

ICDSC 2015

9th International Conference on
Distributed Smart Cameras

September 8-11, 2015
Seville, SPAIN

Sponsored by



in cooperation with ACM/SIGBED



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Welcome to ICDSC 2015

This year's edition of ICDSC welcomes you to Seville, Spain. We would like to thank you for your participation in the Conference. If you have authored one of the papers in the program, we would like to congratulate you and your colleagues and recognize the valuable contribution that you have realized to this event.

The main objective of the Conference is fostering collaboration and the exchange of ideas in our multidisciplinary community. For this, a program containing the most recent results on distributed smart cameras and their many application fields is the perfect agenda. We would like to thank the Technical Program Committee and its Chairs for their extraordinary work. This is going to be an exciting opportunity to listen to and discuss with experts in different areas, from integrated sensors design to embedded systems and to application development.

The program is complemented by live demonstrations, a panel for discussing opportunities in this field and the appreciated contribution of the three Keynote Speakers, to whom we are grateful.

We would like to recognize and acknowledge the support of our sponsors: the University of Seville and the Institute of Microelectronics of Seville-CNM (CSIC), as well as the cooperation of the ACM/SIGBED.

Finally many thanks to the members of the organizing committee whose support has made ICDSC 2015 a reality.

We hope that your participation in this year's conference is an enriching experience. We look forward to meeting you during the conference, and we also hope that you find time in your schedule to join the social program and visit the many interesting places that you can find in Seville.

**September 2015
Seville, Spain**

**ICDSC 2015
General Chairs**
Ricardo Carmona-Galán
Ángel Rodríguez-Vázquez

Welcome message from the TPC Chairs

Welcome to the 9th edition of the International Conference on Distributed Smart Cameras, held in Seville (Spain) in cooperation with ACM/SIGBED, the Special Interest Group on Embedded Systems of the Association of Computing Machinery. A total of 38 regular submissions from 19 different countries were received this year, distributed among 6 multidisciplinary subject areas: "Smart Image Sensors and Vision Chips", "Emerging Applications and Case Studies", "Smart Camera and Network Architectures", "Mobile Vision", "Distributed Computer Vision" and "Visual Sensor Networks". These submissions underwent a thorough double-blind review process, each being reviewed by at least two members of the Technical Program Committee matching their subject areas. According to the review scores, 26 papers were selected for oral presentation, grouped into 5 Regular Sessions plus 1 Special Session on "Design of Embedded Vision Systems on FPGAs". 6 papers were also selected to make up a Poster Session. The regular program was completed by 8 Demos and 3 Ph.D. Forum papers that were respectively reviewed by the Demo and Ph.D. Forum Chairs. All the papers composing this program have been published in the ACM Digital Library.

We would first like to thank all the authors for their contributions. They have allowed us to arrange for a high-quality technical program. We are also deeply grateful to the members of the Technical Program Committee for their timely and accurate reviews. Special thanks to the members of the Steering Committee that consensually decided about the Best Paper Award among the Top 4 Regular Submissions in terms of review scores. Finally, we would like to thank the General Chair of this year's edition, Prof. Ricardo Carmona, for his guidance and support during the whole process of bringing the technical program into existence.

We hope you will be able to make the most of this exciting conference while enjoying the many charming corners Seville has to offer.

September 2015
Seville, Spain

ICDSC 2015
Technical Program Committee Chairs
Jorge Fernández-Berni
François Berry
Christian Micheloni

About IMSE (CSIC-University of Seville)

The Institute of Microelectronics of Seville (IMSE-CNM) is an R+D center integrated by members of the Spanish Council for Scientific Research (CSIC) and the University of Seville. It is one of the three institutes, together with the centers in Madrid and Barcelona, incorporating the National Center for Microelectronics (CNM). The Institute is mainly dedicated to the design of analog, digital and mixed-signal CMOS integrated circuits

The IMSE-CNM started its operations in October 1989, as an agreement of the Andalusian Regional Government, CSIC and the University of Seville. The initial research activities were based on the premises of the Scientific Computing Center of Andalucía (CICA). The IMSE was a subsidiary department of the Institute of Microelectronics of Barcelona (IMB-CNM). Later, in 1996, it was established as an autonomous research laboratory of the CSIC network. In 2008, the Institute was relocated to new premises at the Sci+Tech Park of La Cartuja, in Seville.

The IMSE staff is composed of 100 people, approximately, which include university and research professors, scientists and support technicians. They are involved in the advancement of scientific knowledge and design of high-level technical solutions. They participate in an active technology transfer, with more than 20 patents in their portfolio. They take part in official higher-education programs at the University of Seville, through different degrees in engineering and physical sciences and master and PhD studies.

Scientists at IMSE participate in different projects, funded by EU, Spanish and regional R+D programs. They are focused on implementing innovative concepts in silicon, using either the CNM's own technology, developed at IMB-CNM, or external foundries, contracted through Europractice or CMP services. The Institute also participates in technology and knowledge transfer activities with microelectronics companies, in the form of research contracts, training courses and technical consulting.

Overview of ICDSC 2015

Smart camera networks are becoming a fundamental piece of our intelligent cities, buildings and homes, progressively inserting themselves in our lives. From smart surveillance systems composed of a multitude of smart camera nodes to small wearable cameras able to render a visual log of our daily experience. These devices interact with each other and with a wealth of other smart stuff, and of course the internet. This rapid development is being possible thanks to the convergence of several technologies. From advanced image sensors and vision chips to embedded vision systems capable of efficient feature extraction, image encoding and wireless transmission of the relevant visual content. This opens the door to new application domains, where video analytics and the extraction of semantic information from the scene is performed in a distributed fashion, implementing a new type of cooperative and/or collaborative vision, and even fusing visual information with other sensory data.

The International Conference on Distributed Smart Cameras (ICDSC) was held for the first time in September 2007 in Vienna, co-sponsored by the ACM and the IEEE. It was organized by Klagenfurt University, chaired by Prof. Bernhard Rinner and Prof. Wayne Wolf. Technical Program Co-Chairs were Hamid Aghajan from Stanford University and Richard Kleihorst from NXP. The aim of this conference was, in their words, "to provide an opportunity for researchers working in the areas of smart camera architectures, algorithm design, embedded vision-based processing, and smart environments to exchange their most recent results".

The second edition of ICDSC was held in September 2008 in Stanford, California (USA). Chaired by Hamid Aghajan, the CFP insisted in that "distributed smart cameras combine techniques from computer vision, distributed processing, sensor networks, and embedded computing". This represents a multidisciplinary effort that is not properly addressed at existing forums because it requires "a change of paradigm in the processing methodologies, thus creating opportunities for designing distributed and collaborative vision-based techniques. As a result, novel smart environment applications can be enabled that are interpretive, context aware, and user centric in nature."

What we are facing here is the consolidation of a community that is composed of experts in different fields, i. e. computer vision, embedded systems, image sensor chips, sensor networks. All of these experts have different but overlapping backgrounds, and they are finding ways to collaborate and create what can be new wealth of embedded vision devices, opening the gate to new applications and services.

The 3rd edition was held in Como, Italy in 2009, the 4th in Atlanta, Georgia (USA), in 2010. The 5th was held in Ghent, Belgium, in 2011. The 6th in Hong Kong, 2012. The 7th in Palm Springs, California (USA), 2013. And last year, 2014, in Venice (Italy), organized by Andrea Prati from the University IUAV of Venice. A commitment to "resource management and task allocation,

embedding video analytics into low power devices, organizing the sensor network, efficient video communication, edge/cloud computing, distributed analysis, etc.” was demanded at the call for paper.

The International Conference on Distributed Smart Cameras (ICDSC) is thus the appropriate forum to discuss recent advances and open issues in these topics. After the previous successful events, this year ICDSC is held in Seville, Spain —sponsored by the University of Seville and the Spanish Council for Scientific Research (CSIC), in cooperation with ACM/SIGBED, the Special Interest Group on Embedded Systems of the ACM.

The Conference scope is defined by the following topics:

Smart image sensors and vision chips Emerging apps and case studies

- Circuits and systems for image sensing
- Parallel processing hardware
- Hardware/software co-design for embedded vision
- Reconfigurable vision processing architectures
- High-performance image sensors
- Vision-based smart environments
- Surveillance and tracking applications
- Distributed multimedia and gaming applications
- Position discovery and middleware applications
- Context-aware networks
- Sports

Smart camera and network arch.

