



# ISMAR 2016

September 19 - 23 | Merida, MEXICO

CONFERENCE PROGRAM

# Sponsors and Supporters

Gold



# Sponsors and Supporters

## Silver



vuforia™



envrmt  
by verizon labs



experience  
what's inside™

## Bronze

PREFIXA

## SME

fayteq  
technologies beyond imagination

## Exhibitors



## Media Partners



## Supporting Organizations



UADY  
UNIVERSIDAD  
AUTÓNOMA  
DE YUCATÁN



University of  
BRISTOL



UNIVERSIDAD AUTÓNOMA  
DE SAN LUIS POTOSÍ



IEEE TRANSACTIONS ON  
VISUALIZATION AND  
COMPUTER GRAPHICS

# Table of Contents

Sponsors and Supporters.....	2
Message from the General Chairs .....	5
Conference Committee .....	7
Program Timetable .....	11
Keynotes .....	16
19 <sup>th</sup> September S&T Talks, Posters and Demos .....	18
20 <sup>th</sup> September S&T Talks, Posters and Demos .....	21
21 <sup>th</sup> September S&T Talks, Posters and Demos .....	25
22 <sup>nd</sup> September Tutorials and Workshops .....	28
23 <sup>rd</sup> September Tutorials and Workshops.....	32
Hackathon.....	37
First Augmented Reality School AR101 .....	38
Venue Floorplan.....	40
Restaurants and other services around venue.....	41
A Brief Guide to Yucatan’s Cuisine .....	42

# Message from the General Chairs



## Welcome to ISMAR 2016 in Mexico!

We are delighted to welcome you to the 15th IEEE International Symposium on Mixed and Augmented Reality (ISMAR 2016) held during the 19th to the 23rd of September 2016, in Merida Mexico.

ISMAR has established itself as the most significant academic event in Mixed and Augmented Reality, and that has its foundations on the fusion of two former events: the International Symposium on Augmented Reality (ISAR) and the International Symposium on Mixed Reality (ISMR).

The 15th ISMAR brings new horizons to the community as it is the first in the series to be held in Latin America.

The host city of Merida is the largest of the Yucatan Peninsula. It is surrounded by historical jewels of the Maya civilisation and is a vibrant part of modern Mexico. It is this mixture of the modern and the historical that we hope will enhance your ISMAR experience.

We are introducing a number of new activities this year. They include the very first *AR101* outreach event aimed to entice host's country students into our research field, and to become the future of our community. We are also organising the first ISMAR hackathon, following on the strong tradition of the tracking competition. We hope the hackathon will refresh this important part of what we like in the community, to challenge ourselves to do more and on top of what is out there.

The essence of ISMAR is the quality works presented, and we are proud to have a strong program in all the conference strands: the Science and Technology Program, the continuation from 2015 of the Poster Papers Track, an inspiring selection of Workshops which includes MASH'D and the essential ISMAR Demos Track.

# Message from the General Chairs

Complementing all this we are honoured to have two world experts as our keynote speakers. *Prof. Andrew Davison* from Imperial College who is a world renowned expert in real-time visual mapping and *Prof. Steve Feiner* who directs the Computer Graphics and User Interfaces Lab at Columbia University and who has inspired us for many years.

ISMAR happens because of many volunteers that donate significant time and expertise for over a year and even after every event finishes. We express our extended thanks to the members of the program committee and all reviewers for helping to ensure a strong academic offering, the authors themselves for their trust and hard work, our sponsors for their financial support and everyone that has contributed to make ISMAR 2016 a reality. Thank you all.

We hope you will find ISMAR 2016 an exciting and motivating event.

## **Your ISMAR 2016 General Chairs**

Walterio Mayol-Cuevas – General Chair  
Anabel Martin-Gonzalez – Deputy General Chair  
Flavio Viguera-Gomez – Deputy General Chair  
Erick Mendez – Deputy General Chair

# Conference Committee

## General Chair

- Walterio Mayol-Cuevas, University of Bristol, UK

## Deputy General Chairs

- Anabel Martin-Gonzalez, Universidad Autónoma de Yucatán, Mexico
- Erick Mendez, Daqri, Austria
- Flavio Viguera-Gómez, Universidad Autónoma de San Luis Potosí, Mexico

## Publications Chair

- Veronica Teichrieb, Universidade Federal de Pernambuco, Brazil

## Workshop and Tutorial Chairs

- Raphael Grasset, Parametric Technology Corporation, Austria
- Maki Sugimoto, Keio University, Japan
- Alejandro Martín, Universidad Autónoma de San Luis Potosí, Mexico

## Hackathon Chairs

- Manuel Huber, Technische Universität München (TUM), Germany
- Renato Salas, Oculus, USA
- Jean Bernard Hayet, Centro de Investigación en Matemáticas (CIMAT), Mexico

## Posters Chairs

- Eduardo Veas, National University of Cuyo, Argentina
- Tobias Langlotz, University of Otago, New Zealand
- Jose Martinez-Carranza, INAOE, Mexico

## Outreach Chairs

- Greg Welch, University of Central Florida, USA
- Flavio Viguera-Gómez, Universidad Autónoma de San Luis Potosí, Mexico

## Demos Chairs

- Alessandro Mulloni, Freelancer, Austria
- Jens Grubert, University of Passau, Germany
- Francisco Javier Hernández López, Centro de Investigación en Matemáticas (CIMAT), Mexico

# Conference Committee

## **AR101 Chair**

- Flavio Viguera-Gómez, Universidad Autónoma de San Luis Potosí, Mexico

## **Sponsorship Chair**

- Erick Mendez, Daqri, Austria

## **Registration Chair**

- Arturo Espinosa-Romero, Universidad Autónoma de Yucatán, Mexico

## **Local Arrangements Chairs**

- Carlos Brito-Loeza, Universidad Autónoma de Yucatán, Mexico

## **Finance Chair**

- Anabel Martin-Gonzalez, Universidad Autónoma de Yucatán, Mexico

## **TVCG Liaison**

- Dieter Schmalstieg, Technische Universität Graz, Austria

## **Publicity Chairs (Global)**

- Yuta Itoh, Keio University, Japan.
- Jonathan Ventura, University of Colorado Colorado Springs, USA

