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Computer Science

Facial analysis in video sequences

Ioan Marius BILASCO

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Jury

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M. Chaabane Djeraba	Professeur - Université de Lille	Advisor

Abstract

Video streams are ubiquitous in our daily lives. The effective use of the visual information embedded in video streams forsees the advent of intelligents systems for assisting humans in their daily life activities. In this general context, our research addresses human behavior understanding in an individual setting based on video analysis. More specifically, we explore aspects related to facial video analysis such as : head pose estimation, gender recognition and expression recognition. All these aspects together sustain the developpement of intelligent systems having access to accurate user profiles in terms of characteristics, interests and needs.

In this work, we present non-intrusive approaches for estimating head pose by using the characteristics of facial symmetry and by identifying transformations that can bring the face in a near-frontal configuration. We also employ geometric and photometric normalisation techniques for gender recognition using simple features like pixel intesities. The intra- and extra-facial features like hair, beard or mustache are used jointly with the normalized pixel intensities within a fuzzy inference system to make gender recognition more effective. Finally, we propose a unified approach for micro- and macro-expression recognition. We introduce local motion patterns in order to deal with a large panel of expression intensities as one can meet in uncontrolled settings.

Keywords: Computer vision, Facial analysis, Head orientation, Bilateral symmetry, Gender recognition, Facial normalisation, Histogram specification, Fuzzy inference system, Expression recognition, Micro expression, Macro expression, Optical flow, Coherent movement, Local motion patterns, Facial segmentation models.

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Part I

Introduction

1 Overview of my research activites

Since my nomination as *Maître de Conférences*[1] in September 2009, I mainly work in the field of computer vision and more specifically on facial analysis. The core of my research addresses head pose estimation, gender and facial expression recognition. In parallel, in my early career, I successfully conducted research related to my PhD in the field of semantics and metadata management. This came naturally as when conceiving intelligent systems reacting to events or behaviors, one faces challenges related to the integration of data issued from heterogeneous sources (video analysis or others). It is useful to lean on methodologies and tools that enhance the interoperability and the integration of semi-structured data extracted from various systems.

Today, I look forward to exploring new research topics, such as evolved learning schemes (deep or neuromorphic) and their contributions to facial analysis. These new directions emerge following exchanges with the *Embedded Real-Time Adaptative System Design* (Émeraude) team from *Centre de Recherche en Informatique, Signal et Automatique de Lille* (CRIStAL) and with the *Circuits, Systèmes et Applications des Micro-ondes* (CSAM) team from *Institut d'Électronique, de Microélectronique et Nanotechnologies* (IEMN) in Lille. These inter-disciplinary collaborations were facilitated as all three teams are hosted at *Institut de Recherche sur les Composants logiciels et matériels pour l'Information et la Communication Avancée* (IRCICA, USR CNRS 3380).

Figure I.1 shows the timeline of my research activities in terms of PhDs and post-doctoral fellowships that were partially under my supervision.

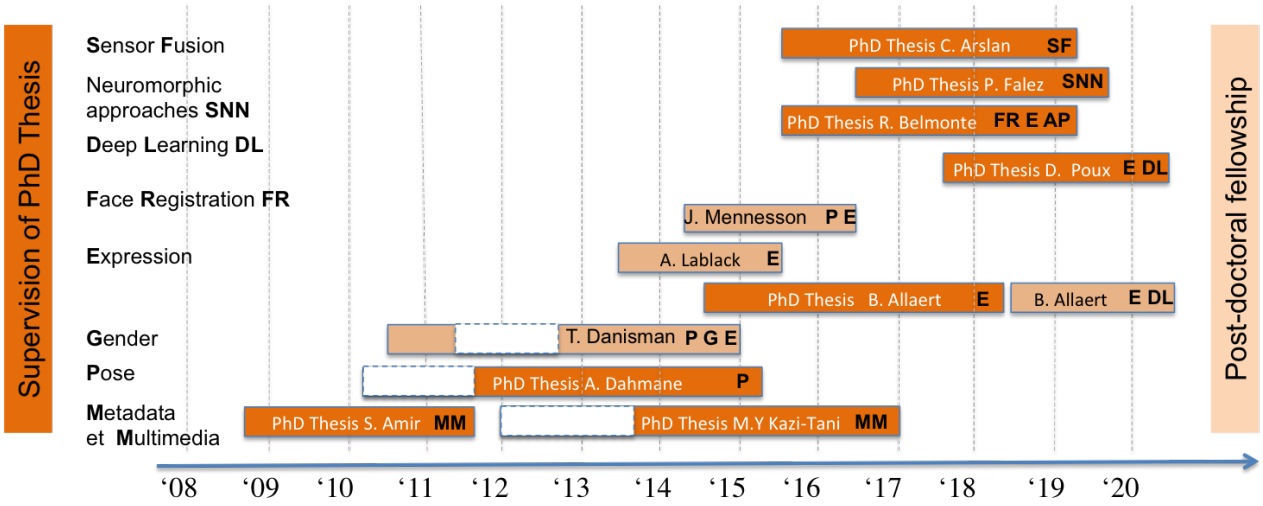

Figure I.1 – *Per reseach topic, PhD (8) and post-doctoral (4) fellows partially under my supervision.*

Right after my PhD in the field of document and metadata management, I integrated the team *Fouille de dOnnées CompleXes* (FOX) hosted at CRIStAL (formerly *Laboratoire Informatique Fondamentale de Lille*). FOX was founded in 2003 by Chaabane Djeraba (Professor, *Université de Lille*). From

[1] similar to Associate Professor, second rank of the faculty path in French academia

the start, I had the opportunity to supervise Samir Amir's PhD thesi s[2] on metadata integration issues. Then, gradually, I oriented my research interests towards facial analysis. In the field of head pose estimation, I started by supervising Afifa Dahmane's PhD thesis[3]. Afterwards, in the same field, I coordinated the work of two post-docs Taner Danisman[4] and José Mennesson[5]. The collaboration with Taner Danisman continued on topics related to gender and facial expression recognition applied to static images. Adel Lablack[6] joined our efforts in the field of static facial expression recognition under my supervision. Then, I wanted to address new challenges in the field of dynamic facial expression recognition. In Benjamin Allaert's PhD thesis[7], we studied facial expression recognition in presence of various expression intensities. With the growing succes of deep learning approaches, we turned towards tools and methodologies issued from deep learning in order to combine our handcrafted knowledge with data-intensive techniques in the field of facial analysis. In this line, I had the opportunity to co-supervise Romain Belmonte's PhD thesis[8] studying deep learning-based spatio-temporal facial alignment. In the same context, following the Benjamin Allaert's work, Delphine Poux[9] explores deep learning approches for studying the impact of occlusion on facial expression recognition. In parallel, I'm getting involved in studying bio-inspired learning approaches applied to computer vision, such as spiking neural networks employed in Pierre Falez's PhD thesis[10]. Beside the above works, which constitutes the core of my research activities, I've also got involved in the PhD thesis of Cagan Arlsan[11] and the one of Mohamed Yassine Kazi Tani[12]. Cagan Arlsan's works concern sensor data fusion in an interaction context. Mohamed Yassine Kazi Tani's PhD thesis explores the use of semantic reasoning for crowd event recognition.

[2]Samir Amir, PhD student from Sept. 2008 to Dec. 2011, *FOX team, CRIStAL lab.*, currently R&D team leader at Press'Inov, Lyon.

[3]Afifa Dahmane, PhD student from May 2010 to Feb. 2015, *FOX team, CRIStAL lab.*, co-supervised with *Université de Sciences et Technologies Houari Boumediene*, Algeria, currently *Maître de Conférences* at USTHB, Algeria.

[4]Taner Danisman, post-doctoral fellow from Sept. 2010 to June 2011 and research engineer from June 2012 to Oct. 2014, *FOX team, CRIStAL lab.*, currently Associate Professor at *Akdeniz Üniversitesi*, Turkey.

[5]José Mennesson, research engineer from Nov. 2014 to Dec. 2015, *FOX team, CRIStAL lab.*, currenly *Maître Assistant* at *Institut Mines-Telecom Lille Douai, FOX team, CRIStAL lab.*

[6]Adel Lablack, research engineer from June 2013 to Aug. 2015, *FOX team, CRIStAL lab.*, currently R&D engineer at *FLIR*, Kortrijk, Belgium.

[7]Benjamin Allaert, PhD student from Oct. 2014 to June 2018, *FOX team, CRIStAL lab.*, currently research engineer, *FOX team, CRIStAL lab.*

[8]Romain Belmonte, PhD student since Oct. 2015, *FOX team, CRIStAL lab.*, co-financed by *Ecole d'ingénieurs des Hautes Technologies et du Numérique - ISEN YNCREA* and *Métropole Européenne de Lille*.

[9]Delphine Poux, PhD student since Oct. 2017, *FOX team, CRIStAL lab.*, co-financed by *Université de Lille* and *l'Ecole d'ingénieurs des Hautes Technologies et du Numérique - ISEN YNCREA.*

[10]Pierre Falez, PhD student since Oct. 2016, *FOX team, CRIStAL lab.*, co-supervised with *Émeraude team, CRIStAL lab.*

[11]Cagan Arslan, PhD student since Oct. 2015, *FOX team, CRIStAL lab.*, co-supervised with *MINT team, CRIStAL lab.*.

[12]MY. Kazi Tani, PhD student from January 2012 to March 2018 registred at *Université d'Oran Es Sénia*, Algeria and hosted at *FOX team, CRIStAL lab.* from Sept. 2013 to Oct. 2013, Apr. 2014 to May 2014 and Nov. 2014.

2 Research topics

In the following, I give a brief overview of the research topics introduced earlier by synthetizing notable results, as well as, supervision tasks:

Head pose estimation In order to provide solutions for unconstrained head pose estimation, as part of Afifa Dahmane's thesis, we proposed a symmetry-based approach (Dahmane et al. 2015) [13]. Complementary work on the same topic has been conducted in collaboration with Taner Danisman (post-doc, *FOX team, CRIStAL lab.*) and José Mennesson (post-doc, *FOX team, CRIStAL lab.*) and published in (Danisman et Bilasco 2016)[14] and (Mennesson et al. 2016).

Gender Recognition While continuing the collaboration with Taner Danisman, we have addressed some soft biometrics[15] issues by studying gender recognition. We have proposed a global method operating under severe conditions (e.g., very small image size, low illumination) that are difficult to handle with conventional methods. The work carried out underlined the importance of the face normalisation process prior to gender recognition when the pose is not constrained. Interesting inter-corpus cross validation results were obtained using different databases (Danisman et al. 2014). However, gender recognition based solely on the elements of the face cannot respond to the variety of situations that we can encounter in everyday life. Some individuals have facial features that are closer to the opposite sex than theirs. Thus, we continued this work enriching the gender recognition process with information characterizing both, specific elements inside the face (mustache, beard) and elements surrounding the face (such as hair) (Danisman et al. 2015) [16].

Facial Expression Recognition Starting from the observation that facial normalisation can improve facial characterisation processes, we have explored the recognition of *happiness*. We used the same normalisation approach as for gender recognition. These first works in the field of static facial expression recognition resulted in the construction of pixel-level face masks that are able to improve the recognition of the expression of *happiness*. Hence, just by exploiting pixel-level intensities and without going through complex descriptors, we boosted *happiness* recognition accuracy (Danisman et al. 2013) [17]. The work done on static data (images or frames of a video) was continued by the research carried out as part of Benjamin Allaert's PhD thesis. This PhD thesis aims to characterize the emotional state of individuals while engaged in a natural interaction (such as video-conferencing). Natural interaction greatly challenges the recognition process, because the

[13] A. Dahmane; S. Larabi; I.M. Bilasco; C. Djeraba - Head pose estimation based on face symmetry analysis - Signal, Image and Video Processing (SIViP), Springer, 2015, 9 (8), pp 1871-1880 (Impact factor: 1.643 source Journal Citations Reports 2018).

[14] T. Danisman; I.M. Bilasco - In-plane face orientation estimation in still images - Multimedia Tools and Applications, Springer Verlag, 2016, 75 (13), pp.7799-7829 (Impact factor: 1.541 source JCR 2018).

[15] Soft biometrics differentiate persons on the basis of their characteristic (e.g. eye color, facial shape, gender), but not specifically identify them.

[16] T. Danisman; I.M. Bilasco; J. Martinet - Boosting gender recognition performance with a fuzzy inference system - Expert Systems with Applications, Volume 42, Issue 5, 1 April 2015, pp. 2772-2784 (Impact factor: 3.768 source JCR 2018)

[17] T. Danisman; I.M. Bilasco; J. Martinet; C. Djeraba - Intelligent pixels of interest selection with application to facial expression recognition using multilayer perceptron - Signal Processing, Elsevier, 2013, Special issue on Machine Learning in Intelligent Image Processing, 93 (6), pp. 1547-1556 (Impact factor: 3.470 source JCR 2017).

intensity of the expressions can vary (from micro- to macro-expressions). In addition, the overall movement of the person strongly influences intra-facial movements that materialize the appearance and disappearance of expressions. Focusing on the challenge posed by the intensity variations, we study an approach that takes into account the physical characteristics of facial movements and that filters out the noise without harming the extracted information. (Allaert et al. 2017).
In order to overcome the head movement problem, most methods propose to use facial normalisation techniques, but this normalisation induces texture distortions that interfere with the expressions. In (Allaert et al. 2018) [18], we have proposed a methodology and a database called Synchronous Natural and Posed 2D Facial Expressions (SNaP-2DFE), which quantifies the impact of normalisation on facial expression recognition accuracy. The work initiated by Benjamin Allaert continues with Delphine Poux's PhD thesis, which started in October 2017. The first results obtained by Delphine Poux show that the movement can contribute efficiently to expression recognition in presence of severe partial occlusions (Poux et al. 2018).