- Camera system designs and architectures
- Image sensing/processing for smart cameras
- Architectures for camera networks
- Embedded vision programming
- Distributed video coding

Mobile Vision

- Crowdsourcing
- Sensing for mixed/augmented reality
- Structure-from-motion in mobile devices
- Visual landmark localization
- Object recognition
- Egovision

Distributed computer vision

- Distributed video analytics
- Resource management and task allocation
- Multi-sensor data aggregation
- Collaborative extraction, information fusion
- Edge and cloud computing

Visual sensor networks

- Active vision
- Self-reconfiguring camera networks
- Wireless and mobile image sensor networks
- Topology discovery
- Social media and big data

Committees

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Ángel Rodríguez-Vázquez

Instituto de Microelectrónica de Sevilla
IMSE-CNM (CSIC-Universidad de Sevilla), Spain

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Keynote Speakers

Wednesday, September 9

Smart image sensors: new paradigms or back to old concepts?

Antoine Dupret, CEA-LETI, Grenoble (France)



Abstract: There was less than one decade between Carver Mead's electronic retina (the early 1980s') and Eric Fossum's Active Pixel CMOS imager. Within the next decade the CMOS image sensors have gained a dominant position in imager's market by replacing CCDs in almost any application. Since that time, the design of image sensor has been driven by the demand for, first of all, pixel density for Digital Still Camera, and secondly for better images. To keep on the race towards ever smaller pixels and with lower noise, many recent market-oriented works emphasis on new pixel structures or 3D IC stacking, even if recently new functionalities such as 3D image sensors emerge. On the opposite the concept of electronic retina seems to have failed to find a commercial success. Yet, one of the very first

CMOS optoelectronics circuits was Lyon's optical mouse. Lyon pioneer's works has settled some of the fundamental aspects of design methodologies for smart image sensors, i.e. use of very simple, not to say conservative devices, mixing analog and digital circuits, facing the challenge of their implementation in the reduced area devoted to the processing elements. The conflicting requirements in image acquisition lead to explore novel optoelectronic sensors, and to revisit the concept of smart image sensor, for instance by considering the implementation of recent progresses in the domains of signal processing and of micro-optical devices.

Dr. Antoine Dupret graduated in electrical engineering from the Ecole Normale Supérieure de Cachan, France. He received the D.E.A. (Master degree), PhD, and the "Habilitation à Diriger les Recherches" degrees from the Université de Paris Sud 11 in 1991, 1995, and 2004 respectively, all three in electrical engineering. In 1996, he held an assistant professor position with the Université de Paris 13, and was researcher at Institut d'Electronique Fondamentale (IEF), Université de Paris Sud 11-CNRS, France. His works were about smart image sensors and compact model based sensor/processing co-design for MEMS. In 2009, he held a full professor position at ESIEE Engineering, in Noisy-le-Grand, France. He joined CEA-LETI in 2010 where he is senior expert in Image sensors. His current interests are in vision circuits (heterogeneous image sensors; silicon retinas) and opto-electronics. He has successfully leaded, and is currently leading, several projects related to smart

image sensors and heterogeneous integrated systems design. His projects have been funded by French public research agencies (ANR, DGA...), and by industrial partners. He is author or co-author of over 80 papers in International Conferences and Journals. He served as a program chair of several international Workshops.

Thursday, September 10

Embedded Video and Fusion Analytics Solutions for a Global Intelligent Lighting Platform

Csaba Rekeczky, Eutecus Inc. Berkeley, CA (USA)



Abstract: Eutecus, Inc. has been developing video analytics systems for many years. Based on our [Multi-channel Video Analytics Engine \(MVE™\)](#), these systems make use of real-time video-based algorithms that have the ability to understand essential information in the scene. Currently, we are incorporating such miniature cameras and credit card-sized video processors into Solid State Lighting (SSL) systems to support the Intelligent City initiative. Primary goals of these Intelligent Lighting Systems (ILS) are to provide intelligent controls that will enable significant reduction in our national use of electricity as well as a means to enhance global safety and security by providing non-conventional surveillance and filtered event-based information to law enforcement agencies and municipalities. It is estimated that thirty

billion lights exist around the world. Imagine light fixtures (i.e., luminaries) which not only maximize lighting efficiency locally but connect with other similar devices globally to make efficient use of energy and share information to those who use and need it. By 2050, fifty billion such connected devices (e.g., lights, refrigerators, thermostats, turbine engines, full cities) are expected to exist (source: Cisco, CCS 2013) and the penetration of such connected things is expected to grow from 0.6% in 2012 to 2.7% by 2020. When one considers the sheer volume of data produced by such devices, especially accounting for the rapid growth of high-definition video sensors, the numbers become staggering and it is clear that the Cloud will not have the required bandwidth to support this volume of data. With their technology partners, Eutecus has realized that only the most relevant data be produced at the luminaire before being transmitted to the Cloud as a means to control bandwidth requirements; we have made significant progress to date and more is required. Also as a means to help safeguard our privacy, our products do not stream personal information to the Cloud but restrict such information to details of events (time, location, type of event, etc.) which have occurred and were detected by our video analytic methods. Typically, such information relates to counting vehicles, pedestrians, available parking spaces, traffic violations and other safety-related events. When part of an ILS system, Eutecus' ReCo™ family of miniature video analytic camera/processor systems ([ReCo™-Duo](#) dual-camera and [ReCo™-Pro](#) four-camera) video analytic systems add significant value and functionality.

Dr. Csaba Rebeczky contributed over a decade to the research, innovation and design of massively parallel algorithms and cellular multi-core architectures for various application areas ranging from medical imaging to surveillance and reconnaissance, then went on to transition and commercialize technology achievements in start-up and spin-off company arrangements. He received the M.S. degree in electrical engineering from the Technical University of Budapest in 1993. After graduation he joined the Neuromorphic Information Technology interdisciplinary postgraduate program and continued his studies at the Analogical and Neural Computing Systems Laboratory of the Computer and Automation Institute of the Hungarian Academy of Sciences. As part of his PhD studies, in 1994 and 1995, he spent a year at the Tokushima University (Tokushima, Japan) as a visiting scholar working on research projects focusing on the application of cellular neural network based computing to medical image processing. In 1997 and 1998 he conducted research in nonlinear image processing and neuromorphic modeling of the vertebrate retina at the University of California at Berkeley (Berkeley, USA). He received the PhD degree in electrical engineering from the Budapest University of Technology and Economics in 1999, and spent a post-doctoral research period at UCB during 2000. Along with his co-authors, he won the Best Paper Award for a contribution published in International Journal of Circuit Theory and Its Applications in 2000. In 2001 and 2002 he served as one of the Associate Editors for IEEE TCAS-I. Several years later, he also served as an Associate Editor of the International Journal of Circuit Theory and Applications (2010). In 2000 he co-founded AnaLogic Computers Ltd. in the EU, then in 2003 Eutecus, Inc. in the US, and in recent years played a major role in transitioning a cellular nonlinear network based multi/many-core processor and an associated massively parallel algorithmic design technology from the academic environment to the industry. Currently he serves as CEO and President of Eutecus, Inc., a high-tech US Silicon Valley company with an EU subsidiary developing products and services at the fore front of multi-core video and fusion analytics technology. He is currently on leave from his Associate Professor position at PPCU, but maintaining a very active collaboration with and supervising several graduate students through the Virtual Video Analytics Laboratory, recently established by PPCU and Eutecus, to promote engineering research in the quickly emerging technical and business segment of Advanced Driver Assistance Systems.