## **Country-specific publicity chairs**

- Woontack Woo, KAIST, Korea
- JAPAN: Koji Makita, Canon, Inc. Japan

## **Chair Mentors**

- Daisuke Iwai (Publications), Osaka University, Japan

## **Student Volunteers Chair**

- Fernando Curi, Universidad Autónoma de Yucatán, Mexico

## **Web Chairs**

- Rodrigo Esparza, Universidad Autónoma de Yucatán, México
- Ulrich Eck, Technische Universität München, Germany

# Conference Committee

## Science and Technology Program Chairs

- Wolfgang Broll, Ilmenau University of Technology / fayteq, Germany
- Hideo Saito, Keio University, Japan
- J Edward Swan II, Mississippi State University, USA

## Americas

- Steve Feiner, Columbia University, USA
- Rafael Radkowski, Iowa State University, USA
- Jonathan Ventura, University of Colorado Colorado Springs, USA
- Feng Zheng, Magic Leap, USA

## Asia-Pacific

- Daisuke Iwai, Osaka University, Japan
- Itaru Kitahara, University of Tsukuba, Japan
- Tobias Langlotz, University of Otago, New Zealand
- Bruce Thomas, University of South Australia, Australia
- Woontack Woo, Korea Advanced Institute of Science and Technology, Korea

## Europe

- Jens Grubert, University of Passau, Germany
- Stephan Lukosch, TU Delft, The Netherlands
- Guillaume Moreau, Ecole Centrale de Nantes, France
- Cristina Portales, Universidad de Valencia, Spain
- Ian A. Williams, Birmingham City University, UK

# Conference Committee

## Steering Committee Co-Chairs

- Prof. Gudrun Klinker (Technische Universität München, Germany)
- Prof. Mark Billingham (University of Canterbury, New Zealand)

## Steering Committee members

- Ronald Azuma
- Mark Billingham
- Jay Bolter
- Henry Duh
- Henry Fuchs
- Simon Julier
- Hirokazu Kato
- Gudrun Klinker
- Kiyoshi Kiyokawa
- Rob Lindeman
- Nassir Navab
- Hideo Saito
- Christian Sandor
- Julian Staddon
- Dieter Schmalstieg
- Haruo Takemura
- Bruce Thomas

## Emeritus members

- Reinhold Behringer
- Oliver Bimber
- Tom Drummond
- Steve Feiner
- Raphael Grasset
- Tobias Hoellerer
- Heedong Ko
- Vincent Lepetit
- Mark Livingston
- David Mizell
- Stefan Mueller
- Jun Park
- Gerhard Reitmayr
- Jannick Rolland
- Didier Stricker
- Hideyuki Tamura
- Greg Welch
- Sean White
- Martin Wiedmer
- Hiroyuki Yamamoto
- Naokazu Yokoya

# Program Timetable (Monday)

Monday, 19 September 2016			
Time	Yucatán 2	Yucatán 1	Celestún
08:00 - 09:00	Registration Begins at the Registration Desk		
09:00 - 09:30	Opening Ceremony		
09:30 - 10:30	Keynote Andrew Davison		
10:30 - 10:45	Coffee Break		
10:45 - 12:00	Session SLAM Tracking	Exhibition Open	
12:00 - 13:20	Lunch Break		
13:30 - 15:10	Session Lighting & Rendering	Exhibition Open	Hackathon
15:10 - 15:25	Coffee Break		
15:30 - 16:30	Poster & Demo Teaser Group A		
16:30 - 18:30		Exhibits, Posters, Demos Group A	
19:00 - 21:00	<b>Welcome Reception "Drinks on Daqri"</b> Terraza Montejo		



Scan for latest program information

# Program Timetable (Tuesday)

Tuesday, 20 September 2016				
Time	Yucatán 2	Yucatán 1	Celestún	Mérida
08:00 - 09:00	Registration Begins at the Registration Desk			
09:00 - 10:40	Session Calibration & Tracking			
10:40 - 10:55	Coffee Break			
10:55 - 12:10	Session Collaboration & Interaction	Exhibition Open		
12:10 - 13:20	Lunch Break			
13:30 - 14:45	Session Head Mounted Displays	Exhibition Open		
14:45 - 15:00	Coffee Break			
15:00 - 16:00	Poster & Demo Teaser Group B			
16:00 - 18:00		Exhibits, Posters, Demos Group B		
18:00 - 19:00				Pitch your Lab*
19:30 - 22:00	Conference Banquet Yucatán 2			



Scan for latest program information

# Program Timetable (Wednesday)

Wednesday, 21 September 2016			
Time	Yucatán 2	Yucatán 1	Celestún
08:00 - 09:00	Registration Begins at the Registration Desk		
09:00 - 10:00	Keynote Steven Feiner		
10:00 - 10:20	Coffee Break		
10:20 - 12:00	Session Education & Modeling	Exhibition Open	
12:00 - 13:20	Lunch Break		
13:30 - 14:45	Session AR Everywhere	Exhibition Open	Hackathon
14:45 - 15:00	Coffee Break		
15:00 - 16:00	Poster & Demo Teaser Group C		
16:00 - 18:00		Exhibits, Posters, Demos Group C	
18:00 - 18:40	Closing Ceremony Yucatán 2		
18:40 - 20:00	Closing Reception Foyer		



Scan for latest program information

# Program Timetable (Thursday)

Thursday, 22 September 2016					
Time	Celestún	Valladolid	Mérida 1	Mérida 2 & 3	Foyer
08:00 - 09:00					
09:00 - 10:00	Daqri Tutorial				
10:00 - 13:00	Int. Workshop on Diminished Reality as Challenging Issue in Mixed and Augmented Reality (IWDR2016)	AR Principles and Practice Tutorial	MASHD	Collaborative Mixed Reality Environments (CoMIRE)	Coffee Isle
13:00 - 14:30	<b>Workshops &amp; Tutorials Reception</b> Club de Industriales				
14:30 - 15:00	Int. Workshop on Diminished Reality as Challenging Issue in Mixed and Augmented Reality			Collaborative Mixed Reality Environments (CoMIRE)	
15:00 - 16:00			MASHD		Coffee Isle
16:00 - 17:00					