Beyond the topics introduced above, that are strongly related to the field of facial analysis, I was able, on the one hand, to continue the work carried out as part of my PhD thesis, and on the other hand to build new collaborations on the following subjects:

- semantics and metadata ;
- deep learning approaches for facial analysis ;
- neuromorphic approaches for facial analysis.

These themes are briefly introduced below and are not detailed in this manuscript. However, the work related to deep and neuromorphic learning is mentioned more widely in the Part III of this document when presenting my scientific project for the years to come. For further details, the list of all my research publications is available in the Part IV, Chapter 2.

Semantics and metadata In a typical computer vision process, we start with raw data, characterized by descriptors. Then, the descriptors are fed into implicit processes (classification and learning) or explicit (rule systems) in order to construct more complex descriptors. In most of the achievements mentioned so far, we rely on implicit processes. As part of the work of Mohamed Yassine Kazi Tani, I suggested addressing the contributions of semantic reasoners in the resolution of some vision problems, such as crowd event analysis (Tani et al. 2017). Together, we have proposed ontologies, as well as, specific rules that, starting from the evolution of moving blobs (individual or group) infer their nature and their behavior. When this information is exchanged and processed by third parties, it is necessary to have approaches capable of integrating semi-structured data of various kinds (XML, RDF). Thus, in Samir Amir's PhD thesis, we have tackled the problems of data integration and proposed a formal framework that facilitates aligning the information from heterogeneous sources in (Amir et al. 2011; 2013).

[18] B. Allaert; J. Mennesson; I.M. Bilasco; C. Djeraba - Impact of the face registration techniques on facial expressions recognition - Signal Processing: Image Communication, EURASIP, Elsevier, 2017, 61, pp. 44-53 (Impact factor: 2.073 source JCR 2018).

Deep learning for facial analysis The interpretation of video streams captured in uncontrolled environments must take into account changes occuring in the visual context (e.g., changes in brightness, loss of sharpness) and the behavior of the individuals (e.g., head pose changes, occlusions). These changes greatly influence the various underlying processes. Taking these changes into account would make it possible to improve the analysis process by choosing the most appropriate techniques for a given situation. The characterisation of the environment can be as complicated as the main treatment. Thus, we study approaches capable of tackling these evolutions. In Romain Belmonte's PhD thesis, in collaboration with the *Ecole d'ingénieurs des Hautes Technologies et du Numérique* (ISEN - YNCREA), we explore deep learning processes to take into account this multitude of factors by multiplying the situations presented. The first work take into account the evolution over time of the facial landmarks to improve the precision of face registration in (**?**) [19]

Neuromorphic approaches for facial analysis Learning processes are at the heart of all our work. Since 2014, we are interested in unsupervised learning processes based on spiking neural networks (SNN). Together with colleagues interested in manufacturing (*CSAM team, IEMN lab.*) and simulation (*Émeraude team, CRIStAL lab.*) of these networks, we explore issues related to computer vision requirements (e.g., large networks, information encoding). The work that we carried out jointly allowed us in 2016 to benefit from a doctoral contract to study the neuromorphic architectures based on spiking neurons for the vision. In close collaboration with Pierre Tirilly (*FOX team, CRIStAL lab.*), Philippe Devienne (*Émeraude team, CRIStAL lab.*) and Pierre Boulet (*Émeraude team, CRIStAL lab.*), we guide the work of Pierre Falez in the field of unsupervised feature learning using spiking neurons and bio-inspired local learning mechanisms such as the spike-timing dependent plasticity (STDP). The results obtained were published in (Falez et al. 2018) [20].

3 Outline

In the second part of this document, I detail the main contributions made in three areas of facial analysis:

- **head pose estimation** - In chapter 1, we include the following papers presenting our contributions in the field of head pose estimation:
  - (Dahmane et al. 2015) - A. Dahmane; S. Larabi; I.M. Bilasco; C. Djeraba - *Head Estimation Based on Symmetry Analysis* - Signal, Image and Video Processing (SIVIP), 2014, pp 1-10 (Impact Factor: 1.643 source JCR 2018);
  - (Danisman et al. 2015) - T. Danisman; IM Bilasco - *In-plane face orientation estimation in still images* - Multimedia Tools and Applications, Springer Verlag, 2016, 75 (13), pp.7799-7829 (Impact Factor: 1.541 source JCR 2018).

[19] R. Belmonte; P. Tirilly; I.M. Bilasco; Ch. Djeraba; N. Ihaddadene - Video-based face alignement with local motion modeling - Proc. Int'l Winter Conf. on Applications of Computer Vision, Jan. 2019, Hawaii

[20] P. Falez; P. Tirilly; I. M. Bilasco; Ph Devienne; P. Boulet - Mastering the output frequency in spiking neural networks - Proc. Int'l Joint Conf. on Neural Networks (IJCNN), Jul. 2018, Rio de Janeiro, Brazil.

- **gender recognition** - In Chapter 2, we include the following papers presenting our contributions in the field of gender recognition:
  - (Danisman et al. 2014) - T. Danisman; I.M. Bilasco; C. Djeraba - *Cross-database evaluation of normalized raw pixels for gender recognition under unconstrained settings* - Proc. Int'l Conf. on Pattern Recognition 2014, Stockholm, Sweden, pp. 3144-3149 ;
  - (Danisman et al. 2015) - T. Danisman; I.M. Bilasco; J. Martinet - *Boosting gender recognition performance with a fuzzy inference system* - Expert Systems with Applications, Volume 42, Issue 5, 1 April 2015, pp. 2772-2784 (Impact Factor: 3.768 source JCR 2018).

- **facial expression recognition** - In Chapter 3, we include the following papers presenting our contributions in the field of facial expression recognition:
  - (Danisman et al. 2013) - T. Danisman; I.M. Bilasco; J. Martinet; C. Djeraba - *Intelligent pixels of interest selection with application to facial expression recognition using multilayer perceptron* - Signal Processing, Elsevier, 2013, Special issue on Machine Learning in Intelligent Image Processing, 93 (6), pp. 1547-1556 (Impact factor: 3.470 source JCR 2017) ;
  - (**?**) - B. Allaert; I.M. Bilasco; C. Djeraba - Advanced local motion patterns for macro and micro facial expression recognition[21] - Computing Research Repository (CoRR), `https://arxiv.org/abs/1805.01951` ;
  - (Allaert et al. 2018) - B. Allaert; J. Mennesson; I.M. Bilasco; C. Djeraba - *Impact of the face registration techniques on facial expressions recognition* - Signal Processing: Image Communication, EURASIP, Elsevier, 2017, 61, pp. 44-53 (Impact factor: 2.073 source JCR 2018).

The document continues with the presentation of my research perspectives, in Part III. A summary of my research activities including collaborative projects, as well as, my pedagogical and administrative responsibilities is presented in Part IV, Chapter 1. The details of the publications produced are presented in Part IV, Chapter 2.

[21] This pre-print is an extented version of the work already published in (Allaert et al. 2017)

Part II

Facial analysis in video streams

Head Pose Estimation 1

In this chapter, we include the following papers presenting our representative contributions in the field of head pose estimation:

- (Dahmane et al. 2015) - A. Dahmane; S. Larabi; I.M. Bilasco; C. Djeraba - *Head Estimation Based on Symmetry Analysis* - Signal, Image and Video Processing (SIVIP), 2014, pp 1-10 (Impact Factor: 1,643 according to JCR 2018)

- (Danisman et al. 2015) - T. Danisman; I.M. Bilasco - *In-plane face orientation estimation in still images* - Multimedia Tools and Applications, Springer Verlag, 2016, 75 (13), pp.7799-7829 (Impact Factor: 1,541 according to JCR 2018)

Gender Recognition 2

In this chapter, we include the following papers presenting our contributions in the field of gender recognition:

- (Danisman et al. 2014) - T. Danisman; I.M. Bilasco; C. Djeraba - *Cross-database evaluation of normalized raw pixels for gender recognition under unconstrained settings* - Proc. Int'l Conf. on Pattern Recognition 2014, Stockholm, Sweden, pp. 3144-3149 ;

- (Danisman et al. 2015) - T. Danisman; I.M. Bilasco; J. Martinet - *Boosting gender recognition performance with a fuzzy inference system* - Expert Systems with Applications, Volume 42, Issue 5, 1 April 2015, pp. 2772-2784 (Impact Factor: 3,768 according to JCR 2018).

Facial expression recognition 3

In this chapter, we include the following papers presenting our representative contributions in the field of facial expression recognition:

- (Danisman et al. 2013) - T. Danisman; I.M. Bilasco; J. Martinet; C. Djeraba - *Intelligent pixels of interest selection with application to facial expression recognition using multilayer perceptron* - Signal Processing, Elsevier, 2013, Special issue on Machine Learning in Intelligent Image Processing, 93 (6), pp. 1547-1556 (Impact factor: 3.470 source JCR 2017) ;

- (**?**) - B. Allaert; I.M. Bilasco; C. Djeraba - Advanced local motion patterns for macro and micro facial expression recognition[1] - Computing Research Repository (CoRR), https://arxiv.org/abs/1805.01951. ;

- (Allaert et al. 2018) - B. Allaert; J. Mennesson; I.M. Bilasco; C. Djeraba - *Impact of the face registration techniques on facial expressions recognition* - Signal Processing: Image Communication, EURASIP, Elsevier, 2017, 61, pp. 44-53 (Impact factor: 2.073 source JCR 2018).

[1] This pre-print is an extented version of the work already published in (Allaert et al. 2017)

Synthesis 4

With my colleagues, we contributed to facial analysis domain mainly studying in unconstrained contexts: head-pose orientation, gender recognition and facial expression recognition.

In the field of **head pose estimation**, we propose two innovative approaches. The first, made in the context of the Afifa Dahmane' PhD thesis [1], is based on the characterisation of facial symmetry. The second, designed with Taner Danisman[2] and José Mennesson[3], exploits the specificities of frontal detectors and, through an inverse transformation, offers an estimate of roll and yaw.

With Taner Danisman, we also obtained valuable results in the field of **gender recognition**. In an inter-corpus validation setting, we applied inner face normalisation in order to respond appropriately to the challenges encountered in a large panel of databases. Still, as some individuals have facial features that are closer to the opposite sex than theirs we enriched the recognition process with information characterizing contextual elements such as hair, beard, mustache. These informations were all fed into a fuzzy inference system for gender recognition.

Our gender recognition contributions have emphasized the importance of facial normalisation processes before facial analysis in a static context. Thus, we have been able to generalize the previous approach to the **facial expression recognition** by proposing a global method for the detection of *happiness* in severe conditions (e.g., very small image size, low illumination). We construct facial pixel masks having the ability to improve *happiness* expression recognition accuracy using only gray level pixels intensities without going through complex descriptors.

Work carried out on static data (images or frames of a video) was continued in Benjamin Allaert's PhD thesis [4] under my co-supervision. This work aims to reduce the gap between the recognition of exaggerated expressions and the recognition of expressions with varying intensities. We proposed an approach to filter out the noise and characterize the facial movement by keeping only the coherent information, regardless of the intensity of the underlying expression. The method obtains excellent results for the recognition of micro- and macro-expressions.

[1] Afifa Dahmane, PhD student from May 2010 to Feb. 2015, *FOX team, CRIStAL lab.*, currently *Maître de Conférences* at *Université de Sciences et Technologies Houari Boumediene*, Algeria.

[2] Taner Danisman, post-doctoral fellow from Sept. 2010 to June 2011 and research engineer from June 2012 to Oct. 2014, *FOX team, CRIStAL lab.*, currently Associate Professor at *Akdeniz Üniversitesi*, Turkey.

[3] José Mennesson, research engineer from Nov. 2014 to Dec. 2015, *FOX team, CRIStAL lab.*, currenly *Maître Assistant* at *Institut Mines-Telecom Lille Douai, FOX team, CRIStAL lab.*

[4] Benjamin Allaert, PhD student from Oct. 2014 to June 2018, *FOX team, CRIStAL lab.*, currently research engineer.

Part III

Research project

Most of my recent research activities have been focused on the recognition of facial expressions (micro and macro) in unconstrained contexts. This type of context presents many challenges: intensity variations, specific activation sequences, head movements, occlusions.

The work done in the context of Benjamin Allaert's PhD thesis[5] has shown that the movement information can address several challenges, such as intensity variations of facial movements (micro and macro movements) and the temporal segmentation of the muscular activation. This drives me to explore the use of facial movement analysis to address other challenges (e.g., facial occlusions or head movements) in unconstrained interaction settings.

Exploiting the movement information seems a promising path to follow. However, responding to the challenges posed by head movements and occlusions requires more precise facial characterisation techniques. This begins with addressing problems related to the location of facial landmarks in presence of head movements. With Pierre Tirilly (Assoc. Prof., *FOX team, CRIStAL lab.*), Nacim Ihaddadene (Assoc. Prof., *ISEN YNCREA*) and Chaabane Djeraba (Prof., *FOX team, CRIStAL lab.*), we started working on more precise facial landmark localisation as part of Romain Belmonte's PhD thesis[6]. This work aims at designing deep neural networks that jointly encode the spatial and temporal dimensions of a video sequence, while offering a good compromise between complexity and efficiency. I consider it worthwhile to continue these efforts to identify architectures that natively deal with video sequences in the early phases of feature construction, without being limited to a late fusion of per frame results.