Friday, September 11

Use of Distributed Smart Cameras for research in ecology: the case of the lesser kestrel

Javier Bustamante, Doñana Biological Station EBD-CSIC, Seville (Spain)



Abstract: Much research in ecology is based on direct observation of animal, plants or natural processes. But observing nature is not easy. For example, animals are shy and the observer frequently interferes with the behavior of the animal he tries to study. In this situation, cameras can be of great help. I will introduce a research project on an endangered species, the Lesser Kestrel (*Falco Naumanni*), a small falcon of

colonial habits, for which we have been using Information and Communication Technologies (ICT) for the long-term record of behavioral and population dynamics parameters at a breeding colony. The lesser kestrel is an insectivorous species breeding in colonies. It used to be very abundant in agricultural landscapes around the Mediterranean. In the 60's and 70's of the XXth century it suffered a marked decline associated with agricultural intensification and the abandonment of marginal agriculture. The species disappeared in many European countries and declined in Spain. Currently is considered an endangered species. At Doñana Biological Station we have been studying the ecology of the species since the 1980's. In 2006 we started a research project named HORUS with the aim of using sensor networks to study breeding behavior and the long-term dynamics of the species at a breeding colony. We have developed a "smart nest-box" equipped with sensors that collects information on the kestrels breeding inside. We have implemented RFID (radio-frequency identification) tags that are read by an antenna when kestrels enter the nest-box, IR barriers that record movement direction, a balance that weights the individuals, temperature sensors, and video cameras. Each nest-box is controlled by an Arduino, and all nest-boxes are connected to a network and transmit data to a centralized database. A pilot system was installed at a building holding a grain elevator at La Palma del Condado, Huelva, Spain, where kestrels were nesting at the window sills. The kestrels accepted the smart nest-boxes hand have been using them to breed since 2009. The system is connected to the internet so it is possible have remote access to the cameras, the data that are collected, and to operate the system. The camera in the nest-box is programmed to record a single frame and a 10s video sequence with movement detection and all videos and photos are stored on-site. Researchers can access to the live streaming of a single camera, to a mosaic of all cameras, to photographic summaries of

images taken at specific times, or to all images recorded. I will show some of the results obtained in the project and discuss the new problems that working with cameras and images represent for us.

Dr. Javier Bustamante graduated and completed his PhD in Environmental Biology at the Universidad Autónoma de Madrid in 1988 and 1990, respectively. He held post-doctoral positions at the CSIRO Division of Wildlife and Ecology, in Canberra (Australia), Berchtesgaden National Park (Germany) and the Doñana Biological Station, where he is a staff Research Scientist since 1996. He is currently working in spatial ecology. His background is that of a field ornithologist, that has gradually moved more into mathematical models of species distributions, statistical analysis, geographical information systems and remote sensing. He started working in behavioral ecology of birds of prey (Parent-offspring conflict in kites, ospreys and kestrels was the subjects of his PhD thesis work). He did some research in penguin reproductive ecology --Chinstrap penguins-- in Antarctica, and then moved into species distribution modelling (SDM). The fact that environmental predictors in species distribution models were needed forced him to start working with GIS and remote sensing. He continues working with Lesser Kestrels (*Falco Naumanni*) in a long term research project. They are building an automatic monitoring system for a breeding colony in Andalusia using GPS-dataloggers, accelerometers and smart nest-boxes. He also does research in species distribution models in Spain and South America. He is interested in different aspects, but specially in building tools that can be used in species conservation, management, and conservation planning at different spatial scales. In remote sensing, he is particularly interested in the use of satellite images for time series analysis, to be able to reconstruct how natural systems work at large spatial scales. He currently works in a project on historical reconstruction of the flood dynamics of Doñana wetlands. He has been member of the Board of Directors of the Society for Conservation Biology - Europe Section and Associate Editor of the Journal of Applied Ecology.

Program at a Glance

Tuesday, September 8

9:30 - 10:40	Registration
10:40 - 11:00	Welcome & Opening Remarks
11:00 - 12:50	Oral Session 1: "Mobile and Embedded Vision"
13:00 - 14:30	Lunch Break
14:30 - 16:35	Oral session 2: "Tracking in Camera Networks"
16:35 - 16:55	Coffee Break
16:55- 18:15	Poster Session
20:00 - 21:30	Welcome cocktail

Wednesday, September 9

9:30 - 10:30	Keynote: A. Dupret
10:30 - 11:00	Coffee Break
11:00 - 12:50	Oral Session 3: "Camera-based Smart Environments"
13:00 - 14:30	Lunch Break
14:30 - 16:35	Special Session: "Design of Embedded Vision Systems on FPGAs"
16:35 - 16:55	Coffee Break
16:55- 18:15	Demo Session

Thursday, September 10

9:30 - 10:30	Keynote: Cs. Rekeczky
10:30 - 11:00	Coffee Break
11:00 - 12:50	Oral Session 4: "Distributed Vision"
13:00 - 14:30	Lunch Break
14:30 - 16:00	Panel
16:00 - 16:20	Coffee Break
16:20 - 17:30	PhD Forum
18:30 - 23:00	Guided visit and Gala Dinner

Friday, September 11

9:30 - 10:30	Keynote: J. Bustamante
10:30 - 11:00	Coffee Break
11:00 - 12:50	Oral Session 5: "Person Re-identification and Multi-Camera Pattern Recognition"
13:00 - 14:30	Lunch Break
14:30 - 14:45	Wrap-up Remarks

Session details

ORAL SESSION 1 - "Mobile and Embedded Vision"

Tuesday, September 8, 11:00-12:50

Chairman: François Berry, Institute Pascal

11:00-11:25

Low Complexity FPGA based Background Subtraction Technique for Thermal Imagery

Muhammad Imran, Mattias O'Nils, Huma Munir, Benny Thörnberg
Mid Sweden University

11:25-11:50

A Hybrid Pose Tracking Approach for Handheld Augmented Reality

Juan Li¹, Maarten Slembrouck², Francis Deboeverie^{3,4}, Ana Bernardos¹, Juan Besada¹, Peter Veelaert^{3,4}, Hamid Aghajan^{3,4,5}, Wilfried Philips², José Casar¹
¹ Technical University of Madrid, ² Ghent University, ³ IPI-TELIN, ⁴ iMinds, ⁵ Stanford University

11:50-12:15

On Filter Banks of Texture Features for Mobile Food Classification

Niki Martinel, Claudio Piciarelli, Christian Micheloni, Gian Luca Foresti
Università di Udine

12:15-12:40

Simulation Environment for a Vision-System-on-Chip with Integrated Processing

Peter Reichel, Jens Döge, Christoph Hoppe, Nico Peter
Fraunhofer IIS

ORAL SESSION 2 - "Tracking in Camera Networks"
Tuesday, September 8, 14:30-16:35
Chairwoman: Senem Velipasalar, Syracuse University

14:30-14:55

Reliable Multi-object Tracking Dealing with Occlusions for a Smart Camera

Aziz Dziri¹, Marc Duranton¹, Roland Chapuis²
¹CEA LIST, ²Institut PASCAL

14:55-15:20

Real-Time Multi-People Tracking by Greedy Likelihood Maximization

Nyan Bo Bo¹, Francis Deboeverie^{1,2}, Peter Veelaert^{1,2}, Wilfried Philips³
¹IPI-TELIN, ²Ghent University/iMinds, ³Ghent University

15:20-15:45

Using Dominant Sets for Data Association in Multi-Camera Tracking

Ahmed Kedir Hamid¹, Lakew Surafel Melaku¹, Marcello Pelillo¹, Andrea Prati²
¹University Ca' Foscari of Venice, ²Università IUAV di Venezia)

15:45-16:10

High Performance Multi-Camera Tracking Using Shapes-From-Silhouettes and Occlusion Removal

Maarten Slembrouck¹, Jorge Niño-Castañeda¹, Gianni Allebosch¹, Dimitri Van Cauwelaert¹, Peter Veelaert^{2,3}, Wilfried Philips¹
¹Ghent University, ²IPI-TELIN, ³Ghent University/iMinds

16:10-16:35

Distributed Multi Target Tracking in Camera Networks Using Sigma Point Information Filters

Shiva Kumar Kamhari Abbugari, Ramakrishnan K. R., Rathna G. N.
Indian Institute of Science

POSTER SESSION

Tuesday, September 8, 16:55-18:15

Chairman: Jorge Fernández-Berni, IMSE-CNM

Building Low-Cost Wireless Image Sensor Networks: From Single Camera to Multi-Camera System

Congduc Pham¹, Vincent Lecuire²

¹University of Pau, ²University of Lorraine

Robust and Reliable Step Counting by Mobile Phone Cameras

Koray Ozcan, Senem Velipasalar

Syracuse University

Power Consumption Analysis of a Wireless 1K-pixel Visual Sensor Node: to Compress or not?