Scan for latest program information

# Program Timetable (Friday)

Friday, 23 September 2016						
Time	Celestún	Valladolid	Mérida 1	Mérida 2 & 3	Santa Lucía	Foyer
08:00 - 09:00			Registration Begins at the Registration Desk			
09:00 - 10:00	Microsoft Hololens Tutorial					
10:00 - 13:00	Perceptual Issues in Augmented Reality	Human Behavior Analysis and Visualization for Collective Visual Sensing	MASHD	Standards for Mixed and AR	Interaction Design Principles of AR focusing on the Ageing Population	Coffee Isle
13:00 - 14:30	<b>Lunch Break</b> Club de Industriales					
14:30 - 15:30	Perceptual Issues in Augmented Reality				Interaction Design Principles of AR focusing on the Ageing Population	
15:30 - 16:00				Standards for Mixed and AR		
16:00 - 16:30			MASHD			
16:30 - 17:00						Coffee Isle



Scan for latest program information

## Andrew Davison, Imperial College London

September 19, 09:30 - 10:30, Yucatán 2

### The History and Future of Visual SLAM

Over the past 25 years, SLAM (Simultaneous Localisation and Mapping) has developed from a theoretical research topic into a crucial enabling technology for augmented reality, robotics and mobile devices.

Standard cameras and other visual sensors have become increasingly important because they offer the most flexible and accurate sensing for localisation and mapping while still being low-cost and compact. Progress has most usefully been measured by advances in real-time systems, almost always supported by real-time demos open source software releases, and I will review some of the most important systems which have driven the field forward. We are now at the point where SLAM technology is entering exciting real products, while in research labs we continue to work on new challenges. Future SLAM systems for AR and beyond must deliver fully dense, semantically aware and lifelong mapping, while retaining always-on, low power operation, and there are still many problems to be solved.



---

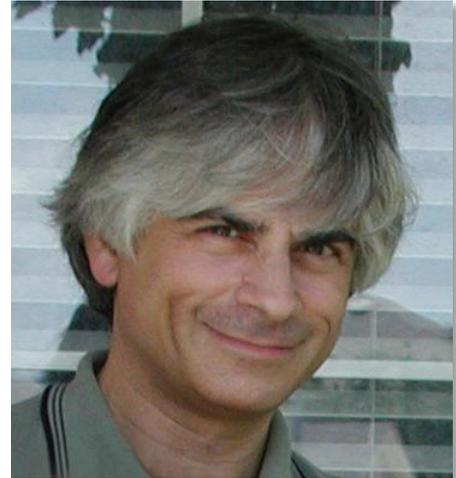
**Andrew Davison** is Professor of Robot Vision and Director of the Dyson Robotics Laboratory at Imperial College London. He did a B.A. physics and a D.Phil. in computer vision from the University of Oxford in 1994 and 1998, respectively. In his doctorate at Oxford's Research Group he developed one of the first robot SLAM systems using vision. He spent two years as a post-doc at AIST, Japan, where he continued to work on visual robot navigation. In 2000 he returned to the University of Oxford and as an EPSRC Advanced Research Fellow from 2002 he developed the well known MonoSLAM algorithm for real-time SLAM with a single camera. He joined Imperial College London as a Lecturer in 2005, held an ERC Starting Grant from 2008 to 2013 and was promoted to Professor in 2012. His Robot Vision Research Group continues to focus on advancing the basic technology of real-time localisation and mapping using vision, publishing advances in particular on real-time dense reconstruction and tracking, high speed vision and tracking, object-level mapping, manipulation and the use of novel sensing and processing in vision. He maintains a deep interest in exploring the limits of computational efficiency in real-time vision problems. He worked with Dyson for over 10 years to design the breakthrough visual SLAM system in Dyson's first robotic project the 360 Eye robot vacuum cleaner. In 2014 he became the founding Director of the new Dyson Robotics Laboratory at Imperial College, a lab working on the applications of computer vision to real-world domestic robots where there is much potential to open up new product categories.

## Steven Feiner, Columbia University

September 21, 09:00 - 10:00, Yucatán 2

### Mixing It Up, Mixing It Down

Our field is approaching the 50th anniversary of its first publication. Decades without a name, it has since acquired many, referring to a range of experiences: Augmented Reality, Mixed Reality, Mediated Reality, Diminished Reality, and Augmented Virtuality—to list more than a few, yet fewer than all. Why do we find these experiences so compelling that we devote our lives to exploring them, despite limitations in the displays, sensors, algorithms, and user interfaces from which they are built? I will try to answer this question, appealing to some of the many ways in which we can mix and modify the physical and virtual worlds: individually and collaboratively, indoors and outdoors, and in specialist domains and everyday life.



---

**Steven Feiner** is a Professor of Computer Science at Columbia University, where he directs the Computer Graphics and User Interfaces Lab, and co-directs the Columbia Vision and Graphics Center. His lab has been doing AR research for over 25 years, designing and evaluating novel interaction and visualization techniques, creating the first outdoor mobile AR system using a see-through head-worn display, and pioneering experimental applications of AR to fields such as tourism, journalism, maintenance, and construction. Prof. Feiner received an A.B. in Music and a Ph.D. in Computer Science, both from Brown University. He has served as General Chair or Program Chair for over a dozen ACM and IEEE conferences, is coauthor of *Computer Graphics: Principles and Practice*, received the *IEEE VGTC 2014 Virtual Reality Career Award*, and was elected to the *CHI Academy*. Together with his students, he has won the *ACM UIST Lasting Impact Award* and *best paper awards at IEEE ISMAR, IEEE 3DUI, ACM UIST, ACM CHI, and ACM VRST*.