Although some expertise emerges from the analytical study of the problems related to the facial analysis, recent approaches often go through a feature learning process. Learning has a fundamental role in all of the recognition processes discussed in this manuscript, though it often accompanies an analytical step that reflects our understanding of the challenges and our expertise in responding to them. The success of the deep learning approaches, naturally invites us to devote time to a better understanding of different architectures that can effectively encode the dynamic characterisation of the face. In connection with these architectures, data augmentation processes are intimately linked to the success of deep learning methods. Many augmentation methods have been explored to artificially generate large volumes of annotated data from corpora of moderate size. The common augmentation techniques are transposed for sequences by applying image-by-image augmentation operators to the frames in a sequence. However, in my opinion, this limits the possibilities of increasing in an appropiate and effective way dynamic data. I wish to explore new augmentation processes exploiting the temporal nature of sequences.

Current trends are based on large neural architectures with complex constructs resulting in increasing learning times as well as increasing energy consumption. While trying to limit the energy and the complexity of architectures, I want to continue the work initiated around the spiking

[5]Benjamin Allaert, PhD student from Oct. 2014 to June 2018, *FOX team, CRIStAL lab.*, currently research engineer, *FOX team, CRIStAL lab.*

[6]Romain Belmonte, PhD student since Oct. 2015, *FOX team, CRIStAL lab.*

neural networks that offer a good compromise from the point of view of energy consumption.

In the following, I detail the topics evoked above which I summarize as follows:

- facial expressions recognition in presence of partial occlusions of the face;
- separation of movement sources on the face;
- construction of new architectures for the analysis of video sequences;
- design of new data augmentation techniques for spatio-temporal data;
- development of learning mechanisms adapted to spiking neural networks.

Facial expressions recognition in presence of partial occlusions of the face
The first works concerning occlusions are conducted in Delphine Poux's PhD thesis[7]. This thesis is naturally succeeding Benjamin Allaert's work exploring issues related to movement in presence of occlusions. The first results obtained show that the study of movements offers interesting perspectives when one is interested in the challenges raised by facial occlusions. Indeed, the natural propagation of the movement beyond the occluded areas makes it possible to partially exploit the movement information. Although the epicenter of the movement is occluded, the movement of the region spreads to nearby visible regions. In Delphine Poux's recent work (Poux et al. 2018), we show that, by expression and by type of occultation, it is possible to select a small number of regions in order to find similar performances to situations where no facial occlusion occurs. These promising results will be further analysed in order to propose more generic solutions that concomitantly support all expressions and a wide range of occlusions. In addition, methods for reconstructing movements in the occluded areas of the face are under study.

Separation of movement sources on the face
Methods that study movement, or, more generally, characterize the temporal evolution of the facial texture, work well when the only movement perceived on the face is the one induced by the expression. However, in spontaneous situations, facial expressions are often accompanied by head movements. When the head moves while a person conveys a certain expression, the perceived facial movement reflects both the movement induced by the head and the movement induced by the facial expression. For example, expressions of *surprise* or *fear* are usually accompanied by a rearward movement of the head. In this case, it is necessary to explore tools and methods for accurately exploiting the facial movement in presence of head movements.

Face alignment techniques have often been used to correct head pose variations in order to have a facial image presenting no head movement. In order to effectively deal with moving faces, some authors try to precisely segment the face. Without this precise segmentation, the benefits of

[7]Delphine Poux, PhD student since Oct. 2017, *FOX team, CRIStAL lab.*, co-financed by *Université de Lille* and *l'Ecole d'ingénieurs des Hautes Technologies et du Numérique - ISEN YNCREA.*

dynamic facial characterisation are lost. Facial alignment approaches are steadily improving to meet the challenges posed by unconstrained interaction settings. Nevertheless, it is still difficult to find solutions that effectively preserve facial expressions, especially in presence of low intensities and wide head pose variations. The drop in performance, when alignment processes are used to correct head pose variations, is partly due to the artefacts generated by the alignment, as highlighted in Allaert et al. (2018).

Thus, we believe that it is necessary to deal with the problem of separating head movements from inner face movements directly at optical flow level, without applying any geometric normalisation. This remains a difficult problem to solve as the specificities of each source make the separation difficult. The movement of the head is often important and it takes over the expression movement. We are currently considering two methods to differentiate between the two movements: an analytical method and a learning-based method. In collaboration with François Lemaire (Assoc. Prof., *Calcul Formel et Haute Performance (CFHP) team, CRIStAL lab.*), we try to mathematically formulate the impact of the head movements on the inner facial movement in order to be able to separate them afterwards. In parallel, we explore the use of auto-encoders to separate the two sources of motion. We provide video sequences containing, on the one hand, only the movement induced by the expression, and on the other hand, the movement induced by the variation of the head including that of the expressions. The sequences available in the *SNaP-2DFE* database (Allaert et al. 2018) were simultaneously collected in order to be able to study implicitly the extraction of the facial movement in presence of head movements.

Construction of new architectures for the analysis of video sequences

When one is interested in the study of dynamic phenomena involving motion, one often starts with architectures designed for the analysis of static images. The intermediate descriptors are then interpreted on a larger temporal scale to study the phenomenon as a whole. Supported by the results obtained by directly studying the movement, we envision setting up spatio-temporal convolutions very early in the analysis process. This is not intended to be an alternative to solutions implying a late introduction of temporal analysis, but rather a complementary tool. The results obtained in this direction in (**?**) are very encouraging. By setting up spatio-temporal convolutions and using a relatively small number of layers, we obtain state-of-the-art performances for facial landmark localisation. Other works such as (Baccouche et al. 2011, Zhang et al. 2017, **?**) conducted in the field of action or expression recognition underline the benefits of building spatio-temporal architectures.

At first, I want to explore similar approaches to characterize activation sequences related to facial expressions. In this context, it is important to carefully study the impact of the size of the temporal and spatial window used for the convolutions. Lessons learned from the experiences acquired using Benjamin Allaert's local motion patterns may provide clues for the size of the spatio-temporal convolution window. In the same way, the numerous works concerning the computation of optical flow by relying on deep architecture will constitute privileged objects of study.

Design of new data augmentation techniques for spatio-temporal data
Deep learning is characterized by architectures that depend on a huge number of parameters. The convergence of these networks and the identification of optimal parameters require a large amount of training data. When deep learning techniques are applied to small or medium size data collections, it is necessary to go through artificial data augmentation processes to construct larger learning set. The augmentation techniques identified in the literature are mainly focused on image augmentation and consist of scaling operations, rotations or constructions of the horizontal or vertical mirror image. The provision of heterogeneous data reinforces the generalisation capacities of the learning process by learning situations not foreseen in the initial corpus.

The new architectures dealing directly with the spatio-temporal analysis of sequences could, in my opinion, take advantage of augmentation processes that are not applied only frame by frame, but which deal with the sequence as a whole. For example, various activation patterns can be obtained starting from the activation sequence of an expression by performing different temporal interpolation operations. In order to make the facial analysis robust in presence of head movements, specific augmentations could be implemented to generate data reflecting in-plane and out-of-plane rotations simulating the head movements. The introduction of these new forms of augmentation requires special attention in order to ensure that the augmentations do not interfere with the underlying expression introducing artifacts that change the nature of the expression and hence bias the learning process. I believe that the implementation of these augmentation techniques will naturally accompany new learning architectures that explore the temporal nature of video sequences.

Development of learning mechanisms adapted to spiking neural networks
In parallel with the study of deep learning architectures, I want to continue my research activities concerning spiking neurons networks. These are positioned as a less energy consuming alternative to classical neural architectures. The first results obtained in Pierre Falez's PhD thesis[8] demonstrated the ability of spiking neural network architectures to recognize and characterize elementary unit motions: points and lines in an image. This suggests the possibility of studying more complex movements (for example, gestures or expressions). In this context, I want to explore methods that efficiently encode motion information, in a broad sense, in SNN architectures. New dynamic vision systems (DVS) encode motion in a scene as an activation sequence. It is necessary to study different SNN architectures that can effectively exploit the temporality of the phenomenon studied. Besides, the understanding of SNN architectures effectively dealing with motion can also be beneficial in presence of movements extracted from conventional cameras. The extracted motion can be encoded as a stream that keeps track of changes in a scene. Thus, it is relevant to study the encoding mechanisms of optical flows in the form of pulse trains.

The long-term goal is to use these architectures to solve vision problems in the context of human behavior analysis. The implementation of end-to-end bio-inspired vision systems would require the use of bio-inspired sensors (e.g., artificial retinas like DVS) and the addition of supervised learning

[8]Pierre Falez, PhD student since Oct. 2016, *FOX team, CRIStAL lab.*, co-supervised with *Émeraude team, CRIStAL lab.*

rules. The work done so far has identified a number of problems to be addressed in order to attain this objective:

- the choice of pretreatments and encoding of the input data (in particular, to preserve the color information);
- the adequacy of learning rules and network architectures to the tasks addressed;
- scaling (number of layers, quantity and complexity of data).

Part IV

Curriculum Vitae

Personal data

Bilasco Ioan Marius — marius.bilasco@univ-lille.fr
Age: 38 years (born on January 8th 1980) — 15 rue Fémy
Nationality : Romanian, Franch — 59800 Lille
Maried, 2 children — mobile phone: (+33) 6 63 61 91 97

Professional experience

Associate Professor (*Maître de Conférences - MCF)*)

Since 2009 — *Département Informatique, Faculté de Sciences et Technologies de l'Université de Lille*
- Teaching activities related to Bachelor and Master degrees in Computer Science and *Méthodes Informatiques Appliquées à la Gestion des Entreprises* (MIAGE)
- Head of studies for Computer Science Master degree, track E-Services - initial training (FI) and alternating training (FA) – since 2012
- Coordinateur of pedagogical follow-up of alternanting Bachelor and Master students enrolled at *Département Informatique, Faculté de Sciences et Technologies*
Member of *Fouille de dOnnées compleXes* team from *Centre de Recherche en Informatique, Signal et Automatique* lab. in Lille (UMR 9189)
Recipient of Ph.D. and Research Supervising Bonus - since 2015

***CNRS* post doctoral**

2008 – 2009 — *Laboratoire d'Informatique Fondamentale de Lille* (LIFL) - *Unité Mixte de Recherche* (UMR 8022) – *Fouille de dOnnées compleXes* (FOX) team
Strong involvement in *Information Technology for European Advancement* (ITEA2) *Collaborative Aggregated Multimedia for Digital Home* (CAM4HOME) project – management of the task related to metadata modeling and metadata
Metadata integration and video analysis
Teaching activities at Télécom Lille 1

Attaché temporaire à l'enseignement et à la recherche (similar to Assistant Professor)

2006 – 2008 — *Institut Universitaire de Technologie I – Université Joseph Fourier*, Grenoble
Teaching activities completed at *Département Réseaux et Télécommunications*

Moniteur de l'enseignement supérieur (similar to Assistant Professor)

2003 – 2006 — Institut National Polytechnique Grenoble
Teaching activities completed at *École Supérieure d'Ingénieurs en Systèmes Avancés Rhône-Alpes*, Valence

Education

2003 – 2007 — *Université Joseph Fourier*, Grenoble
PhD in Computer Science: *Une approche sémantique pour la réutilisation et l'adaptation de données 3D*
Defended on December 19th, 2007. Supervisors: Hervé MARTIN et Marlène VILLANOVA-OLIVER *e-thèse*: http://tel.archives-ouvertes.fr/tel-00206220/fr/

2002 – 2003 — *Université Joseph Fourier*, Grenoble
Diplôme d'Etudes Approfondies (DEA) Informatique: Systèmes et Communication ISC

Synthesis of research, administrative and pedagogical activities

1

In this part, I present a temporal view of my co-supervision activities and my implication in related scientific activities (e.g., projects, committees). I also introduce an overview of all my dissemination activities completed since 2009. In order to draw a faithful portrait of all of my activities, before concluding, I also highlight the important pedagogical and administrative responsibilities that I had the opportunity to undertake in parallel with my research activities.

1.1 Supervision of PhD students and post-docs

In this section, I review the co-supervision of PhD students (8) and the coordination of the work of post-doctoral fellows (4). Figure IV.1 offers a synthetic view structured around the main areas of research: metadata and multimedia (MM), head pose estimation (P), gender (G) and expressions (E) recognition, face registration (FR), data fusion from multiple sensors (SF), deep learning (DL) and spiking neural networks (SNN).

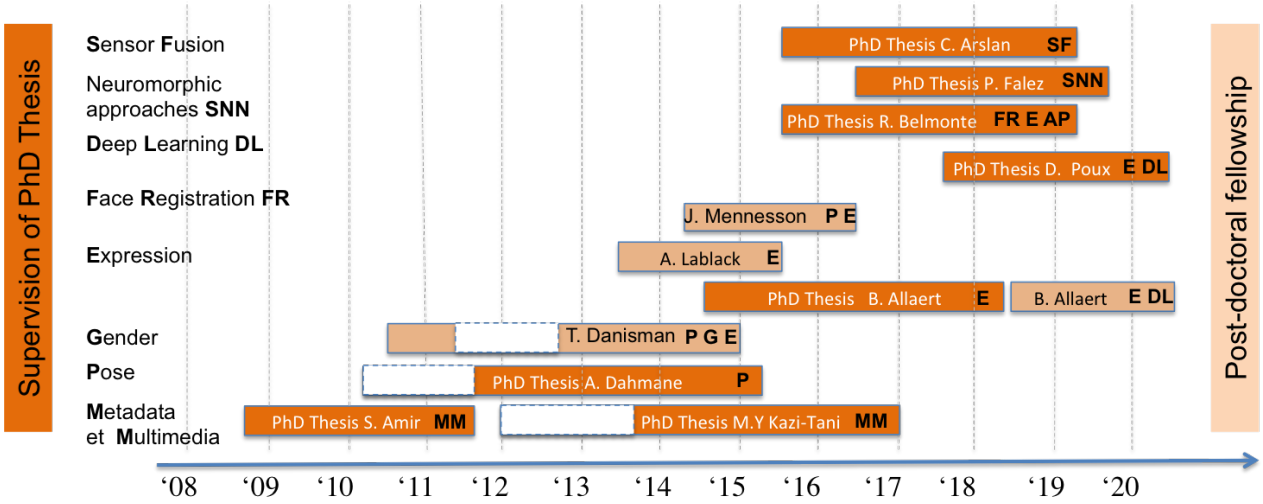

Figure IV.1 – *Overview of my shared supervision activities (PhD thesis and post-doctoral fellowships).*

All the supervision activities (doctoral, post-doctoral) are described below. For each activity I recall the supervision percentage, the publications done, as well as the current situation of doctoral and post-doctoral students. I structure the presentation of PhD thesis in three categories: the theses already defended, the on-going theses within the FOX team and those on-going in collaboration with other teams. In each category, the theses are presented in chronological order.