Geert Braeckman¹, Jan Hanca¹, Richard Kleihorst², Adrian Munteanu¹

¹Vrije Universiteit Brussel, ²Ghent University

Efficient Foreground-Background Segmentation Using Local Features for Object Detection

Fabio Carrara, Giuseppe Amato, Fabrizio Falchi, Claudio Gennaro

ISTI-CNR

People Tracking with Multi-Camera System

Pedro Jorge, João Dias

Lisbon Polytechnic Institute

Compute-Efficient Eye State Detection: Algorithm, Dataset and Evaluations

Supriya Sathyanarayana¹, Ravi Kumar Satzoda², Suchitra Sathyanarayana², Srikanthan Thambipillai¹

¹Nanyang Technological University, ²University of California, San Diego

ORAL SESSION 3 - "Camera-based Smart Environments"
Wednesday, September 9, 11:00-12:50
Chairman: Alfredo Gardel-Vicente, Universidad de Alcalá

11:00-11:25

Detection of Visitors in Elderly Care Using a Low-resolution Visual Sensor Network

Mohamed Eldib¹, Francis Deboeverie^{2,3}, Dirk Van Haerenborgh¹, Hamid Aghajan^{2,3,4}, Wilfried Philips¹
¹ Ghent University, ² IPI-TELIN, ³ Ghent Univ./iMinds, ⁴ Stanford University

11:25-11:50

Video-based Activity Level Recognition for Assisted Living Using Motion Features

Sandipan Pal, Charith Abhayaratne
The University of Sheffield

11:50-12:15

Abnormal Work Cycle Detection Based on Dissimilarity Measurement of Trajectories

Xingzhe Xie¹, Dimitri Van Cauwelaer¹, Maarten Slembrouck¹, Karel Bauters¹, Johannes Cottyn¹, Dirk Van Haerenborgh¹, Hamid Aghajan^{2,3,4}, Peter Veelaert^{3,4}, Wilfried Philips¹
¹ Ghent University, ² IPI-TELIN, ³ Ghent Univ./iMinds, ⁴ Stanford University

12:15-12:40

Discriminative Poses for Early Recognition in Multi-Camera Networks

Scott Spurlock, Junjie Shan, Richard Souvenir
University of North Carolina, Charlotte

SPECIAL SESSION - "Design of Embedded Vision Systems on FPGAs"
Wednesday, September 9, 14:30-16:35
Chairwoman: Piedad Brox, IMSE-CNM

14:30-14:55

Parallel Image Gradient Extraction Core For FPGA-based Smart Cameras

Luca Maggiani¹, Cedric Bourrasset², François Berry², Jocelyn Sérot², Matteo Petracca¹, Claudio Salvadori¹, Paolo Pagano¹
¹ Scuola Superiore Sant'Anna, ² Institute Pascal UBP Clermont-Ferrand

14:55-15:20

The Advantages and Limitations of High Level Synthesis for FPGA Based Image Processing

Donald Bailey
Massey University

15:20-15:45

Accelerating FPGA-based Object Detection via a Visual Information Extraction Cascade

Christos Kyrkou, Theocharis Theocharides
University of Cyprus

15:45-16:10

A Passive RGBD Sensor for Accurate and Real-Time Depth Sensing Self-Contained into an FPGA

Stefano Mattoccia, Matteo Poggi
University of Bologna

16:10-16:35

A Novel Hybrid Architecture for Real-Time Omnidirectional Image Reconstruction

Selman Ergünay, Kerem Seyid, Vladan Popovic, Yusuf Leblebici
Ecole Polytechnique Federale de Lausanne, EPFL

DEMO SESSION

Wednesday, September 9, 16:55-18:15

Chairman: Juan A. Leñero-Bardallo, IMSE-CNM

The Eyes of Things Project

Noelia Vallez, Oscar Deniz, Jose Luis Espinosa-Aranda, Gloria Bueno, Daniel Aguado-Araujo (UCLM), Carlos Sanchez-Bueno
Universidad de Castilla-La Mancha

STC-CAMI, IR-Visual Based Smart Camera System

Muhammad Imran, Mattias O'Nils, Victor Kardeby, Huma Munir
Mid Sweden University

Open-Source and Flexible Framework for Visual Sensor Networks

Luca Bondi, Luca Baroffio, Matteo Cesana, Alessandro Redondi, Marco Tagliasacchi
Politecnico di Milano

Real-Time Distributed Video Coding Simulator for 1K-Pixel Visual Sensor

Jan Hanca, Nikos Deligiannis, Adrian Munteanu
Vrije Universiteit Brussel

A New 360-degree Immersive Game Controller

Juan Li¹, Bart Goossens², Maarten Slembrouch², Francis Deboeverie^{3,4}, Peter Veelaert^{3,4}, Hamid Aghajan^{3,4,5}, Wilfried Philips², Jose Casar¹
¹ Technical University of Madrid, ² Ghent University, ³ IPI-TELIN, ⁴ Ghent Univ./iMinds, ⁵ Stanford University

The Extended VSNSim for Hybrid Camera Systems

Michael Gruber, Melanie Schranz, Bernhard Rinner
Klagenfurt University

Quasar - a New Programming Framework for Real-Time Image/Video Processing on GPU and CPU

Bart Goossens¹, Jonas De Vylder², Simon Donn  ², Wilfried Philips¹
¹Ghent University, ²UGent/TELIN-IPI-iMinds

Mask and Maskless Face Classification System to Detect Breach Protocols in the Operating Room

Adrian Nieto, Manuel Mucientes, Victor Brea
University of Santiago de Compostela

ORAL SESSION 4 - "Distributed Vision"

Thursday, September 10, 11:00-12:50

Chairman: Richard Souvenir, University of North Caroline, Charlotte

11:00-11:25

Cooperative Features Extraction in Visual Sensor Networks: a Game-Theoretic Approach

Alessandro Redondi, Luca Baroffio, Matteo Cesana, Marco Tagliasacchi
Politecnico di Milano

11:25-11:50

A Camera Uncertainty Model for Collaborative Visual Sensor Network Applications

Christos Kyrkou, Eutixios Christoforou, Theocharis Theocharides, Christos Panayiotou, Marios Polycarpou
University of Cyprus

11:50-12:15

Distributed Adaptive Task Allocation for Energy Conservation in Camera Sensor Networks

Christos Kyrkou, Theocharis Theocharides, Christos Panayiotou, Marios Polycarpou
University of Cyprus

12:15-12:40

A Cost-Benefit Analysis of an Ad-Hoc Road Asset Data Collection System Using Fleet-Vehicles

Dana Pordel, Lars Petersson
Australian National University

PhD FORUM

Thursday, September 10, 16:20-17:30

Chairmen: Bart Goossens (Ghent University), Stefano Mattoccia (University of Bologna), Víctor Brea (University of Santiago de Compostela)

16:20-16:45

Mean Field Variational Inference Using Bregman ADMM for Distributed Camera Network

Behnam Babagholami-Mohamadabadi, Sejong Yoon, Vladimir Pavlovic
Rutgers University

16:45-17:05

Hardware-Oriented Feature Extraction Based on Compressive Sensing

Marco Trevisi, Ricardo Carmona-Galán, Ángel Rodríguez Vázquez
Institute of Microelectronics of Seville, CSIC-Universidad de Sevilla

17:05-17:30

CMOS Image Sensor Architecture for Focal Plane Early Vision Processing

Fernanda D. V. R. de Oliveira¹, José Gabriel R. C. Gomes¹, Ricardo Carmona-Galán², Jorge Fernandez-Berni², Ángel Rodríguez Vázquez²

¹ Universidade Federal do Rio de Janeiro, ² Institute of Microelectronics of Seville

ORAL SESSION 5 - "Person Re-identification and Multi-Camera Pattern Recognition"

Friday, September 11, 11:00-12:50

Chairman: Andrea Prati, Università IUAV di Venezia

11:00-11:25

Person Re-Identification via Efficient Inference in Fully Connected CRF

Jiuqing Wan, Menglin Xing
Beihang University

11:25-11:50

Camera Calibration Parameters for Oriented Person Re-identification

Alfredo Gardel¹, Jorge García¹, Ignacio Bravo¹, Felipe Espinosa¹, Thierry Chateau²
¹ University of Alcalá, ² University Blaise Pascal

11:50-12:15

Multi-View Gait Recognition on Curved Trajectories

David López-Fernández, Francisco José Madrid-Cuevas, Ángel Carmona-Poyato, Rafael Muñoz-Salinas, Rafael Medina-Carnicer
Universidad de Córdoba

12:15-12:40

Multi-Camera Head Pose Estimation Using an Ensemble of Exemplars

Scott Spurlock, Peter Malmgren, Hui Wu, Richard Souvenir
University of North Caroline, Charlotte