## S&T ORAL SESSIONS, Room Yucatán 2

### Oral Session 1: SLAM Tracking

10:45-12:00

*Chair: Woontack Woo (KAIST)*

#### **Robust Keyframe-based Monocular SLAM for Augmented Reality**

*Haomin Liu, Guofeng Zhang, and Hujun Bao*

#### **Leveraging the User's Face for Absolute Scale Estimation in Handheld Monocular SLAM**

*Sebastian B. Knorr, and Daniel Kurz*

#### **$\sigma$ -DVO: Sensor Noise Model Meets Dense Visual Odometry (demo)**

*Benzun Wisely Babu, Soohwan Kim, Zhixin Yan, and Liu Ren*

---

### Oral Session 2: Lighting and Rendering

13:30-15:10

*Chair: Rafael Radkowski (Iowa State University)*

#### **Instant Mixed Reality Lighting from Casual Scanning**

*Thomas Richter-Trummer, Denis Kalkofen, Jinwoo Park, and Dieter Schmalstieg*

#### **A Single Camera Image Based Approach for Glossy Reflections in Mixed Reality Applications**

*Tobias Schwandt, and Wolfgang Broll*

#### **An Empirical Model for Specularity Prediction with Application to Dynamic Retexturing**

*Alexandre Morgand, Mohamed Tamaazousti, and Adrien Bartoli*

#### **Edge Snapping-Based Depth Enhancement for Dynamic Occlusion Handling in Augmented Reality**

*Chao Du, Yen-Lin Chen, Mao Ye, and Liu Ren*

---

## S&T POSTERS AND DEMOS SESSION A, Room Yucatán 1

**Teaser Session, Room Yucatán 2, 15:30-16:30**

**Exhibition Session, Room Yucatán 1, 16:30-18:30**

## Poster Session - Group A

- AP01 A Perspective on Non-Isometric Shape-from-Template**  
*Adrien Bartoli and Erol Özgür*
- AP02 EyeAR: Empiric Evaluation of a Refocusable Augmented Reality System**  
*Aitor Rovira, Rompapas Damien Constantine, Christian Sandor, Takafumi Taketomi, Hirokazu Kato, and Sei Ikeda*
- AP03 Measuring Observer Response to Object-Scene Disparity in Composites**  
*Alan Dolhasz, Ian Williams, and Maite Frutos-Pascual*
- AP04 Improving Localization under Varying Illumination**  
*Alexander Plopski, Tomohiro Mashita, Akira Kudo, Tobias Höllerer, Kiyoshi Kiyokawa, and Haruo Takemura*
- AP05 DualCAD: Integrating Augmented Reality with a Desktop GUI and Smartphone Interaction**  
*Alexandre Millette and Michael J. McGuffin*
- AP06 Real Time Noise Reduction to Identify Motion Parameters in AR Maintenance Scenario**  
*Alia Rukubayihunga, Jean-Yves Didier, and Samir Otmane*
- AP07 Challenges for Asynchronous Collaboration in Augmented Reality**  
*Andrew Irlitti, Ross T. Smith, Stewart Von Itzstein, Mark Billingham, and Bruce H. Thomas*
- AP08 Mobile Augmented Reality: Placing Labels based on Gaze Position**  
*Ann McNamara and Chethna Kabeerdoss*
- AP09 Augmenting Surface Reconstructions**  
*Anna Katharina Hebborn, Nils Höhner, and Stefan Müller*
- AP10 Streaming and Exploration of Dynamically Changing Dense 3D Reconstructions in Immersive Virtual Reality**  
*Annette Mossel and Manuel Kroeter*
- AP11 A Systematic Review of Usability Studies in Augmented Reality between 2005 and 2014**  
*Arindam Dey, Mark Billingham, Robert W. Lindeman, and J. Edward Swan II*
- AP12 Full-Scale Visualization of a Person on a Movable Transparent Screen**  
*Atsuya Oikawa, Itaru Kitahara, Yoshinari Kameda, and Yuichi Ohta*
- AP13 Participatory Design of STEM Education AR Experiences for Heterogeneous Student Groups: Exploring Dimensions of Tangibility, Simulation, and Interaction**  
*Ben Thompson, Laura Levy, Amelia Lambeth, David Byrd, Joelle Alcaininho, Iulian Radu, and Maribeth Gandy*
- AP14 An Augmented Reality Guide for Assisting Forklift Operation**  
*Bhuvaneswari Sarupuri, Gun A. Lee, and Mark Billingham*
- AP15 Mimicking an Object Using Multiple Projectors**  
*Bilal Ahmed, Jong Hun Lee, Yong Yi Lee, and Kwan H. Lee*

- AP16 EgoSAR: Towards a personalized spatial augmented reality experience in multi-user environments**  
*Brett Ridell, Loïs Mignard-Debise, Xavier Granier, and Patrick Reuter*
- AP17 Robust 3D Object Tracking Using an Elaborate Motion Model**  
*Byung-Kuk Seo and Harald Wuest*
- AP18 Pre-attentive Features in Natural Augmented Reality Visualizations**  
*Carla Barreiros, Eduardo Veas, and Viktoria Pammer-Schindler*
- AP19 Visual Guidance for Encountered Type Haptic Display: A feasibility study**  
*Chang-Gyu Lee, Gregory Lynn Dunn, Ian Oakley, and Jeha Ryu*
- AP20 Mobile Augmented Reality Based on Invisible Marker**  
*Changmin Lim, Chanran Kim, Jong-Il Park, and Hanhoon Park*
- AP21 TeachAR: An Interactive Augmented Reality Tool for Teaching Basic English to Non-Native Children**  
*Che Samihah Che Dalim, Arindam Dey, Thammathip Piumsomboon, Mark Billinghurst, and Shahrizal Sunar*
- AP22 Visualisation of the electronic horizon in Head-Up-Displays**  
*Christian A. Wiesner, Mike Ruf, Demet Sirim, and Gudrun Klinker*
- AP23 Enhancing 3D Mapping via Real-Time Superpixel-based Segmentation**  
*Claudia Cruz Martínez, José Martínez Carranza, Walterio Mayol-Cuevas, and Miguel O. Arias Estrada*
- AP24 A Hand-Held, Self-Contained Simulated Transparent Display**  
*Daniel Andersen, Voicu Popescu, Chengyuan Lin, Maria Eugenia Cabrera, Aditya Shanghavi, and Juan Wachs*
- 

## Demos Session - Group A

- AD01 deBallution – Interactive Artwork by Throwing Pseudo Balls Based on Cultural Heritages**  
*Je-ho Oh, So-young Kim, Yun Tae Nam, and Chung-kon Shi*
- AD02 Robust Keyframe-based Monocular SLAM for Augmented Reality**  
*Haomin Liu, Guofeng Zhang, and Hujun Bao*
- AD03 A Remote Collaboration System with Empathy Glasses**  
*Youngho Lee, Katsutoshi Masai, Kai Kunze, Maki Sugimoto, and Mark Billinghurst*
- AD04 Mixed Reality Extended TV**  
*Caroline Baillard, Vincent Alleaume, Matthieu Fradet, Pierrick Jouet, Anthony Laurent, Tao Luo, Philippe Robert, and Fabien Servant*
- AD05  $\sigma$ -DVO: Sensor Noise Model Meets Dense Visual Odometry (paper)**  
*Benzun Wisely Babu, Soohwan Kim, Zhixin Yan, and Liu Ren*

