal-01415027

[11] J. L. COUTAZ, J. L. CROWLEY. *Appsgate, a Programmable Domestic Eco-system: Learning from "Living in it"*, in "Journal d'Interaction Personne-Système (JIPS)", October 2018, vol. Volume 7, Number 1, n^o 1, pp. 1-35, https://hal.archives-ouvertes.fr/hal-01898173

[12] T. GUNTZ, R. BALZARINI, D. VAUFREYDAZ, J. L. CROWLEY. *Multimodal Observation and Classification of People Engaged in Problem Solving: Application to Chess Players*, in "Multimodal Technologies and Interaction", March 2018, vol. 2, n^o 2 [*DOI :* 10.3390/MTI2020011], https://hal.inria.fr/hal-01886354

[13] G. NIETO, F. DEVERNAY, J. L. CROWLEY. *Rendu basé image avec contraintes sur les gradients*, in "Traitement du Signal", 2018, pp. 1-26 [*DOI :* 10.3166/HSP.X.1-26], https://hal.archives-ouvertes.fr/hal-01900200

[14] M. PAL, A. ALZOUHRI ALYAFI, S. PLOIX, P. REIGNIER, S. BANDYOPADHYAY. *Unmasking the causal relationships latent in the interplay between occupant's actions and indoor ambience: a building energy management outlook*, in "Applied Energy", January 2019, https://hal.archives-ouvertes.fr/hal-01984833

Invited Conferences

[15] S. NABIL, R. BALZARINI, F. DEVERNAY, J. L. CROWLEY. *Designing objective quality metrics for panoramic videos based on human perception*, in "IMVIP 2018 - Irish Machine Vision and Image Processing Conference", Belfast, United Kingdom, August 2018, pp. 1-4, https://hal.inria.fr/hal-01849043

International Conferences with Proceedings

[16] E. BALIT, D. VAUFREYDAZ, P. REIGNIER. *PEAR: Prototyping Expressive Animated Robots - A framework for social robot prototyping*, in "HUCAPP 2018 - 2nd International Conference on Human Computer Interaction Theory and Applications", Funchal, Madeira, Portugal, January 2018, 1 p. , https://hal.inria.fr/hal-01698493

[17] J. G. DA SILVA FILHO, A.-H. OLIVIER, A. CRÉTUAL, J. PETTRÉ, T. FRAICHARD. *Human inspired effort distribution during collision avoidance in human-robot motion*, in "RO-MAN 2018 - 27th IEEE International Symposium on Robot and Human Interactive Communication", Nanjing and Tai'an, China, Springer, August 2018, pp. 1111-1117 [*DOI :* 10.1109/ROMAN.2018.8525623], https://hal.inria.fr/hal-01831757

[18] E. FERRIER-BARBUT, D. VAUFREYDAZ, J.-A. DAVID, J. LUSSEREAU, A. SPALANZANI. *Personal space of autonomous car's passengers sitting in the driver's seat*, in "IV'2018 - The 29th IEEE Intelligent Vehicles Symposium", Changshu, Suzhou, China, IEEE, June 2018, pp. 2022-2029, https://arxiv.org/abs/1805.03563 [*DOI :* 10.1109/IVS.2018.8500648], https://hal.inria.fr/hal-01786006

[19] T. GUNTZ, J. L. CROWLEY, D. VAUFREYDAZ, R. BALZARINI, P. DESSUS. *The Role of Emotion in Problem Solving: First Results from Observing Chess*, in "ICMI 2018 - Workshop at 20th ACM International

Conference on Multimodal Interaction", Boulder, Colorado, United States, October 2018, pp. 1-13, https://arxiv.org/abs/1810.11094 , https://hal.inria.fr/hal-01886694

[20] D.-V. N. NGUYEN, R. DE CHARETTE, T.-K. DAO, E. CASTELLI, F. NASHASHIBI. *WiFi Fingerprinting Localization for Intelligent Vehicles in Car Park*, in "IPIN 2018 : Ninth International Conference on Indoor Positioning and Indoor Navigation", Nantes, France, September 2018, https://hal.inria.fr/hal-01851504

[21] V.-C. TA, T.-K. DAO, D. VAUFREYDAZ, E. CASTELLI. *Smartphone-based user positioning in a multiple-user context with Wi-Fi and Bluetooth*, in "IPIN 2018 - 9th International Conference on Indoor Positioning and Indoor Navigation", Nantes, France, September 2018, pp. 1-13, https://arxiv.org/abs/1807.05716 , https://hal.inria.fr/hal-01839574

[22] P. VASISHTA, D. VAUFREYDAZ, A. SPALANZANI. *Building Prior Knowledge: A Markov Based Pedestrian Prediction Model Using Urban Environmental Data*, in "ICARCV 2018 - 15th International Conference on Control, Automation, Robotics and Vision", Singapore, Singapore, November 2018, pp. 1-12, https://arxiv.org/abs/1809.06045 , https://hal.inria.fr/hal-01875147

Conferences without Proceedings

[23] J. CUMIN, G. LEFEBVRE, F. RAMPARANY, J. L. CROWLEY. *Inferring Availability for Communication in Smart Homes Using Context*, in "PerCom 2018 - IEEE International Conference on Pervasive Computing and Communications", Athènes, Greece, March 2018, pp. 1-6, https://hal.archives-ouvertes.fr/hal-01762137

[24] P. DESSUS, L.-H. AUBINEAU, D. VAUFREYDAZ, J. L. CROWLEY. *A Framework for a Multimodal Analysis of Teaching Centered on Shared Attention and Knowledge Access*, in "Grenoble Workshop on Models and Analysis of Eye Movements", Grenoble, France, June 2018, https://hal.archives-ouvertes.fr/hal-01811092

[25] R. FRISCH, M. FAIX, E. MAZER, L. FESQUET, A. LUX. *A cognitive stochastic machine based on Bayesian inference: a behavioral analysis*, in "ICCI*CC 2018 - 17th IEEE International Conference on Cognitive Informatics and Cognitive Computing", Berkeley, United States, July 2018, pp. 1-8, https://hal.archives-ouvertes.fr/hal-01867789

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