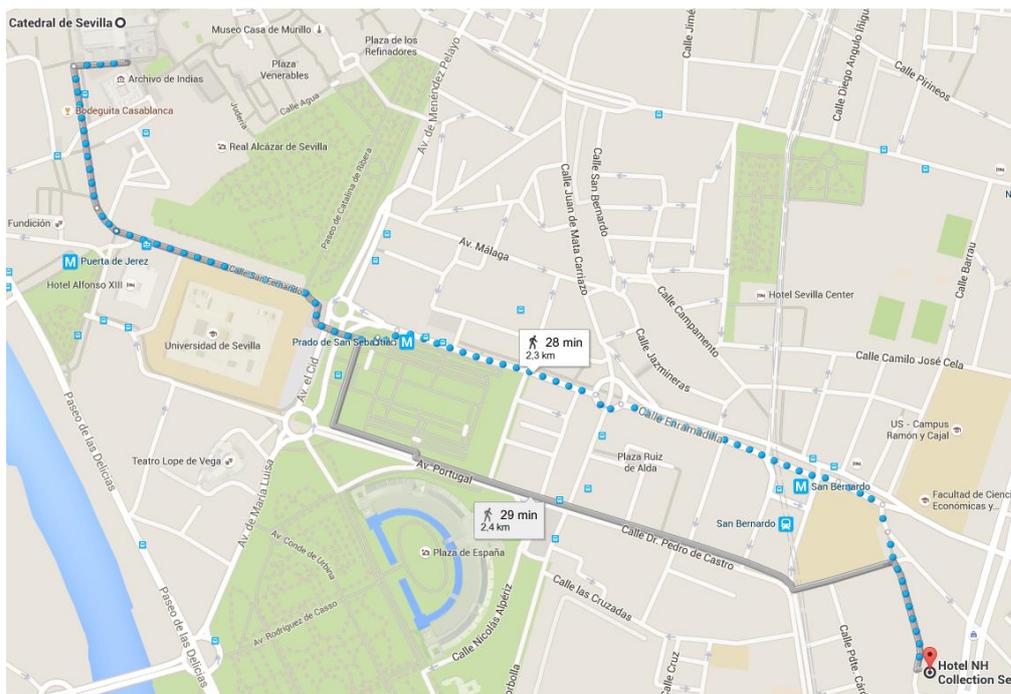
Conference venue



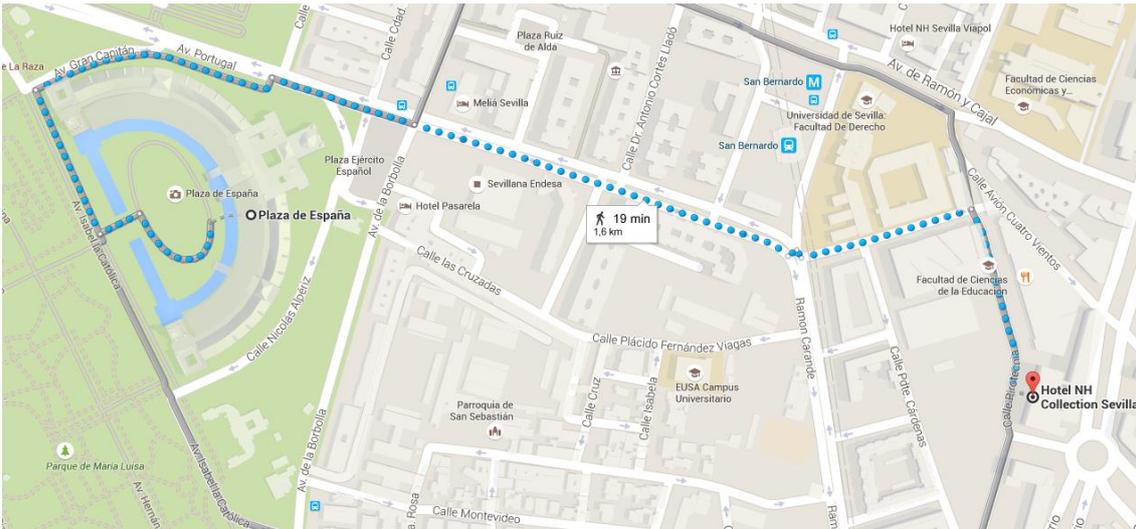
NH Collection Sevilla
Avda Diego Martínez Barrio, 8.
41013, Seville, Spain
Tel.: +34 95 4548500
([37.375011, -5.976318](tel:+34954548500))



ICDSC 2015 is held at the NH Collection Sevilla. This hotel has a privileged position in Seville's financial and business district. The historical area is a short walk away. And the public transport links are first-class so getting around the city is easy:



28min walk to the Cathedral ([37.386042, -5.993118](tel:+34954548500))



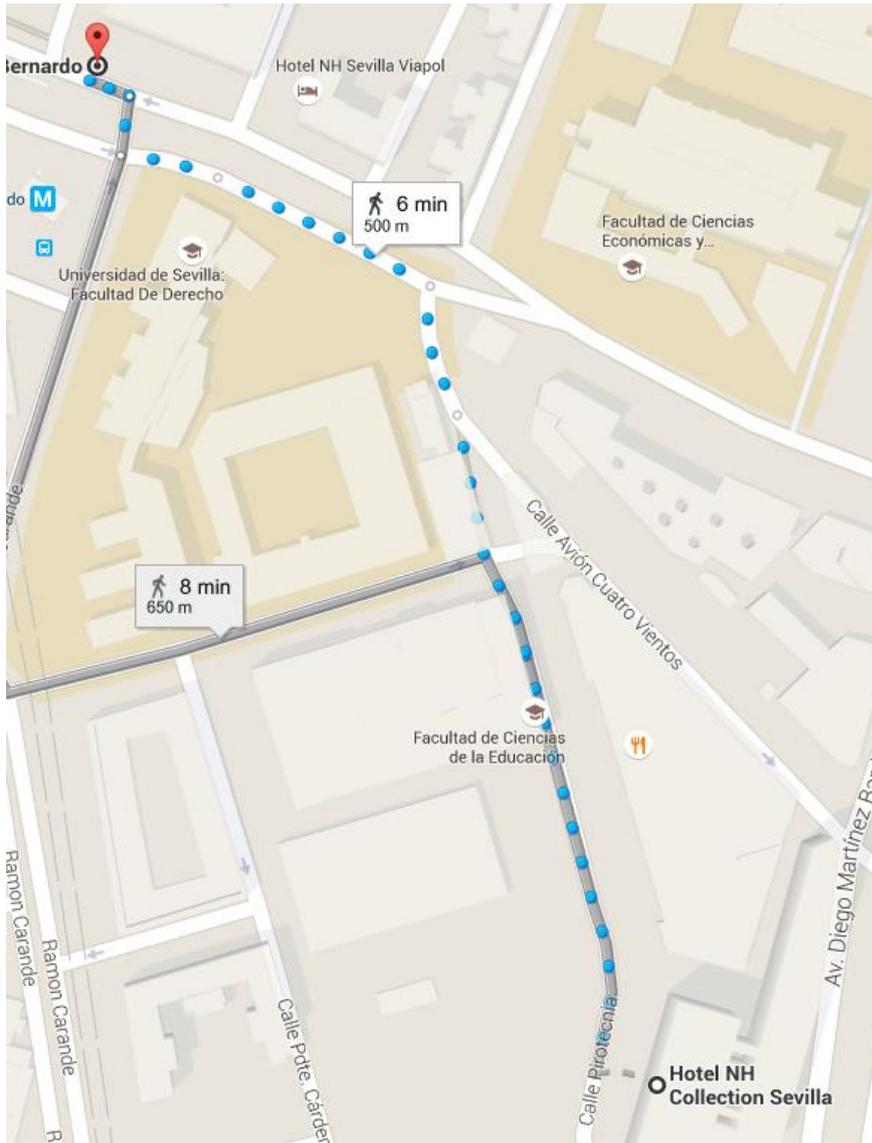
19min walk to Plaza de España ([37.377393, -5.986895](#)), landmark example of the Renaissance Revival style in Spanish architecture and —only for SW fans— very closely resembled to Theed, capital city of planet Naboo.