## S&T ORAL SESSIONS, Room Yucatán 2

### Oral Session 3: Calibration and Tracking

09:00-10:40

*Chair: Feng Zheng (Magic Leap, Inc.)*

*\* TVCG Special Section Paper*

#### **Spatio-Temporal Point Path Analysis and Optimization of a Galvanoscopic Scanning Laser Projector**

*Simon Willi and Anselm Grundhöfer*

#### **Practical and Precise Projector-Camera Calibration**

*Liming Yang, Jean-Marie Normand, and Guillaume Moreau*

*\* TVCG Special Section Paper*

#### **Towards Kilo-Hertz 6-DoF Visual Tracking Using an Egocentric Cluster of Rolling Shutter Cameras**

*Akash Bapat, Enrique Dunn, and Jan-Michael Frahm*

#### **Learning to Fuse: A Deep Learning Approach to Visual-Inertial Camera Pose Estimation**

*Jason R. Rambach, Aditya Tewari, Alain Pagani, and Didier Stricker*

---

### Oral Session 4: Collaboration and Interaction

10:55-12:10

*Chair: Steven Feiner (Columbia University)*

#### **PPV: Pixel-Point-Volume Segmentation for Object Referencing in Collaborative Augmented Reality)**

*Kuo-Chin Lien, Benjamin Nuernberger, Tobias Höllerer, and Matthew Turk*

*\* TVCG Special Section Paper*

#### **Do You See What I See? The Effect of Gaze Tracking on Task Space Remote Collaboration (demo)**

*Kunal Gupta, Gun A. Lee, and Mark Billinghurst*

#### **Analysis of Medium Wrap Freehand Virtual Object Grasping in Exocentric Mixed Reality**

*Maadh Al-Kalbani, Ian Williams, and Maite Frutos-Pascual*

## Oral Session 5: Head Mounted Displays

13:30-14:45

*Chair: Jens Grubert (University of Passau)*

*\* TVCG Special Section Paper*

### **Real-Time Radiometric Compensation for Optical See-Through Head-Mounted Displays**

*Tobias Langlotz, Matthew Cook, and Holger Regenbrecht*

### **Automated Spatial Calibration of HMD Systems with Unconstrained Eye-cameras**

*Alexander Plopski, Jason Orlosky, Yuta Itoh, Christian Nitschke, Kiyoshi Kiyokawa, and Gudrun Klinker*

*\* TVCG Special Section Paper*

### **Gaussian Light Field: Estimation of Viewpoint-Dependent Blur for Optical See-Through Head-Mounted Displays**

*Yuta Itoh, Toshiyuki Amano, Daisuke Iwai, and Gudrun Klinker*

---

## **S&T POSTERS AND DEMOS SESSION B, Room Yucatán 1**

**Teaser Session, Room Yucatán 2, 15:00-16:00**

**Exhibition Session, Room Yucatán 1, 16:00-18:00**

---

### **Poster Session - Group B**

**BP01 A Haptic Serious Augmented Reality Game for Motor Assessment of Parkinson's Disease Patients**

*Erik van der Meulen, Marina A. Cidota, Stephan G. Lukosch, Paulina J.M. Bank, Aadjan J.C. van der Helm, and Valentijn T. Visch*

**BP02 Indoor Localisation and Navigation on Augmented Reality Devices**

*Gaurav Gupta, Nishant Kejriwal, Prasun Pallav, Ehtesham Hassan, Swagat Kumar, and Ramya Hebbalaguppe*

**BP03 Technical Concept and Technology Choices for Implementing a Tangible Version of the Sokoban Game**

*Granit Luzhnica, Christoffer Öjeling, Eduardo Veas, and Viktoria Pammer*

**BP04 Enhancing Immersive Cinematic Experience with Augmented Virtuality**

*Gun A. Lee, Joshua Chen, Mark Billingham, and Robert Lindeman*

**BP05 Diminishing Real Objects and Adding Virtual Objects Using a RGB-D Camera**

*Hajime Sasanuma, Yoshitsugu Manabe, and Noriko Yata*

- BP06 Frustration Free Pose Computation For Spatial AR Devices in Industrial Scenario**  
*Hemal Naik, Mahmoud Bahaa, Federico Tombari, Peter Keitler, and Nassir Navab*
- BP07 Low-Cost Depth Camera Pose Tracking for Mobile Platforms**  
*Insung Ihm, Youngwook Kim, Jaehyun Lee, Jiman Jeong, and Ingu Park*
- BP08 iRay: Mobile AR Using Structure Sensor**  
*Ioannis A. Kakadiaris, Mohammad M. Islam, Tian Xie, Christophoros Nikou, and Alan B. Lumsden*
- BP09 I want to change my floor: dominant plane recognition from a single image to augment the scene**  
*J. A. de Jesús Osuna-Coutiño, Claudia Cruz-Martínez, Jose Martinez-Carranza, Miguel Arias-Estrada, and Walterio Mayol-Cuevas*
- BP10 The RealityMashers: Augmented Reality Wide Field-of-View Optical See-Through Head Mounted Displays**  
*Jaron Lanier, Victor Mateevitsi, Kishore Rathinavel, Lior Shapira, Joseph Menke, Patrick Therien, Joshua Hudman, Gheric Speiginer, Andrea Stevenson Won, Andrzej Banburski, Xavier Benavides, Judith Amores, Javier Porras Lurashi, and Wayne Chang*
- BP11 3D Character Customization for Non-Professional Users in Handheld Augmented Reality**  
*Iris Seidinger and Jens Grubert*
- BP12 Distributed Optimization for Shadow Removal in Spatial Augmented Reality**  
*Jun Tsukamoto, Daisuke Iwai, and Kenji Kashima*
- BP13 IoT Platform-based iAR: a Prototype for Plant O&M Applications**  
*Jungmin Lee, Kyungho Lee, Byeongwook Nam, and Yuepeng Wu*
- BP14 Chromaticity Based Local Linear Regression for Color Distortion Estimation of Optical See-Through Displays**  
*Kang-Kyu Lee, Jae-Woo Kim, Je-Ho Ryu, and Jong-Ok Kim*
- BP15 Modeling Physical Structure as Additional Constraints for Stereoscopic Optical See-Through Head-Mounted Display Calibration**  
*Long Qian, Alexander Winkler, Bernhard Fuerst, Peter Kazanzides, and Nassir Navab*
- BP16 A Transitional AR Furniture Arrangement System with Automatic View Recommendation**  
*Mami Mori, Jason Orlosky, Kiyoshi Kiyokawa, and Haruo Takemura*
- BP17 Riverwalk: Incorporating Historical Photographs in Public Outdoor Augmented Reality Experiences**  
*Marco Cavallo, Geoffrey Alan Rhodes, and Angus Graeme Forbes*
- BP18 Designing AR systems to explore point-of-view, bias, and trans-cultural conflict**  
*Maribeth Gandy, Laura Levy, Scott Robertson, Jeremy Johnson, Jeff Wilson, Tony Lemieux, Susan Tamasi, Darlene Mashman, and Michele Sumler*