In order to explicitly inform about the nature of the publications produced as part of my supervision activities, the references cited later in this section use the following format: **A**rticle - **C**onference / **J**ournal / **W**orkshop - **N**ational / **I**nternational, **P**(re-)**P**(rint), **D**ata**B**ase and **A**nnotation or **B**ook**C**hapter. The numbering reflects the reverse chronological order of the date of publication (from the most recent to the oldest) in each category. These references are detailed in Part IV section 2.

1.1.1 PhD thesis (4)

A metadata integration methodology for multimedia systems
Samir Amir, September 2008 - December 2011, enrolled at *Université Lille 1*
Defended on December 6th, 2011 in Lille, France
Supervision: myself at 50% and C. Djeraba (Prof., *FOX team, CRIStAL lab.*)
Funding: ITEA2 CAM4HOME
Publications : [AJI8][AJI9][ACI17][ACI18][ACI21][ACI22][ACI25][ACI26][ACN10][ACN11][BC1][BC2]
Current situation: R&D Team Leader at Press'Innov (Lyon)

Head pose estimation from static images
Afifa Dahmane, May 2010 - February 2015, enrolled at *Université Lille 1* and *Université de Sciences et Technologies Houari Boumediene*, Algeria
Defended on: February 1st, 2015 in Alger, Algeria
Funding: *Ministère de l'Enseignement Supérieur et de la Recherche Scientifique*, Algeria
Supervision: myself at 33% (à partir de nov. 2011), C. Djeraba (Prof., *FOX team, CRIStAL lab.*) and S. Larabi (Prof., *USTHB*, Algeria)
Publications : [AJI6][ACI9][ACI10][ACI16][ACN9][AWI4][DBA1]
Current situation: *Maître de Conférences* (similar to Assoc. Prof.) at USTHB, Algeria

Facial expression recognition in video streams
Benjamin Allaert, October 2014 - June 2018, enrolled at *Université de Lille*
Defended on June 8th, 2018 in Lille
Supervision: myself at 50% and C. Djeraba (Prof., *FOX team, CRIStAL lab.*)
Funding: *Université de Lille*
Publications : [AJI2][ACI8][ACI11][AWI1][ACN4][ACN5][ACN6][DBA3][PP1][PP2][PP3][PP4]
Current situation: Research engineer - ITEA3 PAPUD (2018-2020), *FOX team, CRIStAL lab.*

Integration of semantic inference rules into video analysis processes
Mohamed Yassine Kazi Tani, janvier 2012 à mars 2018, enrolled at *Université d'Oran Es Sénia*, Algeria
Defended on March 24th, 2018 in Oran, Algeria
Funding: Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, Algeria
Supervision: myself at 15% during his doctoral interships (Sept.-Oct. 2013, April-May 2014, Nov. 2014) and A. Ghomari (Assoc. Prof., *Université Oran Es Sénia*, Algeria)
Publications : [AJI3][ACI14][AWI3]

1.1.2 On-going PhD thesis(2)

Contextualisation of individual centered behavioral analysis in unconstrained situations
Romain Belmonte, October 2015 - June 2019, enrolled at *Université de Lille*
Supervision: myself at 25%, P. Tirilly (Assoc. Prof., *FOX team, CRIStAL lab.*), N. Ihaddadene (Assoc. Prof., *École d'ingénieurs des Hautes Technologies et du Numérique - ISEN YNCREA*) and C. Djeraba (Prof., *FOX team, CRIStAL lab.*)
Funding: *ISEN YNCREA* and *Métropole européenne de Lille*
Publications : [ACI2][ACI7][ACN2][PP3]

Facial Expression Recognition in a unconstrained environment
Delphine Poux, October 2017 - September 2020, enrolled at *Université de Lille*
Supervision: myself at 33%, N. Ihaddadene (Assoc. Prof., *École d'ingénieurs des Hautes Technologies et du Numérique - ISEN YNCREA*) and C. Djeraba (Prof., *FOX team, CRIStAL*)
Funding: *Université de Lille* et *ISEN YNCREA*
Publication : [ACI3][ACN1]

1.1.3 On-going PhD thesis in colaboration with other research teams (2)

Data fusion for humain-computer interaction
Cagan Arslan, October 2015 - June 2019, enrolled at *Université de Lille*
Supervision: myself at 20%, J. Martinet (Assoc. Prof., *FOX team, CRIStAL lab.*) et L. Grisoni (Prof., *MINT team, CRIStAL lab.*)
Funding: *Université de Lille*
Publications : [ACI4][ACI6]

Exploring various architectures of a neuromorphic accelerator for vision
Pierre Falez, October 2016 - September 2019, enrolled at *Université de Lille*
Supervision: myself at 25%, P. Tirilly (Assoc. Prof., *FOX team, CRIStAL lab.*), Ph. Devienne (CNRS researcher, *Émeraude team, CRIStAL lab.*) and P. Boulet (Prof., *Émeraude team, CRIStAL lab.*)
Funding: *Université de Lille*
Publications : [ACI5][ACN3][PP**??**]

1.1.4 Post-doc and assimilated supervision (4)

Study of head movements in video streams
José Mennesson, November 2014 - December 2015
Supervision: myself at 100%
Funding: ITEA2 EMPATHIC
Publications : [AJI2][ACI9][ACI11][AWI1][ACN4][ACN5]
Current situation: *Maître Assistant* (similar to Assoc. Prof.) at *Institut Mines-Telecom Lille Douai*

Study of the valence of affective states
Adel Lablack, June 2013 - August 2015
Supervision: myself at 100%
Funding: ITEA2 Empathic Products
Publications : [AJI3][ACI12][ACI14][ACN6][ACN7][AWI3][AWI4][AWI5][AWI6]
Current situation: R&D engineer at FLIR, Kortrijk, Belgium

Recognition of gender and facial expressions; Estimation of the orientation of the head
Taner Danisman, September 2010 - June 2011 and June 2012 - October 2014
Supervision: myself at 75%, J. Martinet (Assoc. Prof., *FOX team, CRIStAL lab.*) and C. Djeraba (Prof., *FOX team, CRIStAL lab.*)
Funding: ITEA2 MIDAS and ITEA2 TWIRL
Publications : [AJI4][AJI5][AJI7][ACI9][ACI12][ACI13][ACI20][ACI23][AWI4][AWI6][ACN8][DBA2] [DBA4][DBA5][DBA6]
Current situation: Assoc. Prof. at *Akdeniz Üniversitesi*, Turkey

Fusing bio-sensor data and facial analysis results for affect understanding
Benjamin Allaert, since September 2018
Supervision: myself at 75%, J. Mennesson (*FOX team, CRIStAL lab.*)
Funding: ITEA3 PAPUD
Publications: [ACI3][ACN1]

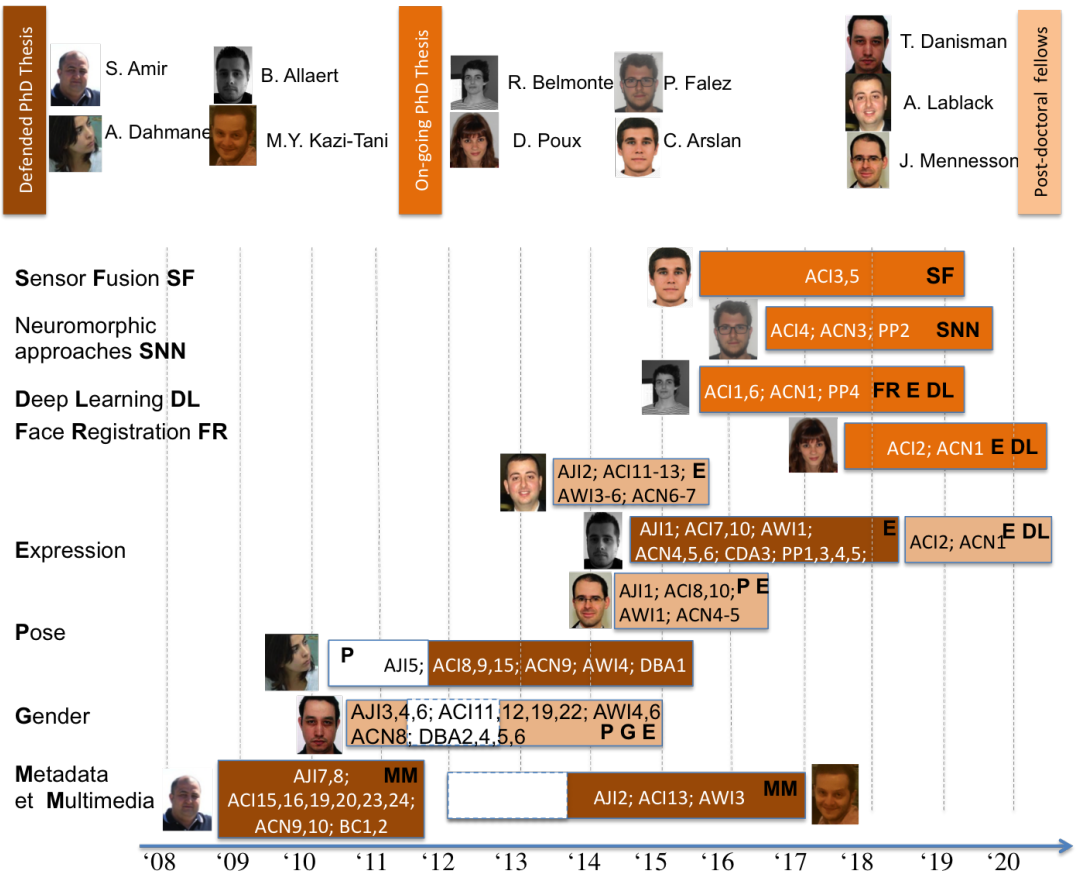

Figure IV.2 – *Dissemination activities per supervision activity*

Figure IV.2 shows, by field of research and in reverse chronological order, the publications produced in collaboration with doctoral and post-doctoral students. Beyond the supervision of PhD students and post-doctoral students, I was also involved in the initiation to research of the Master students. Thus, I was able to supervise 15 2nd year Master students (5 for end-of-study internships and 10 for pedagogical projects related to my research) and 21 1st year Master students (20 for pedagogical projects related to my research and 1 for an internship). These internships were mainly related to projects in the field of facial expression recognition and head pose estimation.

1.2 Scientific responsibilities

In the following, my scientific responsibilities are presented, both in terms of participation in national and European collaborative projects, as well as participation of juries, program committees and reading committees. The Figure IV.3 offers a global view of the scientific projects in which I participated. Those for whom I was strongly involved in terms of proposal and local management are surrounded with thick strokes.

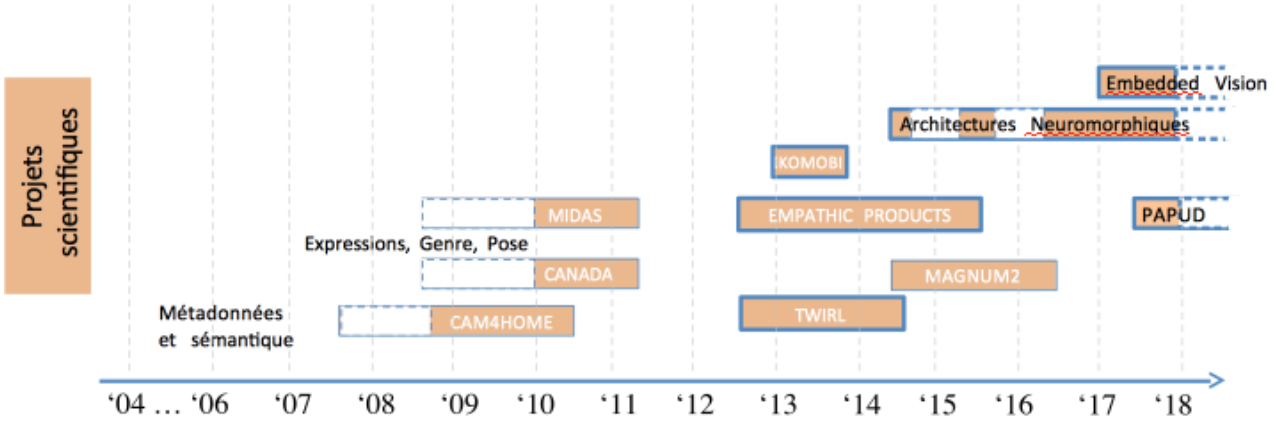

Figure IV.3 – *Overview of collaborative projects*

1.2.1 Setting up and local management of research projects

Since September 2010 I have been actively involved in the setup and local management of 3 European projects in the context of Information Technology for European Advancement (ITEA) framework one of EUREKA clusters : *Twinning virtual World (on-line) Information with Real world (off-line) data sources* (TWIRL, 2012-2014, labeled in 2010 and funded in 2012), *Empathic products: enabling intention and emotion aware products* (EMPATHIC, 2012-2015 - labeled in 2011 and funded in 2012) and *Profiling and Analysis Platform Using Deep Learning* (PAPUD, 2017-2020, labeled and funded in 2017).