You can also reach the historical center from the Conference Venue by public transportation:

By tram:

The tram stop is at Avda. Ramón y Cajal ([37.378713, -5.979026](#))





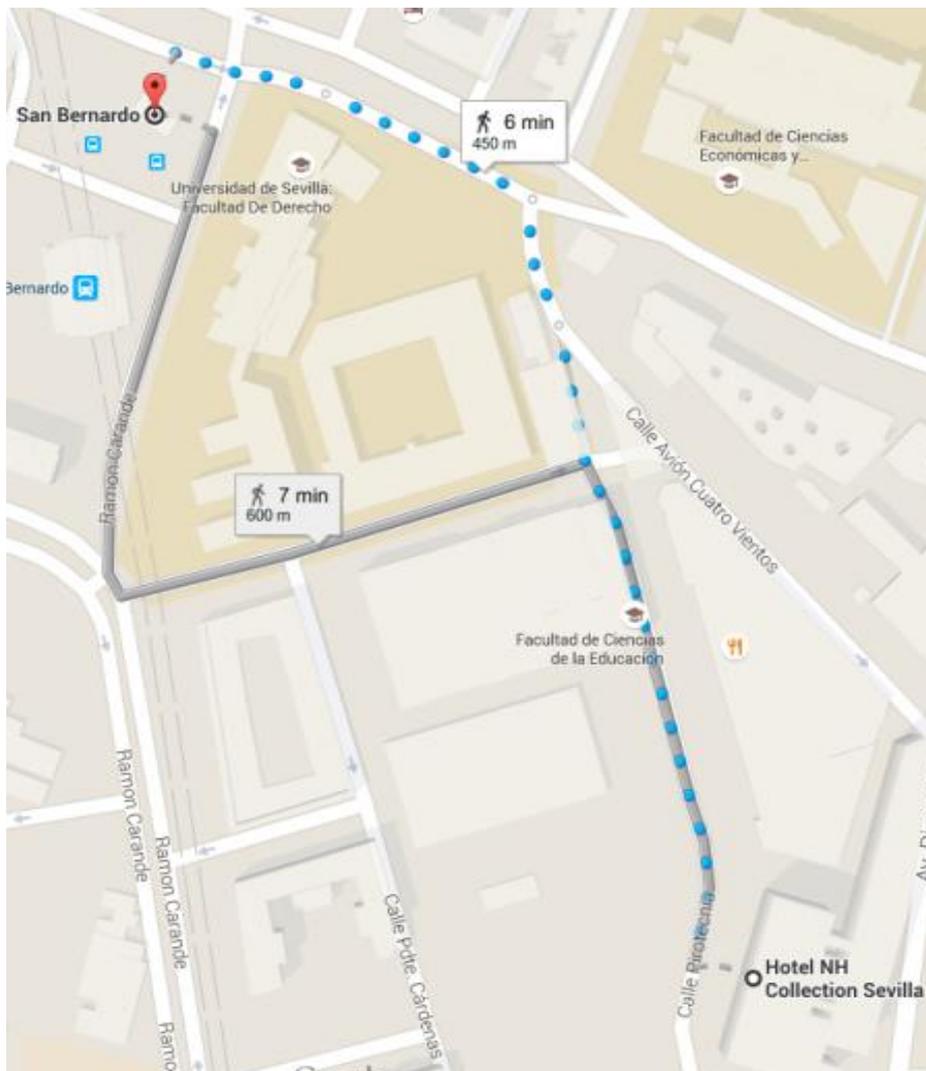
6min walk from NH Collection.

You must take line T1 and jump off at archive de Indias or Plaza Nueva. One way fare is 1.40€



By Metro:

The station is at Avda. Ramón y Cajal ([37.378351](#), [-5.979230](#))



6min walk from NH Collection.

You must take the train at San Bernardo, direction Ciudad Expo, and leave it two stops later in Puerta Jerez. It does not get you much closer to the Cathedral. One way ticket is 1.35€.



By bus:

Buses can get you around the historic center but they do not get you in. The bus lines that stop closer to the NH Collection, close to the tram stop, end some 500m later, so they are not worth the 1.40€ ride.

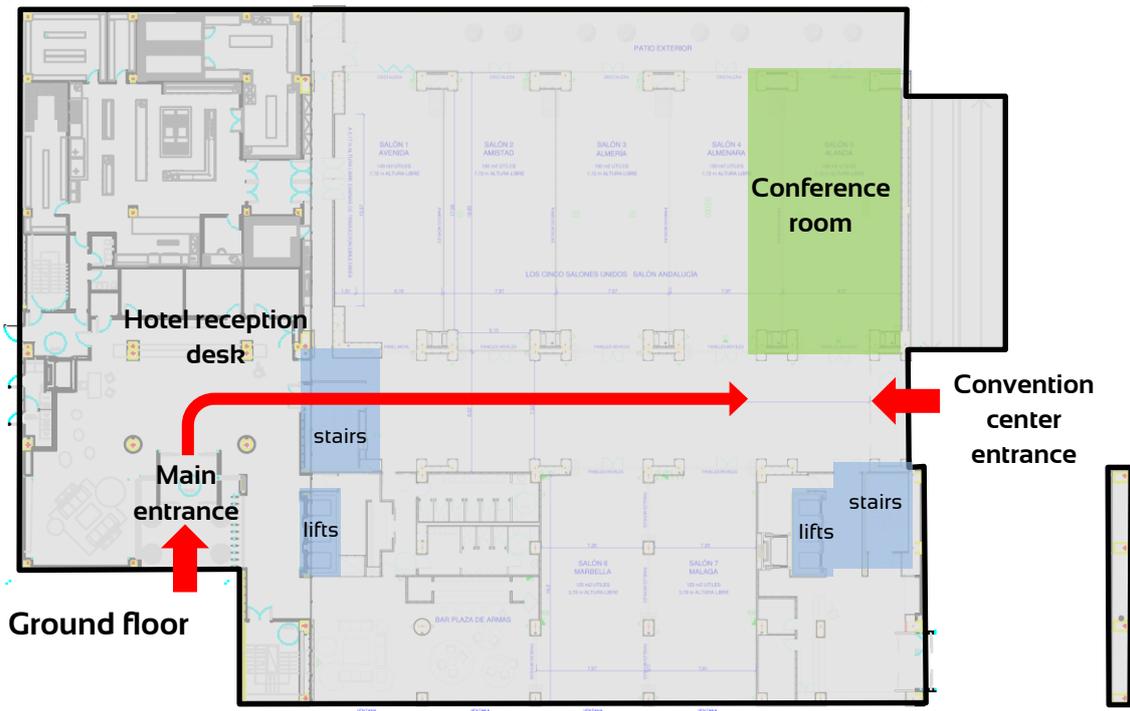


By bike:

Right behind the Metro station at Avda. Ramón y Cajal ([37.378351, -5.979230](#)) you can find a parking spot with bicycles available for rent ([SEVICI](#)). You can subscribe for a week for 13.33€. This can be done with a credit card right at the parking spot. Take into account that 150€ will be blocked as a deposit until the subscription expires.



Hotel floorplan



Social Program

Tuesday, September 8, 20:00h

Welcome cocktail

Hotel NH Collection Sevilla

Av Diego Martínez Barrio, 8

41013 Sevilla

[\(37.375011, -5.976318\)](#)