- BP19 Using Visual Effects to Facilitate Depth Perception for Spatial Tasks in Virtual and Augmented Reality**  
*Marina A. Cidota, Rory M.S. Clifford, Stephan G. Lukosch, and Mark Billinghurst*
- BP20 Acceptability of an A2R application: analysis of correlations between factors in a TAM**  
*Maritzol Tenemaza, Jaime Ramírez, and Angélica de Antonio*
- BP21 A LED-Based IR/RGB End-to-End Latency Measurement Device**  
*Markus Billeter, Gerhard Röthlin, Jan Wezel, Daisuke Iwai, and Anselm Grundhöfer*
- BP22 Real-time High Resolution 3D Data on the HoloLens**  
*Mathieu Garon, Pierre-Olivier Boulet, Jean-Philippe Doiron, Luc Beaulieu, and Jean-François Lalonde*
- BP23 Motion parallax representation for indirect augmented reality**  
*Fumio Okura, Yuya Nishizaki, Tomokazu Sato, Norihiko Kawai, and Naokazu Yokoya*
- BP24 Evaluating Positional Head-Tracking in Immersive VR for 3D Designers**  
*Max Krichenbauer, Goshiro Yamamoto, Takafumi Taketomi, Christian Sandor, Hirokazu Kato, and Steven Feiner*
- BP25 Mobile Guide to Augmented Reality for Campus of the Autonomous University of Nayarit**  
*Adalberto Iriarte-Solis, Palmira González-Villegas, Ricardo Fuentes-Covarrubias, and Gerardo Fuentes-Covarrubias*
- 

## Demos Session - Group B

- BD01 The Object of Absence**  
*Amauta García, David Camargo, Xchel Gallegos, Rubén Maldonado, Estrella Luna, Daniel Godínez, Adrián Monroy, Jaime Lobato, and Erika Athié*
- BD02 From CAD to 3D Tracking — Enhancing & Scaling Model-based Tracking for Industrial Appliances**  
*Harald Wuest, Timo Engekle, Folker Wientapper, Florian Schmitt, and Jens Keil*
- BD03 TeachAR: An Interactive Augmented Reality Tool for Teaching Basic English to Non-Native Children**  
*Che Samihah Che Dalim, Thammathip Piumsomboon, Arindam Dey, Mark Billinghurst, and Shahrizal Sunar*
- BD04 AR4AR based on ARVIDA Reference Architecture: Application Demonstration**  
*Frieder Pankratz and Gudrun Klinker*
- BD05 Do You See What I See? The Effect of Gaze Tracking on Task Space Remote Collaboration (paper)**  
*Kunal Gupta, Gun A. Lee, and Mark Billinghurst*

## S&T ORAL SESSIONS, Room Yucatán 2

### Oral Session 6: Education and Modeling

10:20-12:00

*Chair: Guillaume Moreau (Ecole Centrale de Nantes)*

#### **TactileVR: Integrating Physical Toys into Learn and Play Virtual Reality Experiences**

*Lior Shapira, Judith Amores, and Xavier Benavides*

#### **The Influence of using Augmented Reality on Textbook Support for Learners of Different Learning Styles**

*Jia Zhang, Amy Ogan, Tzu-Chien Liu, Yao-Ting Sung, and Kuo-En Chang*

*\* TVCG Special Section Paper*

#### **Retargeting Human-Object Interaction to Virtual Avatars**

*Yeonjoon Kim, Hangil Park, Seungbae Bang, and Sung-Hee Lee*

#### **Reality Skins: Creating Immersive and Tactile Virtual Environments**

*Lior Shapira, and Daniel Freedman*

---

### Oral Session 7: AR Everywhere

13:30-14:45

*Chair: Tobias Langlotz (University of Otago)*

#### **Augmented Reality 3D Discrepancy Check in Industrial Applications**

*Oliver Wasenmüller, Marcel Meyer, and Didier Stricker*

*\* TVCG Special Section Paper*

#### **A Real-time Augmented Reality System to See-Through Cars**

*François Rameau, Hyowon Ha, Kyungdon Joo, Jinsoo Choi, Kibaek Park, and In So Kweon*