In addition to these collaborative projects at European level, I participated in the activities carried out within the *Institut de Recherche sur les Composants logiciels et matériels pour l'Information et la Communication Avancée* (IRCICA, USR CNRS 3380) which hosts our team since 2010. I initiated a scientific study for a private company (IKOMOBI, 2013) and participated in two inter-team projects. The first project, *Neuromorphic Architectures for Vision*, studies spike-based neural approaches applied to vision tasks. The second, *Embedded Vision* examines the tradeoffs between energy costs and accuracy of embedded video processing.

TWIRL: Twinning virtual World (on-line) Information with Real world (off-Line) data sources
ITEA2 - 2012-2014, labelled in 2010 - https://itea3.org/project/twirl.html
11 partners, 3 countries, managed by Cassidian Cybersecurity France, global budget 5 762 k€, FOX team funding 246 k€
This European project aims to create a platform that can process, search, link and merge data from real-world applications (e.g., road traffic estimates, weather forecasts) with online data (e.g., social networks, forums, blogs, wikis, RSS). Our ambition is to solve problems related to the

amount of data available on the Internet, the heterogeneity of formats and types of data (e.g., blogs, comments, videos, images), and the difficulty of aggregating data from multiple sources. I represented the team from the beginning of the project in February 2010. I contributed to the exchanges that took place during proposal definition meetings at the European level in Amsterdam (June 2010) and at the French level in Paris (August 2010). In October 2010, I had the opportunity to show the positive impact of our participation to the project at the *Direction générale des entreprises* (DGE, formerly *Direction générale de la compétitivité, de l'industrie et des services* - DGCIS). The project was labeled by ITEA2 in December 2010. I was asked to submit a funding application and helped to define the technical annex in October 2011. I was in charge of defining the budget and organizing the involvement of our team in the project. The project was funded in February 2012. I have been coordinating local research activities and recruitments until February 2013. During this period, I set up collaborative tools (wiki) to facilitate exchanges and capitalize on the results obtained within the consortium. The task of piloting was then transferred to my colleague Jean Martinet (Assoc. Prof., *FOX team, CRIStAL lab.*). I continued to participate to the project by working on Task 3.4 (Recognition, Extraction, Categorisation) on extracting information about people from image and video collections.
My publications related to the TWIRL project are [AJI4][AJI5][ACI13][AWI2].

Empathic Products : Enabling intention- and emotion-aware products
ITEA2 - 2012-2015, labelled in 2011 - https://itea3.org/project/empathic.html
29 partners, 8 countries, managed by VTT Technical Research Center, Finland, global budget 15 285 k€, FOX team funding 276 k€
The goal of this project is to improve the user experience by applying "empathic technologies" that can understand and respond to users' intentions and emotions when using applications or systems deployed in the real world. We strive to ensure that "empathic applications" have this extra understanding of their users. Such systems can thus perceive the emotions and intentions of the latter. These capabilities allow them to adapt their settings in order to optimize the user experience.
I coordinated the involvement of our team in the project from its beginnings by participating in the event "Project Outline Days" organized in Paris in March 2011. I was able to defend the contributions of the team to the project, during a meeting with the *Direction générale des entreprises* (DGE, formerly *Direction générale de la compétitivité, de l'industrie et des services* - DGCIS) in November 2011. The project was labelled in December 2011. The writing of the application file for funding on behalf of our team was under my responsibility. The funds were received in September 2012 and I was in charge of coordinating locally the project. In this project, my contribution focused on extracting from video feeds clues about how people perceive their environment and about how the systems perceive individual behavior. This project, organized in successive cycles, allowed me to focus gradually on various scientific barriers under different angles and in different application contexts. Thus, every 3 months various application contexts such as video-conferences, e-learning systems or interactive multimedia experiences were addressed. I managed the Task 3.3 (*Modeling User Interactions / Behaviors*) and coordinated the FOX team's contributions across multiple cycles: *Empathic Video-Conferencing Systems*, *Empathic TV*, *Empathic Bilboard* and *EmoShop*. In April 2013, I

organized a two-day working meeting at our premises where we welcomed thirty people.
My publications related to the EMPATHIC project are [AJI6][ACI11][ACI12][ACI15][AWI1][AWI4][AWI5][AWI6][ACN4][ACN5][ACN6][ACN7]

PAPUD : Profiling and Analysis Platform Using Deep Learning
ITEA3 - 2018-2020, labelled in 2017 - https://itea3.org/project/papud.html
23 partners, 6 countries, managed by Atos Bull France, global budget 9 530 k€, FOX team funding 216 k€
The PAPUD project aims to create new models and algorithms dedicated to the analysis of large masses of textual and heterogeneous data from different applications. Since traditional learning methods have already shown their limitations, in the context of this project, deep learning is advocated as the main approach while taking into account issues related to scaling up the systems. As part of the project, I participated in the definition of a scenario that concerns the exploitation of user traces. During interactions with a system, a multitude of logs are collected. Often this data is used in application maintenance or in the construction of user profiles based on browsing history. The information collected remains objective and does not provide information, for example, on the subjective perception of the user experience, while using a product or an e-service. We are particularly interested in infering cognitive and emotional user state from a set of measures provided by logs, video cameras or bio-sensors. To do this, we exploit correlations between subjective and objective measurements obtained during experiments conducted in an instrumented living lab. The navigation logs generated by the user activity, as well as the sensor outputs are jointly analyzed. The correlations identified are exploited to infer subjective traces, as in a real context, only the objective traces are available. These results make it possible to envision building cognitive and affective profiles of users in a transparent way and without any specific instrumentalisation. The project was labeled by ITEA in February 2017. The French consortium was funded as an *Fonds unique interministériel* (FUI) project in November 2017.
My publications related to the PAPUD project are [ACI2][ACI3][ACN1]

Scientific study on the tracking of mobile objects for IKOMOBI
January 2013 - January 2014
in collaboration with IKOMOBI, FOX team funding 36 k€
I participated in the definition and the realisation of a scientific study concerning the tracking of moving objects in an indoor environment. We were using fisheye cameras placed above the scene. Following preparation meetings held in December 2012, the project started in January 2013. I was in charge of ensuring communication with IKOMOBI by organizing various meetings and ensuring the proper delivery of documents and prototypes. I organized and directed the team's activities in this project in collaboration with my colleagues Jean Martinet (Assoc. Prof., *FOX team, CRIStAL lab.*) and Pierre Tirilly (Assoc. Prof., *FOX team, CRIStAL lab.*).
My scientific contribution was focused on the implementation of people monitoring and tracking by analysing their movements within the scene, while taking into account situations of partial or total occultation and changes of brightness.

Neuromorphic architectures for computer vision
IRCICA 2014-2018
in collaboration with Émeraude team, CRIStAL lab. and CSAM team from IEMN
The goal here is to study new paradigms of vision by adopting similar processes that the one present in the human brain. We explore new ways of processing visual information, focusing on bio-inspired paradigms in general and neuro-inspired in particular. We aim at offering energy efficiency close to that of the brain and gaining several orders of magnitude with regard to the consumption of state-of-the-art solutions. Recent advances in neuroscience and memory devices suggest the possibility of creating radically new architectures that benefit areas such as computer vision. The use of spiking neural networks (SNN) with non-supervised spike timing dependent plasticity (STDP) mechanisms seems to be very promising. As part of this project, I participated on unsupervised learning of visual patterns from various image collections. This work has been applied to the recognition of handwritten figures, as well as object recognition.
My publications related to the this project are [ACI5][ACN3][PP**??**]

Embedded Vision
IRCICA 2016-2017
in collaboration with Émeraude team, CRIStAL lab. and Telecom platform from IEMN
Image recognition algorithms are now used in real-time embedded systems, such as robots, autonomous cars, and so on. Video processing is energy intensive because of the nature of the processed data and the complex processing chain: capture, encoding and analysis. Work to optimize processing times by distributing the analysis or using calculations accelators such as GPU or FPGA have been explored by the community. Large computing capabilities are needed to explore the complete solution space. Few studies have been conducted to measure the impact of a decrease in computing capacity or time allocation on the system accuracy. As part of this project, we are particularly interested in the recognition part by studying the impact on performance of reducing processor times or meeting expected energy costs. I participated in setting up experimental protocols to measure performance losses when using controlled resources. This makes it possible to anticipate the ability of the system to process the data depending on the available resources.

1.2.2 Participations to other collaborative projects

I joined the FOX team as a postdoctoral fellow in the ITEA2 *Collaborative Aggregated Multimedia for Digital Home* project (CAM4HOME, 2007-2010) where I coordinated with Chaabane Djeraba (Prof., *FOX team, CRIStAL lab.*) the activities of the working group around the semantic modeling of metadata. This project received the silver medal at the ITEA-ARTEMIS Symposium held in Ghent, Belgium in 2010. I also participated in the ITEA2 *Multimodal Interfaces for Disabled and Aging Society* project (MIDAS, 2008-2011). I collaborated with Chaabane Djeraba (Prof., *FOX team, CRIStAL lab.*) on research aspects related to expressions recognition [ACI23] and to fatigue detection [ACI20]. We were also both involved in the preparation of related demonstrators.

I was strongly involved as a collaborator, in the project *Measure Flow Management Natively Unified in Malls* (MAGNUM2, 2014-2016) financed by *Fonds unique interministeriel* (FUI). The project was

managed locally by Mohamed Daoudi (Prof., *Modeling and Analysis of Static and Dynamic Shapes (3D-SAM) team, CRIStAL lab.*). The project aimed at designing innovative interactions in stores. In this context, we explored the study of low and high intensity facial expressions [ACI8].

In parallel with this rich activity in collaborative projects, I have also been involved in participation in program and reviewing committees.

1.2.3 Participation in thesis juries, program committees and reading committees

PhD jury comittees (2)

- Samin Mohammadi - Analysis of User Popularity Pattern and Engagement Prediction on Online Social Networks, under the supervision of Noël Crespi, December 4th 2018 (*in the morning*), Telecom Sud Paris, Evry - as external examiner.
- Amir Mohammadinejad - Consensus Opinion Model in Online Social Networks based on impact of Influential Users, under the supervision of Noël Crespi, December 4th 2018 (*in the afternoon*), Telecom Sud Paris, Evry - as external examiner.

Organizing comittees (2)

- Web chair and Organizing comittee member for *Face and Gesture Recognition (IEEE) Conference*, Lille, France, May 2019.
- Organizing comittee member for *COmpression et REprésentation des Signaux Audiovisuels*, Lille, France, May 2012.

Program committees (5)

- Program committee member for *ACM International Symposium on Applied Computing SWA*, 2010-2019.
- Program committee member for *COmpression et REprésentation des Signaux Audiovisuels*, 2012.
- Program committee member for *Grid and Pervasive Computing (GPC) International Conference*, 2011-2016.
- Program committee member for *PECCS Special Session on Simulation and Interaction in Intelligent Environments (SIMIE)*, 2011.
- Program committee member for *Geospatial Semantics International Conference*, 2011.

Reviewing comittees (9)

- External reviewer for *Transactions on Knowledge and Data Engineering* (IEEE Computer Society, since 2018).
- External reviewer for *Journal of Electronic Imaging* (SPIE Digital Library, since 2018).
- External reviewer for *Applied Computing and Informatics* (Elsevier, since 2016).

- External reviewer for *Pattern Recognition* (Elsevier, since 2015).
- External reviewer for *Neural Computing and Applications* (Springer, since 2015).
- External reviewer for *Signal Image and Video Processing* (Springer, since 2014).
- External reviewer for *Journal of Supercomputing* (Springer, since 2010).
- External reviewer for *Multimedia Tools and Applications* (Springer, since 2010).
- External reviewer for *Knowledge and Information Systems* (Springer, since 2008).

1.3 Scientific dissemination

1.3.1 Scientific publications

My scientific output in terms of publications from September 2008 to August 2018 is summarized in Figure IV.4 and includes:

- 8 international journal articles with reviewing committee;
- 4 invited communications;
- 26 articles published in international conferences with reviewing committee and proceedings (including one concerning my thesis activities);
- 6 international workshops with reviewing committee (5 with proceedings);
- 13 articles published in national conferences with proceedings;
- 3 book chapters (including one about my thesis activities).