Thursday, September 10, 18:30

Panoramic ride

Guided walk through the historic center

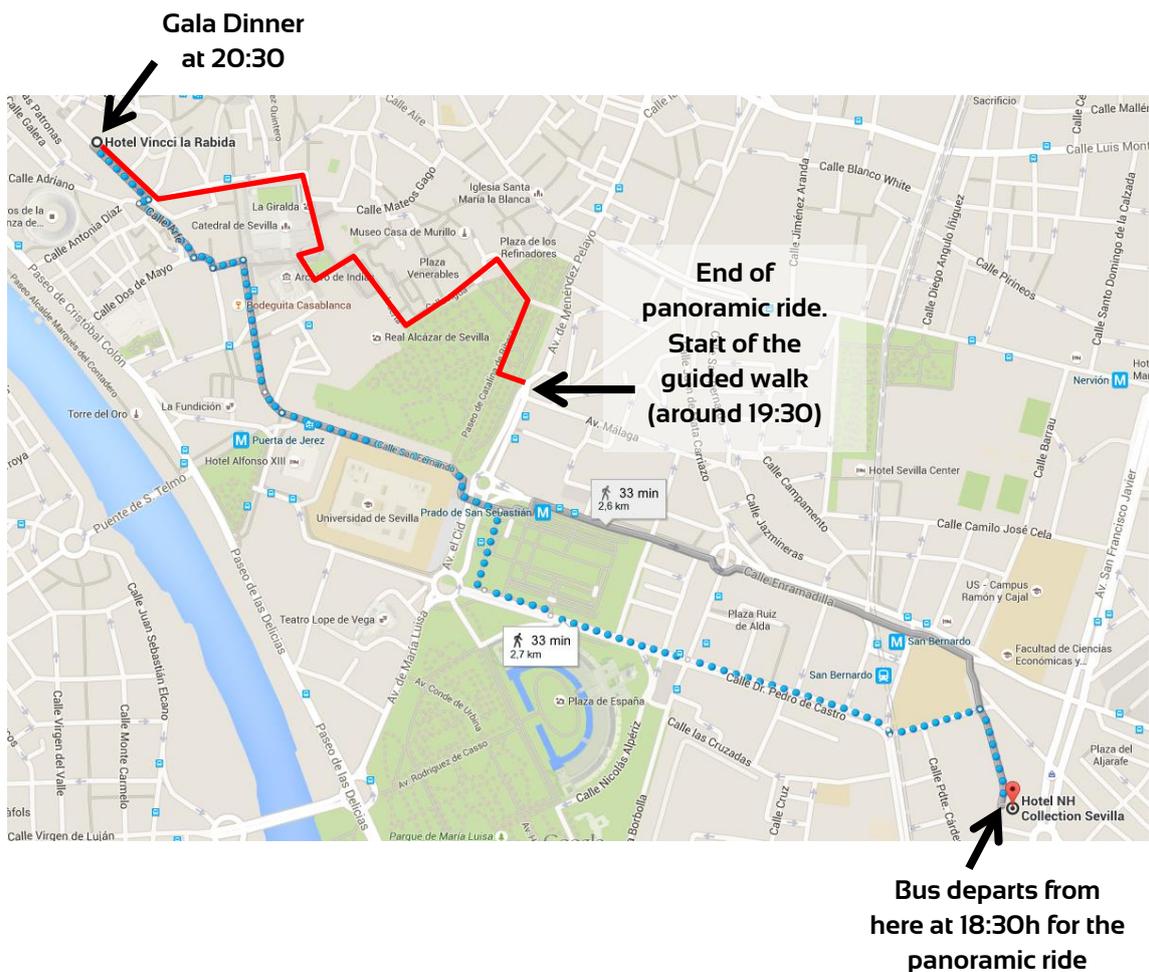
Gala Dinner

Hotel Vincci la Rabida

Calle Castelar, 24

41001 Sevilla

[\(37.387364, -5.997378\)](#)



Welcome to Seville

Seville is the capital and largest city of the autonomous community of Andalusia. It is situated on the plain of the Guadalquivir River. Seville has a population of about 703,000 as of 2011, and a metropolitan population of about 1.5 million, making it the fourth-largest city in Spain and the 30th most populous municipality in the EU. The historic district expands in an area of 4km² (2 sq mi). It contains three UNESCO World Heritage Sites: the Alcázar palace complex ([37.384560, -5.992165](#)), the Cathedral ([37.386042, -5.993118](#)) and the General Archive of the Indies ([37.384577, -5.993315](#)). The harbor, 80 kilometers (50 miles) from the Atlantic Ocean, is the only river port in Spain. Seville is the site of several SciTech parks mainly dedicated to aerospace, information technology, biotechnology and power systems engineering.

Seville was founded as the Roman city of Hispalis, and was known as Ishbiliya (Arabic: إشبيلية) after the Muslim conquest in 712. During the Muslim rule in Spain, Seville was part of the Caliphate of Córdoba before becoming an independent Taifa. Later it was ruled by the Almoravids and the Almohads until finally being incorporated to the Christian Kingdom of Castille by Ferdinand III in 1248. After the discovery of the Americas, Seville became one of the economic centers of the Spanish Empire as its port monopolized the trans-oceanic trade, opening also a Golden Age of arts and literature. Coinciding with the Baroque period of European history, the 17th century represented the most brilliant flowering of the city's culture.

As the Lonely Planet's website describes it: "Some cities have looks, other cities have personality. The sevillanos —lucky devils— get both, courtesy of their flamboyant, charismatic, ever-evolving Andalusian metropolis founded, according to myth, 3000 years ago by the Greek god Hercules. Drenched for most of the year in spirit-enriching sunlight, this is a city of feelings as much as sights, with different seasons prompting vastly contrasting moods: solemn for Semana Santa, flirtatious for the spring fiesta and soporific for the gasping heat of summer.

Like all great cities, Seville has historical layers. Roman ruins testify the settlement's earliest face, memories of the Moorish era flicker like medieval engravings in the Santa Cruz quarter ([37.384901, -5.990524](#)), while the riverside Arenal ([37.386248, -5.996210](#)) reeks of lost colonial glory. Yet, one of the most remarkable things about modern Seville is its ability to adapt and etch fresh new brushstrokes onto an ancient canvas".



The Cathedral

[\(37.386042, -5.993118\)](#)

Seville Cathedral was built to demonstrate the city's wealth, as it had become a major trading center in the years after the Reconquista in 1248. In July 1401 it was decided to build a new cathedral. According to oral tradition,

the members of the cathedral chapter said: "Hagamos una Iglesia tan hermosa y tan grandiosa que los que la vieren labrada nos tengan por locos" ("Let us build a church so beautiful and so grand that those who see it finished will think we are mad"). Construction began in 1402 and continued until 1506. One of its major attractions is La Giralda. It was the former minaret of the Great Mosque of Seville during the Muslim era, restructured into a bell tower under the Christian rule.

Price per person: €8.00

Hours: Mon: 9:30 a 15:30, Tue-Sat: 9:30 a 16:00, Sun: 14:30 a 18:00

Phone: (+34) 954 214 471



The Alcázar of Seville

[\(37.384560, -5.992165\)](#)

It is a royal palace originally developed by Moorish Muslim kings. The palace is renowned as one of the most beautiful in Spain, being regarded as one of the most outstanding examples of mudéjar architecture found on the

Iberian Peninsula. The upper levels of the Alcázar are still used by the royal family as the official Seville residence and are administered by the Patrimonio Nacional. It is the oldest royal palace still in use in Europe. By the way, part of the fifth season of Game of Thrones was shot at several locations in the province of Seville, including the Alcázar

Price per person: €9.50

Hours: Mon- Sun: 09:30 - 19:30

Phone: (+34) 954 502 324



Santa Cruz, City Center and the Arenal

Santa Cruz is Seville's medieval Jewish quarter. Today it is a tangle of quaint, winding streets and lovely plant-decked plazas perfumed with orange blossom in Spring. Plaza de Santa Cruz ([37.385179, -5.988462](#)), Plaza Doña Elvira ([37.384901, -5.990524](#)), the Hospital de los Venerables ([37.385049, -5.989782](#)), are some of the most interesting spots. The rest of the city center is densely packed with narrow streets and broken up by squares: Calle Sierpes ([37.390420, -5.994399](#)), Casa Pilatos ([37.389995, -5.987176](#)), Plaza del Salvador ([37.389981, -5.993086](#)) ... around which the

city's life has revolved for eons. The Arenal, a short walk from the Cathedral, brings the visitor to the Río Guadalquivir. Seville's most interesting sights here include the Torre del Oro ([37.382376, -5.996373](#)), a 13th century watch tower, La Maestranza ([37.385556, -5.998884](#)), which is the bullring, El Hospital de la Caridad ([37.383957, -5.995640](#)) and the Museum of Fine Arts ([37.392527, -5.999806](#)) which is the second art gallery in the country. Another interesting highlight in the city center is Metropol Parasol, [37.392997, -5.992025](#), claimed to be the largest wooden structure in the world, and popularly known as The Mushrooms.



Climate

Seville weather is hot during the summers and mild during the winters and it has a fairly typical Mediterranean climate. Autumn experiences very similar temperatures and weather to spring; these are the best seasons to visit Seville since the night-time remains comfortably cool. However, the beginning of September can still be hot. Average high temperature for September is 29°C

(84°F) and the average low is 17°C (62°F). The average precipitations for this month are 58mm, for an average of 5 rainy days.

FAST FACTS

Country: Spain / España

Status: city / capital of Andalusia

Population: 703,000 in the city + another 700,000 in the outskirts

Language: Spanish

Time zone: UTC+2 at summer time (March 29 to October 25, this year), UTC+1 at winter time

Country dialing code: +34

Currency: Euro is the official currency of Spain. Euro (€) = 100 cents. Notes are in denominations of €500, 200, 100, 50, 20, 10, and 5. Coins are in denominations of €2, €1, and 50c, 20c, 10c, 5c, 2c, and 1c. Money can be withdrawn from ATMs which accept most international cards.