*\* TVCG Conference Partner Presentation*

#### **Towards Pervasive Augmented Reality**

*Jens Grubert, Tobias Langlotz, Stefanie Zollmann, and Holger Regenbrecht*

---

## S&T POSTERS AND DEMOS SESSION C, Room Yucatán 1

**Teaser Session C, Room Yucatán 2, 15:00-16:00**

**Exhibition Session C, Room Yucatán 1, 16:00-18:00**

## Poster Session - Group C

- CP01 Reduction of Interaction Space in Single Point Active Alignment Method for Optical See-Through Head-Mounted Display Calibration**  
*Long Qian, Alexander Winkler, Bernhard Fuerst, Peter Kazanzides, and Nassir Navab*
- CP02 Augmented Cues Facilitate Learning Transfer from Virtual to Real Environments**  
*Natalia Cooper, Ferdinando Milella, Iain Cant, Carlo Pinto, Mark White, and Georg Meyer*
- CP03 Simultaneous Pose Estimation and Augmentation of Elastic Surfaces from a Moving Monocular Camera**  
*Nazim Haouchine, Marie-Odile Berger, and Stephane Cotin*
- CP04 HORUS EYE: See the Invisible Bird and Snake Vision for Augmented Reality Information Visualization**  
*Neven A. M. ElSayed, Ross T. Smith, and Bruce H. Thomas*
- CP05 An artistic and curatorial installation in virtual reality: the development of an artistic low-cost interface at university**  
*Pablo Gobira and Antônio Mozelli*
- CP06 A Tangible Volume for Portable 3D Interaction**  
*Paul Issartel, Lonni Besançon, Tobias Isenberg, and Mehdi Ammi*
- CP07 PoLAR: a Portable Library for Augmented Reality**  
*Pierre-Jean Petitprez, Erwan Kerrien, and Pierre-Frederic Villard*
- CP08 Evaluation of Motion Tracking and Depth Sensing Accuracy of the Tango Tablet**  
*Rafael Roberto, João Paulo Lima, Thúlio Araújo, and Veronica Teichrieb*
- CP09 An Evaluation of Information Connection in Augmented Reality for 3D Scenes with Occlusion**  
*Ralf Dauenhauer and Tobias Müller*
- CP10 An AR Inspection Framework: Feasibility Study with Multiple AR Devices**  
*Perla Ramakrishna, Ramya Hebbalaguppe, Gaurav Gupta, Geetika Sharma, Ehtesham Hassan, Monika Sharma, Lovekesh Vig, and Gautam Shroff*
- CP11 On Combining a Semi-Calibrated Stereo Camera and Massive Parallelism for Fast Plane Extraction**  
*Roberto de Lima, Jose Martinez-Carranza, Alicia Morales-Reyes, and Walterio Mayol-Cuevas*
- CP12 Reflectance and Illumination Estimation for Realistic Augmentations of Real Scenes**  
*Salma Jiddi, Philippe Robert, and Eric Marchand*
- CP13 Use of Random Dot Patterns for Achieving X-Ray Vision with Stereoscopic Augmented Reality Displays**  
*Sanaz Ghasemi, Mai Otsuki, and Paul Milgram*
- CP14 A Low Cost Optical See-Through HMD - Do-it-yourself**  
*Saul Delabrida, Thiago D'Angelo, Edson Carvalho, Antonio A. F. Loureiro, Ricardo A. Rabelo Oliveira, Mark Billingham, and Bruce Thomas*

- CP15 Randomly Distributed Small Chip Makers**  
*Sei Ikeda, Anh Nguyen Trung, Takumi Komae, Fumihisa Shibata, and Asako Kimura*
- CP16 Integrating Building Information Modeling with Augmented Reality for Interdisciplinary Learning**  
*Shahin Vassigh, Albert Elias, Francisco R. Ortega, Debra Davis, Giovanna Gallardo, Hadi Alhaffar, Lukas Borges, Jonathan Bernal, and Naphtali D. Rishé*
- CP17 GestAR: Real Time Gesture Interaction for AR with Egocentric View**  
*Srinidhi Hegde, Ramakrishna Perla, Ramya Hebbalaguppe, and Ehtesham Hassan*
- CP18 Motion-Aware Iterative Closest Point Estimation for Fast Visual Odometry**  
*Ting-Yu Lin, Chun-Wei Chen, Jonas Wang, and Ming-Der Shieh*
- CP19 Effective Registration for Multiple Users AR System**  
*Wen-Jie Chen, Chun-Wei Chen, Jonas Wang, and Ming-Der Shieh*
- CP20 Learning Object and State Models for AR Task Guidance**  
*William Hoff and Hao Zhang*
- CP21 On Stage Interactive Spatial AR for Drama Performance**  
*YanXiang Zhang, ZiQiang Zhu, and Fangbemi Abassin Sourou*
- CP22 Empower VR art and AR book with spatial interaction**  
*Yang Xiang Zhang, ZiQiang Zhu, and Zhu Yun*
- CP23 Augmenting Three-dimensional Effects in Digital Exhibition of a Cultural Artifact using 3D Pseudo Hologram**  
*Yong Yi Lee, Bilal Ahmed, Jong Hun Lee, Hyounggap An, and Kwan H. Lee*
- CP24 AR Tabletop Interface using a Head-Mounted Projector**  
*Yusuke Kemmoku and Takashi Komuro*
- 

## Demos Session - Group C

- CD01 Participatory Mixed Reality Space: Collective Memories**  
*Yun Tae Nam and Je-ho Oh*
- CD02 Scalable Mobile Image Recognition for Real-Time Video Annotation**  
*Philipp Fleck, Clemens Arth, and Dieter Schmalstieg*
- CD03 Blurry (Sticky) Finger: Proprioceptive Pointing and Selection of Distant Objects for Optical See-through based Augmented Reality**  
*Ja Eun Yu and Gerard J. Kim*
- CD04 InspectAR: An Augmented Reality Inspection Framework for Industry**  
*Ramakrishna Perla, Gaurav Gupta, Ramya Hebbalaguppe, and Ehtesham Hassan*
- CD05 Collaborative Content Creation with the OpenUIX Framework**  
*Mikel Salazar and Carlos Laorden*
- CD06 EyeAR: Refocusable Augmented Reality Content through Eye Measurements**  
*Damien Constantine Rompapas, Aitor Rovira, Sei Ikeda, Alexander Plopski, Takafumi Taketomi, Christian Sandor, and Hirokazu Kato*

## TUTORIALS

### T1: Daqri ARToolKit

Room Celestún, 09:00-10:00

#### Organizer:

Ben Vaughan (daqri.com)

Website: <http://artoolkit.org/>

---

### T2: Augmented Reality - Principles and Practice

Room Valladolid, 10:00-13:00

#### Organizer:

Dieter Schmalstieg (Graz University of Technology)

Tobias Höllerer (University of California, Santa Barbara)

Website: <http://www.augmentedrealitybook.org>

**Abstract:** This tutorial will provide a detailed introduction to Augmented Reality (AR). AR is a key user-interface technology for personalized, situated information delivery, navigation, on-demand instruction and games. The widespread availability and rapid evolution of smartphones and new devices such as HoloLens enables software-only solutions for AR, where it was previously necessary to assemble custom hardware solutions. However, ergonomic and technical limitations of existing devices make this a challenging endeavor. In particular, it is necessary to design novel efficient real-time computer vision and computer graphics algorithms, and create new lightweight forms of interaction with the environment through small form-factor devices. This tutorial will present selected technical achievements in this field and highlight some examples of successful application prototypes.