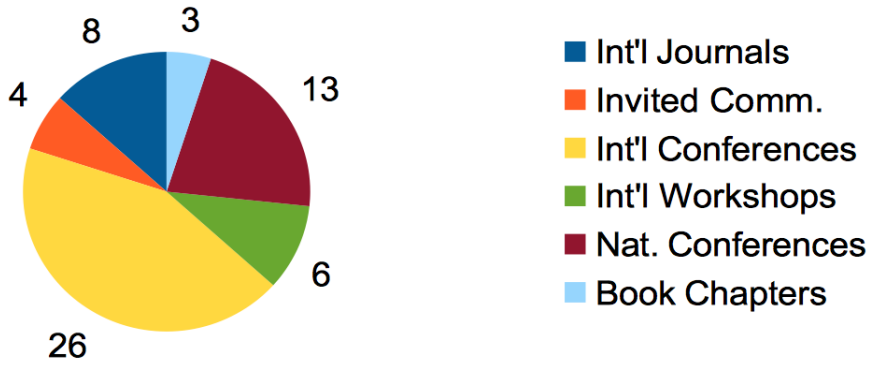

Figure IV.4 – *Publications overview*

Among these publications, I put forward the 7 most representative publications:

- T. Danisman; I.M. Bilasco; J. Martinet - Boosting gender recognition performance with a fuzzy inference system - Expert Systems with Applications, Volume 42, Issue 5, 1 April 2015, pp. 2772-2784. (Impact Factor: 3.768 according to Journal Citations Reports 2018);
- T. Danisman; I.M. Bilasco; J. Martinet; C. Djeraba - Intelligent pixels of interest selection with facial expression recognition using multilayer perceptron - Signal Processing, Elsevier, 2013, Special issue on Machine Learning in Intelligent Image Processing, 93 (6), pp. 1547-1556. (Impact factor: 3.470 according to JCR 2017);
- B. Allaert; J. Mennesson; I.M. Bilasco; C. Djeraba - Impact of the face registration techniques on facial expression recognition - Signal Processing: Image Communication, EURASIP, Elsevier, 2017, 61, pp. 44-53. (Impact factor: 2.073 according to JCR 2018);
- A. Dahmane; S. Larabi; I.M. Bilasco; C. Djeraba - Head Estimation Based on Symmetry Analysis - Signal, Image and Video Processing (SIVIP), 2014, pp 1-10. (Impact factor: 1.643 according to JCR 2018);

- T. Danisman; I.M. Bilasco - In-plane face orientation estimation in still images - Multimedia Tools and Applications, Springer Verlag, 2016, 75 (13), pp.7799-7829. (Impact factor: 1.541 according to JCR 2018);
- B. Allaert; I.M. Bilasco; C. Djeraba - Advanced local motion patterns for macro and micro facial expression recognition[1] - Computing Research Repository (CoRR), https://arxiv.org/abs/1805.01951;
- T. Danisman; I.M. Bilasco; C. Djeraba - Cross-database evaluation of normalized raw pixels for gender recognition under unconstrained settings - Proc. Int'l Conf. on Pattern Recognition 2014, Stockholm, Sweden, pp. 3144-3149.

These publications describe the activities carried out in the field of person characterisation (gender, orientation of the head) and behavior analysis (facial expression). These themes were also explored in the ITEA European projects TWIRL (2012-14), EMPATHIC (2012-15) and PAPUD (2017-2020). The complete list of publications[2] is available in Part IV, Chapter 2.

In addition, as part of my research activities, I also participated in the design and collection of 3 databases used to validate the different approaches we have proposed in the field of facial analysis (estimation of head pose and expression: *FoxFaces* and *SNaP-2DFE*, gender: *Web Gender Database*). In addition, I contributed to the availability of new annotations concerning 4 databases (*GENKI-4K*, *LFW Pro*, *Caltech Faces*, *Youtube Faces*) in order to be able to fully validate our head pose estimation approaches. Details about these databases are available in Part IV, Chapter 2.

1.3.2 Other communications

Since I joined CRIStAL (formerly *Laboratoire d'Informatique Fondamentale de Lille*, LIFL), I have been able to contribute to many science popularisation and dissemination activities. In what follows, I introduce these activities in chronological order.

My initial science popularisation activities were carried out in 2009, as part of *Plateforme Interactions, Réalité Virtuelle et Images* (PIRVI platform) [3]. My contributions were organized around the presentation of the *magasin laboratoire* living lab hosted by the platform. The living lab activities concerned the realisation of demonstrations related to the human behavior analysis.

In October 2010 in Ghent (Belgium), I participated to the dissemination activities related to the ITEA2 CAM4HOME project as part of the *Joint ITEA2 - Artemis Symposium*, where the project was awarded the *silver medal in the Achivement award* category. Within the framework of this project, I and Chaabane Djeraba (Prof., *FOX team, CRIStAL lab.*) were in charge of coordinating the metadata modeling activities and the realisation of a generic platform for metadata management.

In May 2011, I was invited by Leif Hanlen (Technology Director, *Commonwealth Scientific and Industrial Research Organisation*, formerly *National ICT Australia* - NICTA) to present our contributions

[1] This pre-print is an extented version of the work already published in (Allaert et al. 2017)
[2] http://www.cristal.univ-lille.fr/~bilasco/single_publications.html
[3] http://www.lifl.fr/PIRVI

related to the *Extraction of human behavior from video streams* at the *EU-Australia Bilateral Workshop on e-Health* in Budapest, Hungary.

Between December 2011 and June 2012, I was strongly involved in the realisation of the interactive artwork *Tempo Scaduto* [4] imagined by Vincent Ciciliato, doctor of plastic arts. This artwork was designed in collaboration with *Méthodes et outils pour l'INTeraction à gestes* (MINT) team, CRIStAL lab. and *INSID Inc*. We implemented an interactive visual device that immersed the *player* in the mafia war in Palermo, Sicily in the 80s. The *player*, in immersion, can, thanks to a fine analysis of the hand gestures, follow and shoot the author of an impending murder. The work has been exhibited in France and abroad in the following events:

- Panorama 14, Studio d'Art Le Fresnoy, Tourcoing (2012) ;
- Journée Recherche: Art, Recherche et Technologie at Polytech Lille (2013) ;
- Futur en Seine organised by *Pôle de Compétitivité Cap Digital* in Paris (2013) ;
- Realidad Elastica, Laboral Centro de Arte y Creacion Industrial, Gijon, Asturias, Spain (2013).

In December 2012, I participated to the presentation of the ITEA2 TWIRL project at the *Joint ITEA2 - Artemis Symposium*. In December 2013, I reiterated my participation at the *Joint ITEA2 - Artemis Symposium* (Stockholm, Sweden) by disseminating the results of the ITEA2 EMPATHIC project. On the sidelines of the demonstrations, I was able to discuss with visitors the vision-based empathic solutions that we have incorporated into the project (available on the project portal [5]). I renewed this experience in 2015 at the *Joint ITEA2 - Artemis Symposium* (Berlin, Germany) and the *ICT Innovate, Connect, Transform Congres* (Lisbon, Portugal). I also organized a demonstration day at the end of 2014, at IRCICA, presenting the results of the ITEA2 EMPATHIC project to Worldline (Atos). I also demonstrated the previous results during the inauguration of the CRIStAL laboratory (April 2nd, 2015 at Polytech Lille). The demonstrations were seen by a wide range of people including also people from the political and industrial eco-system of the *Métropole européene de Lille* (MEL). On the occasion of the inauguration of the *Métropole européene de Lille* (MEL) in 2015, the demonstrators were also presented to MEL employees (January 16th) and the general public (January 17th).

From 2012 to 2018, I presented and coordinated the various demonstrators reflecting the work of the team during the *Journée Recherche Innovation Création* (RIC). This one-day event is organized annually for students enrolled in Bachelor and Master degrees in Computer Science at *Université de Lille*, *Ecole Centrale de Lille* and *Institut Mines Telecom Lille Douai*. It aims to facilitate the access of students to the research done in the *CRIStAL laboratory*. Following the demonstrations presented, we were asked for several internships and Bachelor and Master end-of-studies projects. Two of these internships continued with the PhD thesis of Benjamin Allaert (PhD defended in June 2018), and the PhD thesis of Delphine Poux (started in October 2017).

[4] http://www.panorama14.net/142/tempo-scaduto-panorama-14 and http://vimeo.com/50522111
[5] http://portal.empathic.eu/

1.4 Teaching and administrative responsibilities

Beyond my research activities, I was eager to get stongly involved in the pedagogical and administrative activities inherent to the life of an Associate Professor. I detail in this section the educational responsibilities taken within the Computer Science department of the *Faculté de Sciences et Technologies* of the *Université de Lille*.
My educational activities and responsibilities (detailed below) are structured as follows:

- Direction of the Master degree in Computer Science, E-Services track (initial training - IT and apprenticeship[6] - AT).
- Coordination of the pedagogical follow-up of apprentice students;
- Coordination of attendance sheet management for apprentice students;

In the following, I present these activities in chronological order to better illustrate my progress in terms of responsibilities within the department.

Coordination of the pedagogical follow-up of apprentice students
Since my recruitment as a lecturer in September 2009, I have been in charge of coordinating the pedagogical follow-up of the students registered under professionalisation contract in MIAGE Bachelor and MIAGE (1st and 2nd year) Master degree at *Université de Lille*. At first, this activity involved about forty students each year. From 2011, I was in charge of coordinating the follow-up of all MIAGE and Computer Science Master apprentice students (about 90 students per year). The other directors also entrusted me with the task of organizing the defences of the apprentice students enrolled in the 2nd year of Master degree. I ensured this task until 2015 for all Master tracks. Since then, I continue to take care of the defenses of the apprentice students enrolled in E-Services track (between 14 and 24 every year). In the Computer Science department, the follow-up of an apprentice student is structured as follows:

- a university tutor chooses a student to follow according to his missions;
- the university tutor gets in touch with the student;
- the university tutor makes a first pedagogical visit to ensure the consistency of the missions announced with the work actually requested from the student;
- the university tutor and the student define together the mission for the defence;
- the university tutor makes a second pedagogical visit;
- the university tutor and the student exchange in a punctual and informal way.

In 2009, I set up a Web application called "Livret Électronique"[7] to cover all of these needs. This application allows students to describe synthetically theirs missions in order to ease the attribution

[6] Students in apprenticeship are partly students and partly employees. They share their weekly activities between the university and the enterprise. They are under the responsability of an entreprise manager, but they also have a university tutor that keeps track of their evolution.
[7] http://stages.fil.univ-lille1.fr/suivi

of the university tutor. The entreprise managers receive the reports recorded in the electronic booklet.

In 2011, I extended the application so that it can also integrate the Bachelor (3rd year) and the 2nd year Master internships of students enrolled in initial training. Currently, every year, about 350 regular internships and apprenticeships are completely managed by the application. Beyond the provision of this application, coordination involves recurrent tasks to inform and remind the monitoring instructions to tutors, as well as advice and mediation tasks in case of conflicts or difficulties in monitoring. The application evolves every year to integrate new features: history of monitoring over several years, geolocation of corporate offices hosting apprentice students, automatic reminders, statistics, generation of mission orders ready to sign, etc.

Coordination of attendance sheet management for apprentice students
Since 2011, the UniPres application[8] monitors the attendance of the apprentice students. The application was entirely designed and deployed by me. The apprentice students have an obligation of presence with regard to their employer. They must be able to provide attendance sheets at the end of the month to justify their participation to educational activities. The training managers, the director of the department and I had many exchanges with the *Service de Formation Continue* (entity of the University of Lille managing relations with companies and funding organisations) to facilitate the management and monitoring of these sheets. I proposed a personalized generation of pre-filled attendance sheets based on the specific Master track of the student and the chosen options. Discussions are currently underway to extend the application to all departements of *Faculté de Sciences et Technologies*.

Direction of Master of Computer Science, E-Services track
I start working in close cooperation with Jean-Marie Lebbe and Yves Roos (study directors of the Bachelor and Master *Méthodes informatiques appliquées à la gestion des entreprises* - MIAGE apprenticeship tracks until 2011) around the implementation of the electronic booklet and the organisation of the pedagogical follow-up. This first experience provided me with an overview of skills and knowledge required to coordinate a Bachelor or a Master course. Thanks to the acquiered experience, I was asked by Lionel Seinturier (the previous director of studies of the Master of Computer Science, E-Services track) to succeed him. We jointly supervised the E-Services track class of 2013 in order to prepare the transition and the definition of the 5-year study contract. I was in charge of preparing the evaluation of the last 5-year period and prepare the next 5-year period. Since September 2013, I have undertaken by myself the management of E-Services track while working in close collaboration with my colleagues in charge of the main teaching assignements: Luigi Lancieri (Prof., *Université de Lille*), Xavier Le Pallec (Assoc. Prof., *Université de Lille*), Lionel Seinturier (Prof., *Université de Lille*) and Jean-Claude Tarby (Assoc. Prof., *Université de Lille*).
The E-Services track has two groups requiring differentiated management: students in initial training (IT) and students in apprenticeship (AS). In fact, this translates into a duplication of lessons and the personalisation of interventions for the AS group in order to cope with the limited time

[8] http://stages.fil.univ-lille1.fr/unipres

students have for their teaching assignments. Since 2013, 247 students have graduated from the Master 2 Computer Science E-Services track. This corresponds to an average of 42 students/year.

1.5 Synthesis

In the last ten years, after obtaining my PhD, I managed to marry in a balanced way my ambitions in terms of research and teaching. The Figure IV.5 illustrates the highlights of my career in terms of courses and educational activities, supervision of PhD theses and scientific projects.