Health and security: Emergency service phone no. 112 (Fire brigade, police, medical emergency, etc.)

Tipping: tipping in Spain is not mandatory but it is common to leave some change or a small tip of 5-10%. There are no added service charges on the final bill at any hotel, restaurant, or bar.

Electricity: 220 volts, 50 Hz - two round-pins plugs (C or F) are used

System of measurements: international metric system, temperature expressed in Celsius degrees

Tourist Office:

Paseo de las Delicias, 9 (Costurero de la Reina)

41012 Sevilla. Phone: +34 954 234 465

Additional touristic information can be found at:

www.turismosevilla.org, www.andalucia.org

Pharmacies

For minor ailments, many people go to their local pharmacy (farmacia), these are easily recognisable by the green flashing cross displayed outside or in the window. Farmacias take turns to provide an out-of-hours service (at night and for holidays) as the farmacia de guardia. You will be able to find out which one is open by looking in a local paper or in the window of any pharmacy where they usually display a list. Pharmacists in Spain are more highly-trained than

in some countries and will provide treatment advice for many common illnesses and ailments, but they are not a substitute for going to a doctor if there is something really wrong with you.

Shops/bank hours

Stores are typically open from 9:30am-2pm in the mornings and then open again in the afternoon from 5-8pm. Department stores and shopping centers usually open from 10am to 19pm. Sundays and local holidays are closed.

Banks are usually open Mon-Fri from 8.30am to 2.00pm, and sometimes on Saturday from 8.30am to 1.00pm.

Currency Exchange

There are many places to exchange currency, the banks being the ones with best rates. There are also foreign exchange outlets at the airport and even in some hotels and restaurants, although the rates are usually not so favorable. Withdrawing money at the ATM is often the most convenient way to obtain Euros.

Credit Cards

Credit cards are widely accepted at businesses and stores throughout Seville. You may be asked to enter your PIN (Personal Identification Number) into a keypad for security purposes. Some shops do not accept credit card payment for small amounts.

ATMs (Automatic Teller Machine)

There are ATMs almost everywhere, and most support Visa/Plus, Cirrus, and other popular systems. Just look for the signs next to the ATM or on the display itself. ATMs are easy to use here and all offer English as well as other languages.

VAT (IVA in Spanish) refund

If you are a visitor to the EU and are about to leave EU territory to go home or to some other place outside the EU, you may be able to buy goods free of VAT. You must pay the full VAT-inclusive price for the goods in the shop; you will get the VAT refunded once you have complied with the formalities and can show proof of export. You should ask for a tax-free receipt, wherever you see the Spain Refund Tax-free Shopping logo, at the point of sale. The Tax-Free check must be stamped, always before the check-in. Show the goods to customs when leaving the country. You can claim your money in the SPAIN REFUND cash agents in airports and borders.

Currency Choice logo

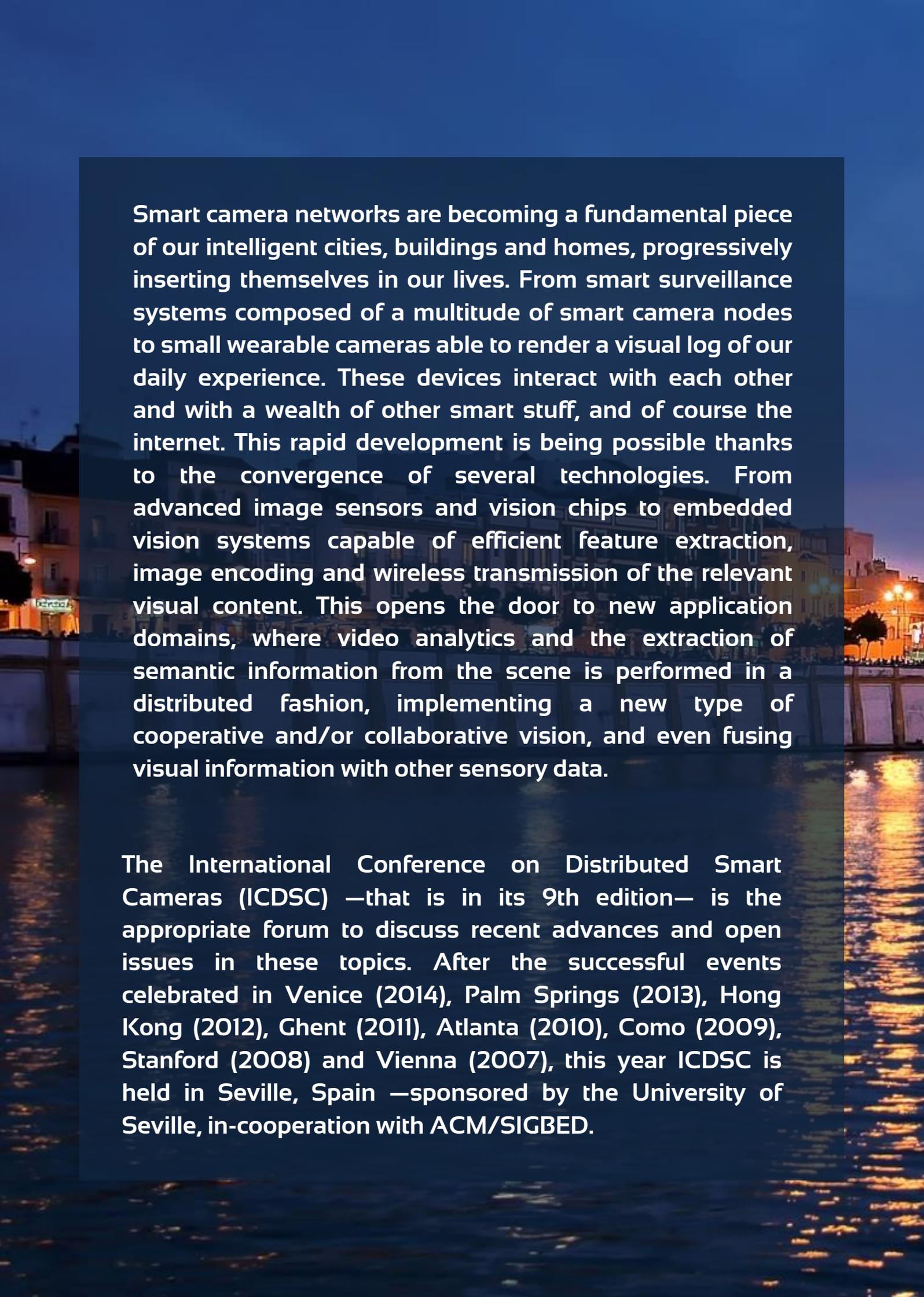
The Currency Choice logo next to a credit card terminal means that there you can pay by credit card in your own national currency. The amount on the receipt is the sum that will be debited to your bank.

Visa information

Holders of passports of the EU, Iceland, Norway and Switzerland, do not require any visa. For visits of less than 90 days, visas are not required for a long list of countries (see the Ministry of Foreign Affairs [list](#)). Citizens of other countries require a visa. We recommend contacting your local Spanish consulate or Embassy for more information on these requirements.

For further information about Seville, please check:

www.infosevilla.com

A night view of a city street with buildings and lights reflected in water. The scene is dark, with the lights from the buildings and street lamps creating a shimmering reflection on the water's surface. The text is overlaid on a dark blue semi-transparent background.

Smart camera networks are becoming a fundamental piece of our intelligent cities, buildings and homes, progressively inserting themselves in our lives. From smart surveillance systems composed of a multitude of smart camera nodes to small wearable cameras able to render a visual log of our daily experience. These devices interact with each other and with a wealth of other smart stuff, and of course the internet. This rapid development is being possible thanks to the convergence of several technologies. From advanced image sensors and vision chips to embedded vision systems capable of efficient feature extraction, image encoding and wireless transmission of the relevant visual content. This opens the door to new application domains, where video analytics and the extraction of semantic information from the scene is performed in a distributed fashion, implementing a new type of cooperative and/or collaborative vision, and even fusing visual information with other sensory data.

The International Conference on Distributed Smart Cameras (ICDSC) —that is in its 9th edition— is the appropriate forum to discuss recent advances and open issues in these topics. After the successful events celebrated in Venice (2014), Palm Springs (2013), Hong Kong (2012), Ghent (2011), Atlanta (2010), Como (2009), Stanford (2008) and Vienna (2007), this year ICDSC is held in Seville, Spain —sponsored by the University of Seville, in-cooperation with ACM/SIGBED.