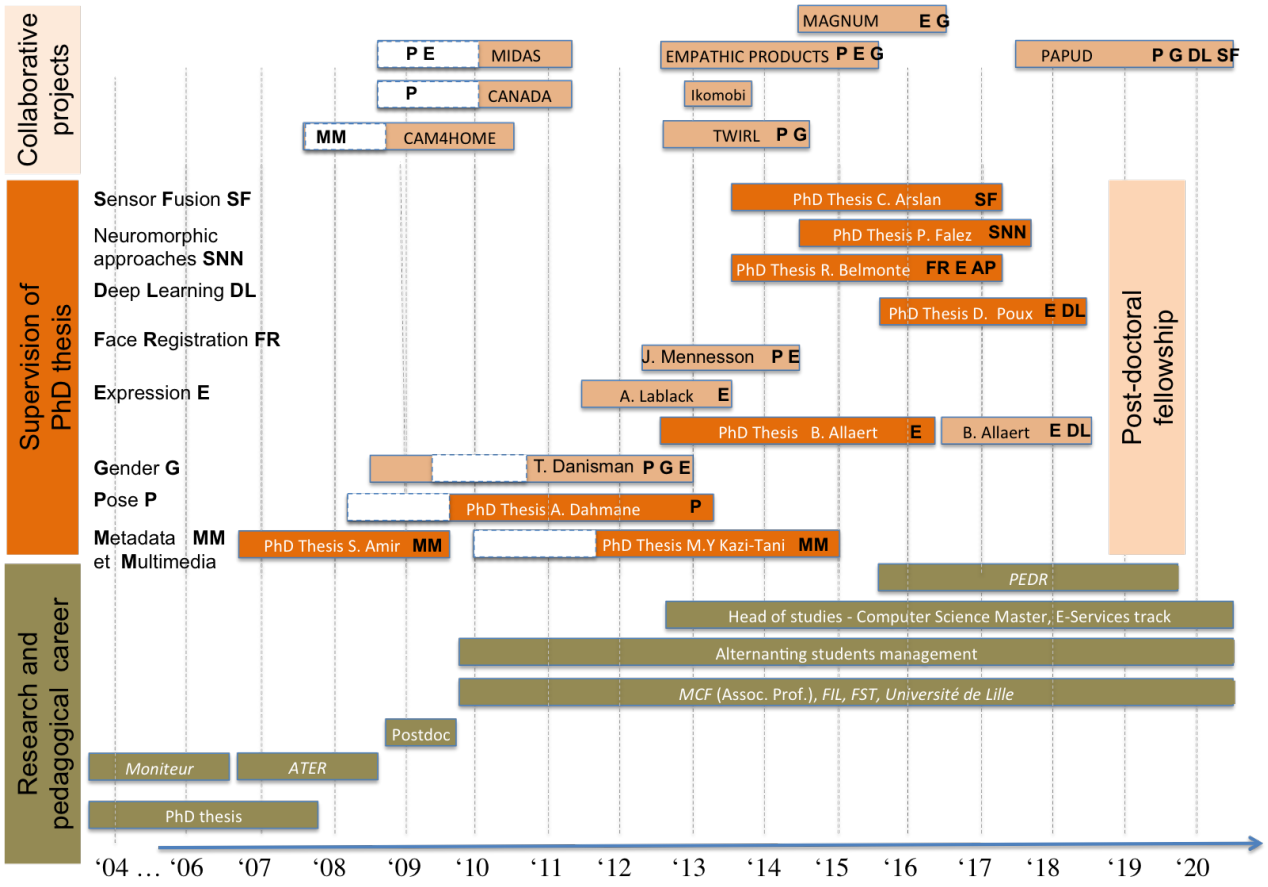

Figure IV.5 – *Overview of my professional career*

As far as my teaching activities are concerned, I was able to build up my skills gradually in the administrative and management aspects. This allowed me to get more immersed in the activities of the teaching department, while implementing new teaching assignments in the Master MIAGE and the E-Services track of the Master of Computer Science.

Although I am strongly involved in teaching activities, I was able to continue my research activities carrying out several important projects for the team. The results of my supervision activities, successfully promoted in conferences and journals recognized by the scientific community, make me consider very positively the continuation of my career. Obtaining my HDR will allow me to give a new dimension to my career.

Publications 2

The publications that keep track of my contributions are grouped into different categories:

- articles in international journal with reviewing committee (AJI)
- articles in national journal without reviewing committee (AJN)
- articles or invited communications (AI)
- articles in proceedings of international conferences with reviewing committee (ACI)
- articles in proceedings of international workshops with reviewing committee (AWI)
- articles in proceedings of national conference with reviewing committee (ACN)
- book chapters (BC)
- pre-prints (PP)
- databases and annotation sets (DBA)

The numbering used in each section follows the reverse chronological order of the date of publication (from the most recent to the oldest in each category). The authors' order mainly reflects the status of the people who actively contribute to each contribution (doctoral or post-doctoral student first and then supervisors).

2.1 Articles in international journal with reviewing committee - AJI (9)

[AJI1] P. Falez; P. Tirilly; I.M. Bilasco; Ph. Devienne; P. Boulet - Unsupervised visual feature learning with STDP: how far are we from traditional feature learning approaches? - Pattern Recognition, 93, pp. 418-429 (Impact factor: 5.898 source Journal Citations Report 2018)

[AJI2] B. Allaert; J. Mennesson; I.M. Bilasco; C. Djeraba - Impact of the face registration techniques on facial expressions recognition - Signal Processing : Image Communication, EURASIP, Elsevier, 2017, 61, pp. 44-53 (Impact factor: 2.073 source JCR 2018).

[AJI3] M.Y. Kazi Tani; A. Ghomari; A. Lablack; I.M. Bilasco - OVIS: Ontology video surveillance indexing and retrieval system - Int'l Journal of Multimedia Information Retrieval, 2017, 6 (4), pp. 295 - 316 (SJR : 0.268 source SCImago Journal Rank 2017).

[AJI4] T. Danisman; I.M. Bilasco - In-plane face orientation estimation in still images - Multimedia Tools and Applications, Springer, 2016, 75 (13), pp.7799-7829. (Impact factor: 1.541 source JCR 2018, SJR : 0.287 source SCImago Journal Rank 2017).

[AJI5] T. Danisman; I.M. Bilasco; J. Martinet - Boosting gender recognition performance with a fuzzy inference system - Expert Systems with Applications, Volume 42, Issue 5, 1 April 2015, pp. 2772-2784 (Impact factor: 3.768 source JCR 2018).

[AJI6] A. Dahmane; S. Larabi; I.M. Bilasco; C. Djeraba - Head pose estimation based on face symmetry analysis - Signal, Image and Video Processing (SIViP), Springer, 2015, 9 (8), pp 1871-1880 (Impact factor: 1.643 source JCR 2018).

[AJI7] T. Danisman; I.M. Bilasco; J. Martinet; C. Djeraba - Intelligent pixels of interest selection with application to facial expression recognition using multilayer perceptron - Signal Processing, Elsevier, 2013, Special issue on Machine Learning in Intelligent Image Processing, 93 (6), pp. 1547-1556 (Impact factor: 3.470 source JCR 2018).

[AJI8] S. Amir; I.M. Bilasco; M. Rautiainen - CAM4Home : A generic ontology for a rich multimedia experience - Int'l Journal of Computer Applications, 2013, 67 (12), pp. 19-25 (Impact factor: 0.702 source IJCA Citations Reports 2018).

[AJI9] S. Amir; I.M. Bilasco; C. Djeraba - MuMIe : Multi-level metadata mapping system - Journal of Multimedia, Academy Publisher, 2011, 6(3), pp. 225-235 (Impact factor: 0.719 source JCR 2013).

2.2 Articles in national journal without reviewing committee - AJN (1)

[AJN1] I.M. Bilasco - La sémantique des scènes 3D : Une approche sémantique pour la recherche et la réutilisation de scènes 3D - Le monde des cartes - Revue du Comité Francais de Cartographie, 2008, 198, pp.31-35.

2.3 Articles or invited communications - AI (4)

[AI1] I.M. Bilasco - Extracting human behaviour from video streams - EU-Australia Workshop on Bilateral Cooperation in e-Health, Mai 2011, Budapest, Hungary.

[AI2] I.M. Bilasco - Extracting human behaviour from video streams - Multitel Spring Workshop on Video Analysis, Juin 2010, Mons, Belgium.

[AI3] I.M. Bilasco - CAM4HOME metadata framework - FP7 NoTube 4th PCC Meeting, Décembre 2009, Munich, Allemagne.

[AI4] I.M. Bilasco - Metadata roles within CAM4HOME, ITEA2-CELTIC Joint Workshop, Juin 2009, Paris, France.

2.4 Articles in proceedings of international conferences with reviewing committee - ACI (27)

[ACI1] P. Falez; P. Tirilly; I. M. Bilasco; Ph Devienne; P. Boulet - Multi-layered Spiking Neural Network with Target Timestamp Threshold Adaptation and STDP - Proc. Int'l Joint Conf. on Neural Networks (IJCNN), Jul. 2019, Budapest, Hungary (Core2018 Rank A).

[ACI2] R. Belmonte; P. Tirrily; I.M. Bilasco; C. Djeraba; N. Ihaddadenne - Video-based face aligned with local motion modeling - Proc. Int'l Winter Conf. on Applications of Computer Vision, Jan. 2019, Hawaii

[ACI3] D. Poux; B. Allaert; J. Mennesson; N. Ihaddadene; I.M. Bilasco; C. Djeraba - Mastering occlusions by using intelligent facial frameworks based on the propagation of movement - Proc. Int'l Conf. on Content-Based Multimedia Indexing (CBMI), Sept. 2018, La Rochelle, France **(best papers session)**.

[ACI4] C. Arslan; I.M. Bilasco; J. Martinet- Dynamic index finger gesture video dataset for mobile interaction - Proc. Int'l Conf. on Content-Based Multimedia Indexing (CBMI), Sept. 2018, La Rochelle, France.

[ACI5] P. Falez; P. Tirilly; I. M. Bilasco; Ph Devienne; P. Boulet - Mastering the output frequency in spiking neural networks - Proc. Int'l Joint Conf. on Neural Networks (IJCNN), Jul. 2018, Rio de Janeiro, Brazil (Core2018 Rank A).

[ACI6] C. Arslan, F. Berthaut, J. Martinet, I.M. Bilasco, L. Grisoni - The Phone with the flow: combining touch + optical flow in mobile instruments - Proc. Int'l Conf. on New interfaces for musical expression (NIME), Juin 2018, Blacksburg, VA, United States.

[ACI7] R. Belmonte; N. Ihaddadenne; P. Tirrily; I.M. Bilasco; C. Djeraba - Towards spatio-temporal face alignment in unconstrained conditions - Proc. Int'l Joint Conf. on Computer Vision, Imaging and Computer Graphics Theory and Applications VISAPP 2018, Funchal, Portugal, pp. 433-438.

[ACI8] B. Allaert; I.M. Bilasco; C. Djeraba - Consistent optical flow maps for full and micro facial expression recognition - Proc. Int'l Joint Conf. on Computer Vision, Imaging and Computer Graphics Theory and Applications VISAPP 2017, Porto, Portugal, vol. 5, pp. 235-242.

[ACI9] J. Mennesson; A. Dahmane; T. Danisman; I.M. Bilasco - Head yaw estimation using frontal face detector - Proc. Int'l Joint Conf. on Computer Vision, Imaging and Computer Graphics Theory and Applications VISAPP 2016, Portugal, vol. 4, pp. 517-524.

[ACI10] A. Aissaoui; A. Dahmane; J. Martinet; I.M. Bilasco - Introducing FoxFaces: a 3-in-1 head dataset - Proc. Int'l Joint Conf. on Computer Vision, Imaging and Computer Graphics Theory and Applications VISAPP 2016, Porto, Portugal, vol. 4, pp. 533-537.

[ACI11] J. Mennesson; B. Allaert; I.M. Bilasco; N. Van Der Aa; A. Denis; S. Cruz-Lara - Faces and thoughts: an empathic dairy - Proc. IEEE Int'l Conf. on Automatic Face and Gesture Recognition 2015, Ljubljana, Slovenia, pp. 1-1.

[ACI12] A. Lablack; T. Danisman; I.M. Bilasco; C. Djeraba - A local approach for negative emotion detection - Proc. Int'l Conf. on Pattern Recognition 2014, Stockholm, Sweden, pp. 417-420.

[ACI13] T. Danisman; I.M. Bilasco; C. Djeraba - Cross-database evaluation of normalized raw pixels for gender recognition under unconstrained settings - Proc. Int'l Conf. on Pattern Recognition 2014, Stockholm, Sweden, pp. 3144-3149.

[ACI14] M.Y. Kazi Tani; A. Ghomari; H. Belhadef; A. Lablack; I.M. Bilasco - An ontology-based approach for inferring multiple object events in surveillance domain - Proc. Int'l Conf. on Science and Information, 2014, London, United Kingdom, pp. 404-409.

[ACI15] O. Hadjerci; A. Lablack; I.M. Bilasco; C. Djeraba - Affect recognition using magnitude models of motion - Proc. Int'l Conf. on MultiMedia Modelling 2014, Dublin, Ireland, LNCS 8362, pp. 339-344 (présentation poster).

[ACI16] A. Dahmane; S. Larabi; C. Djeraba; I.M. Bilasco - Learning symmetrical model for head pose estimation - Proc. 21st Int'l Conf. on Pattern Recognition, Nov 2012, Tsukuba, Japan. pp. 3614-3617 (présentation poster).

[ACI17] S. Amir; Y. Benabbas; I.M. Bilasco; C. Djeraba - MuMIe : a new system for multimedia metadata interoperability - Proc. 1st ACM Int'l Conf. on Multimedia Retrieval 2011, Trento, Italy (8 pages, http://dl.acm.org/citation.cfm-id=1991997).

[ACI18] S. Amir; I.M. Bilasco; T. Danisman; I. El Sayad; C. Djeraba - Multimedia metadata mapping : towards helping developers in their integration task - Proc. 8th Int'l Conf. on Advances in Mobile Computing and Multimedia (MoMM) 2010, Paris, Franc, pp. 205-212.

[ACI19] R. Auguste; A. El Ghini; I.M. Bilasco; N. Ihaddadene; C. Djeraba - Motion similarity measure between video sequences using multivariate time series modeling - Proc. Int'l Conf. on Machine and Web Intelligence (ICMWI), 2010, Algiers, Algeria, pp. 292-296.

[ACI20] T. Danisman; I.M. Bilasco; C. Djeraba; N. Ihaddadene - Drowsy driver detection system using eye blink patterns - Proc. Int'l Conf. on Machine and Web Intelligence (ICMWI) 2010, Algiers, Algeria, pp. 230-233.

[ACI21] S. Amir; I.M. Bilasco; T. Danisman; T. Urruty; I. El Sayad; C. Djeraba - Schema matching for integrating multimedia metadata - Proc. Int'l Conf. on Machine and Web Intelligence (ICMWI) 2010, Algiers, Algeria, pp. 234-239.

[ACI22] S. Amir; I.M. Bilasco; T. Danisman; T. Urruty; C. Djeraba - Semi-automatic multimedia metadata integration - Proc. Conf. EKAW 2010 Poster and Demo Track 2010, Lisboa, Portugal, ISSN 1613-0073, Vol 674 (présentation poster - http://ceur-ws.org/Vol-674/Paper94.pdf).

[ACI23] T. Danisman; I.M. Bilasco; C. Djeraba; N. Ihaddadene - Automatic facial feature detection for facial expression recognition - Proc. Int'l Joint Conf. on Computer Vision, Imaging and Computer Graphics Theory and Applications VISAPP 2010, Angers, France, pp. 407-412.

[ACI24] H. Zhang; H. Nguyen; I.M. Bilasco : L.M. Gyu; H. Wang - IPTV 2.0 from triple play to social TV - Proc. IEEE Int'l Symposium on Broadband Multimedia Systems and Broadcasting (BMSB) 2010, Shanghai, China, pp.1-5.

[ACI25] I.M. Bilasco; S. Amir; P. Blandin; C. Djeraba; J. Laitakari; J. Martinet; E. Martinez Gracia; D. Pakkala; M. Rautiainen; M. Ylianttila; J. Zhou - Semantics for intelligent delivery of multimedia content - Proc. Int'l Symposium On Applied Computing 2010, Sierre, Suisse, pp. 1366-1372.

[ACI26] S. Amir; I.M. Bilasco; C. Djeraba - A semantic approach to metadata management in sensor systems - Proc. Int'l Conf. Cognitive systems with interactive sensors (COGIS) 2009, Paris, France, pp. 112-119.

[ACI27] I.M. Bilasco; R. Lozano Espinosa; H. Martin - In-situ quantification of 3D scene complexity - Proc. Int'l Conf. on Advanced Geographic Information Systems and Web Services 2009, Cancun, Mexico, pp. 34-39.

2.5 Articles in proceedings of international workshops with reviewing committee - AWI (6)

[AWI1] B. Allaert; J. Mennesson; I.M. Bilasco - EmoGame: Towards a self-rewarding methodology for capturing children Faces in an engaging context - Proc. 7th Int'l Workshop, HBU 2016 at ACMMM 2016 , Oct 2016, Amsterdam, Netherlands. 2016, pp 3-14.

[AWI2] T. Danisman; J. Martinet; I.M. Bilasco - Pruning near-duplicate images for mobile landmark identification: A graph theoretical approach - Proc. 13th Int'l Workshop on Content-Based Multimedia Indexing, CBMI 2015, Prague, République Tchèque, pp 1-4.

[AWI3] M.Y. Kazi Tani; A. Lablack; G. Abdelghani; I.M. Bilasco - Events detection using a video-surveillance Ontology and a rule-based approach - CONTACT Workshop in European Conf. on Computer Vision 2014, Zurich, Suisse, pp. 299-308.

[AWI4] I.M. Bilasco; A. Lablack; A. Dahmane; T. Danisman - Analysing user visual implicit feedback in enhanced TV scenarios - in Spontaneous Facial Behavior Analysis Workshop European Conf. on Computer Vision 2014, Zurich, Suisse, pp. 315-324.

[AWI5] L. Ballihi; A. Lablack; B. Ben Amor; I.M. Bilasco; M. Daoudi - Positive/negative emotion detection from RGB-D upper body images - 1st Int'l Workshop on Face and Facial Expression Recognition from Real World Videos (FFER) in Int'l Conf. on Pattern Recognition 2014, Stockholm, Sweden, pp. 109-120.

[AWI6] I.M. Bilasco; A. Lablack; T. Danisman - Data analysis of TV Shows viewers - 1st Workshop on Empathic Television Experiences (EmpaTeX 2014) in ACM Int'l Conf. on Interactive Experiences for Television and Online Video, June 2014, Newcastle-upon-Tyre, United Kingdom (présentation orale uniquement, sans actes).

2.6 Articles in proceedings of national conference with reviewing committee - ACN (12)

[ACN1] D. Poux ; B. Allaert ; N. Ihaddadene; I.M. Bilasco ; C. Djeraba - Étude de l'apport de la reconstruction des régions occultées du visage pour la reconnaissance des expressions - COmpression et REprésentation des Signaux Audiovisuels (CORESA) 2018 (3 pages, actes en-ligne).

[ACN2] R. Belmonte; N. Ihaddadene; P. Tirilly; I.M. Bilasco; C. Djeraba - Vers un alignement spatio-temporel du visage en conditions non contrôlées - COmpression et REprésentation des Signaux Audiovisuels (CORESA) 2017 (6 pages, actes en-ligne).

[ACN3] P. Falez; Ph. Devienne; P. Tirilly; I.M. Bilasco; C. Loyez; I. Sourikopoulos; P. Boulet - Flexible simulation for neuromorphic circuit design: motion detection case study - Actes de Conférence d'informatique en Parallélisme, Architecture et Système (ComPAS), Juin 2017, Sophia Antipolis, France (6 pages, actes en-ligne).

[ACN4] J. Mennesson; I.M. Bilasco; B. Allaert - Fast head turns detection in low quality videos using optical flow - Actes de Reconnaissance des Formes et l'Intelligence Artificielle (RFIA), Jun 2016, Clermont-Ferrand, France (2 pages, actes en-ligne).

[ACN5] B. Allaert; J. Mennesson; I.M. Bilasco; C. Djeraba - Etude de la dynamique du visage en situation d'interaction naturelle - Actes de COmpression et REprésentation des Signaux Audiovisuels (CORESA) 2016, May 2016, Nancy, France (6 pages, actes en-ligne) (**meilleur papier - 2e place**).

[ACN6] B. Allaert; I.M. Bilasco; A. Lablack - Vers une reconnaissance d'état affectif à base de mouvements du haut du corps et du visage - Colloque National Compression et Représentation des Signaux Audiovisuels (CORESA), Nov 2014, Reims, France (6 pages, actes en-ligne, présentation poster).

[ACN7] W. Adaidi; A. Lablack; I.M. Bilasco - Caractérisation locale des changements de texture pour la reconnaissance d'expressions faciales spontanées - Actes de Colloque National Compression et Représentation des Signaux Audiovisuels (CORESA), Nov 2014, Reims, France (6 pages, actes en-ligne, présentation poster).

[ACN8] T. Danisman; I.M. Bilasco; J. Martinet; C. Djeraba - Construction de masques faciaux pour améliorer la reconnaissance d'expressions - Actes de COmpression et REpresentation des Signaux Audiovisuels, May 2012, Lille, France (6 pages, actes en-ligne, présentation poster).

[ACN9] A. Dahmane; S. Larabi; I.M. Bilasco; C. Djeraba - Estimation discrète de l'angle pan de la tête - Actes de COmpression et REprésentation des Signaux Audiovisuels (CORESA), May 2012, Lille, France (6 pages, actes en-ligne, présentation poster).

[ACN10] S. Amir; I.M. Bilasco; T. Urruty; C. Djeraba - Vers une interopérabilité multi-niveaux des métadonnées - Actes INFORSID 2011, May 2011, Lille, France (16 pages, actes en-ligne).

[ACN11] S. Amir; I.M. Bilasco : T. Urruty; C. Djeraba - MuMIE : Une approche automatique pour l'interopérabilité des métadonnées - Actes Extraction et Gestion des Connaissances (EGC) 2011, Jan 2011, Brest, France, pp. 347-352.

[ACN12] R. Auguste; A. El Ghini; I.M. Bilasco; C. Djeraba - Prédiction de séries temporelles et applications à l'analyse de séquences vidéos - Actes Extraction et Gestion des Connaissances (EGC) 2011, Jan 2011, Brest, France, pp. 713-714.

[ACN13] Md.H. Sharif; H. Alustwani; I.M. Bilasco; C. Djeraba - Détection des mouvements anormaux dans des vidéos - Actes Extraction et Gestion des Connaissances (EGC) 2011, Jan 2011, Brest, France, pp. 699-700.

2.7 Book chapters - BC (3)

[BC1] S. Amir; I.M. Bilasco; Md.H. Sharif; C. Djeraba - Towards a unified multimedia metadata management solution - Intelligent Multimedia Databases and Information Retrieval: Advancing Applications and Technologies (Ma, Zongmin), IGI Global, 2012, pp. 170-194.

[BC2] S. Amir; I.M. Bilasco; T. Urruty; J. Martinet; C. Djeraba - Designing intelligent content delivery frameworks using MPEG-21 - The Handbook of MPEG Applications: Standards in Practice (Agius, Harry and Angelides, Marios), John Wiley and Sons Ltd, 2010, ch. 19, pp. 455-476.

[CH1] I.M. Bilasco; J. Gensel; H. Martin; M. Villanova-Oliver - Indexing three dimensional scenes. - Encyclopedia of Multimedia, Springer, 2008, pp.346-352.

2.8 Pre-prints (5)

[PP1] B. Allaert; I.M. Bilasco; C. Djeraba - Advanced local motion patterns for macro and micro facial expression recognition - Computing Research Repository (CoRR), https://arxiv.org/abs/1805.01951.

[PP2] B. Allaert; I.M. Bilasco; C. Djeraba; Z. Zhang - Fully-connected neural networks and local motion patterns for micro and macro facial expression recognition.

[PP3] R. Belmonte; B. Allaert; P. Tirilly; I.M. Bilasco - Study of the impact of face alignment on subsequent face analysis tasks in presence of head movements.

[PP4] B. Allaert; I.M. Bilasco - Towards an adaptation of optical flow methods for facial expression analysis.

2.9 Databases and annotations - DBA (6)

Databases (3)

[DBA1] **Fox Faces Database** This collection contains images of faces captured in the laboratory with different poses of the head, illumination conditions, facial expressions, acquisition modalities (duration-of-flight or time-of-flight camera, stereoscopic camera and Kinect). The collection contains 2624 images and 64 distinct people. The provision of a synchronous capture between different acquisition methods makes it possible to identify the way in which the modalities considered make it possible to best meet the challenges posed in the context of capture (pose, expressions, illumination). These corpora have been presented in [ACI10].

[DBA2] **Web Gender Database** This collection contains images of male and female faces. The images were obtained by querying the Web search engines with terms related to each sex in different languages (French, English, German, Chinese, Turkish ...), and filtered by a face detector (Viola-Jones), then manually. The collection contains 4700 images. We designed this corpus in order to test the genericity capacity of classifiers learned especially in an inter-corpus validation context. The variety of capturing conditions and subjects allowed us to converge towards robust classifiers. This corpus was used in the inter-corpus experiments concerning the gender recognition reported in [ACI13] and [AJI5].

[DBA3] **Synchronous Natural and Posed 2D Facial Expressions (SNaP-2DFE)** This collection contains sequences of images recorded simultaneously by two cameras reflecting different usage conditions. The first camera is attached to a helmet that follows the natural movements of the head. The second camera is fixed in front of the person. The camera attached to the headset continuously records the face in front pose, while the front camera records images with head variations and wide movements. The *SNaP-2DFE* collection measures the impact of head movements on the recognition of facial expressions. The collection contains 1260 sequences recorded using 15 volunteers simultaneously performing expressions and movements of the head. Each volunteer was recorded following six types of movements (3 rotations, 2 translations and a fixed pose) by reproducing for each movement seven expressions (anger, disgust, nervousness, joy, neutral, fear, surprise, sadness). This corpus was used in [AJI2] to study the impact of face normalization methods on expression recognition by comparing the measured performance on the front camera, compared to the camera attached to the helmet. It has also been used in [ACI2] and [PP3] to study the impact of head pose variations on face alignment methods.

Annotation sets (3)

[DBA4] **Eye Center Annotations** This corpus provide manual annotations of the center of the eye positions for faces in the *Caltech Faces* collection (Weber 1999) and in the *Youtube Faces* collection (Wolf et al. 2011). The number of annotated images in the two collections is 450, respectively 5000. These annotations were used to estimate the head pose, and in particular the roll, as part of the work published in [AJ4]. We wanted to show the genericity of our approach on a large number of corpora of images.

[DBA5] **Gender LFW Pro Annotations** This corpus provide manual annotations to categorize the *LFW Pro* (Huang et al. 2007) face image collection by topic genre. The annotations concern 7895 images. These annotations serve to have a wide range of images that validates the approaches of characterization of the genus in an inter-corpus context proposed in [ACI13] and [AJI5] .

[DBA6] **GENKI4K Gender-Emotion Annotations** This corpus provide manual annotations to categorize the *GENKI-4K* (MPLab 2011) face image collection by subject's genre and facial expressions. The annotations concern 4000 images of the corpus. As in the case of the *Gender LFW Pro* annotation corpus, we wanted to make new data available to the community for gender recognition. Having rich and varied corpora makes it possible to implement learning processes with a high degree of genericity. These annotations were used in [ACI13] and [AJI5] to validate gender recognition in an inter-corpus context.

More details on these data and annotations corpora are available at the following address: http://www.cristal.univ-lille.fr/FOX/index.php?page=datasets

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