## WORKSHOPS

**WS1: 2nd International Workshop on Diminished Reality as Challenging Issue in Mixed and Augmented Reality (IWDR2016)**

**Room Celestún  
10:00-13:00  
14:30-16:00**

### **Organizer:**

Hideo Saito (Keio University)

Fumihisa Shibata (Ritsumeikan University)

Hideyuki Tamura (Ritsumeikan University)

Shohei Mori (Keio University)

Website: <http://www.rm.is.ritsumei.ac.jp/IWDR2016/>

**Abstract:** While Mixed and Augmented Reality (MR/AR) means technologies that add and/or overlay visual information onto images of real scene for providing users to enhance their visual experiences with the added/overlaid information, Diminished Reality (DR) aims the similar enhanced visual experiences by deleting visual information from the images of real scene. In this workshop, IWDR, the topics of interest are technical issues for DR, such as recovery of hidden area, detecting and tracking the object to be removed/diminished, tracking camera poses, illumination matching and re-lighting, etc. In addition to those technical issues for DR, examples of applications of DR, expected futures with DR, and human factors of DR are also included in the topics of interest of this workshop.

In ISMAR2014, we have organized the tutorial on diminished reality, which is followed by the success of IWDR2015, a workshop in ISMAR2015, which have a significant number of participants (<http://www.rm.is.ritsumei.ac.jp/IWDR2015/>). IWDR2016 will be expected to attract a lot of people in ISMAR2016, so that we can have meaningful meeting in ISMAR2016.

## WORKSHOPS

**WS2: Media, Arts, Social Sciences, Humanities  
& Design (MASH'D)**

**Room Mérida 1  
10:00-13:00  
14:30-17:00**

**Organizer:**

Jorge Ramirez (ANEMONAL)

Julian Staddon (Salzburg University of Applied Sciences)

Thomas Sanchez (MIT Media Lab)

Website: <http://www.anemonal.digital/activities/>

**Abstract:** ISMAR 2016 will cover the full range of technologies encompassed by the MR continuum, from interfaces in the real world to fully immersive experiences. This range goes far beyond the traditional definition of AR, which focused on precise 3D tracking, visual display, and real-time performance.

MASHD would like to invite contributions from areas fundamental to this mixed and augmented reality, particularly in the fields of digital media, art, social sciences, humanities and design. Now effectively in its seventh year, this separation of the conference was established to allow for a more specific focus on areas relating to creative production in mixed and augmented reality environments, both for entertainment and for more meaningful endeavors. This year sees the integration of MASHD into the main program, however we will provide a small series of separate workshops during the conference. MASHD workshop will be celebrated the 22 of September with the possibility to extend to September 23. Participants will be able to attend with the option of day passes, as well as full registrations for the whole ISMAR week from the 19th to 23rd September).

The 15th ISMAR brings new horizons to the community as it is the first in the series to be held in Latin America, responding to the recent explosion of commercial and research activities related to AR, MR, and Virtual Reality (VR) by continuing the expansion of its scope.

## WORKSHOPS

### **WS3: Workshop on Collaborative Mixed Reality Environments (CoMiRE)**

**Room Mérida 2 & 3**  
**10:00-13:00**  
**14:30-16:00**

#### **Organizer:**

Stephan Lukosch (Delft University of Technology)  
Leila Alem (Thoughtworks)  
Mark Billingham (University of South Australia)  
Steven Feiner (Columbia University)  
Kiyoshi Kiyokawa (Osaka University)  
Michael Prilla (Clausthal University of Technology)

Website: <https://comire16.wordpress.com/>

**Abstract:** The world is becoming more complex and problem solving often requires teams of experts to work together at the same or from different locations. To support this there is a need for collaborative tools, and a variety of teleconferencing and telepresence technologies have been developed. However, most of them involve some variation of traditional video conferencing, which has limitations, such as not being able to effectively convey spatial cues or share the user's task space. This workshop will focus on how these limitations can be overcome by using Mixed Reality (MR) technology, leading to the development of radically new types of collaborative experiences.

Mixed Reality (MR) environments are those that present real world and virtual world objects together within a single display, encompassing Augmented Reality (AR) and Augmented Virtuality (AV), as well as Virtual Reality (VR). With Augmented Reality, virtual data is spatially overlaid on top of a live view of the real world. Augmented Virtuality (AV) refers to the merging of real world objects into a virtual world. Virtual Reality replaces the user's real environments with a computer-generated 3D virtual world and lets the user interact in that world. MR environments can be used to merge the shared perceived realities of different users, as well as enrich each user's own individual experience in a collaborative task. However, despite the potential that MR has for collaborative applications, MR research often focuses on individual usage and more exploration needs to be done on the potential of MR for creating innovative collaborative experiences.

This workshop will bring together researchers who are interested in developing collaborative MR systems. We will build a picture of current and prior research on collaboration in MR, as well as set up a common research agenda for work going forward. This, in turn, can be used to grow the research community.

## TUTORIALS

**T3: Microsoft Hololens**

**Room Celestún, 09:00-10:00**

**Organizer:**

Alejandra Gonzales (microsoft.com)

Website: <https://www.microsoft.com/microsoft-hololens/>

---

## WORKSHOPS

**WS2: Media, Arts, Social Sciences, Humanities  
& Design (MASH'D)**

**Room Mérida 1, 10:00-13:00  
14:30-17:00**

**Organizer:**

Jorge Ramirez (ANEMONAL)

Julian Staddon (Salzburg University of Applied Sciences)

Thomas Sanchez (MIT Media Lab)

Website: <http://www.anemonal.digital/activities/>

**Abstract:** MASHD would like to invite contributions from areas fundamental to this mixed and augmented reality, particularly in the fields of digital media, art, social sciences, humanities and design. Now effectively in its seventh year, this separation of the conference was established to allow for a more specific focus on areas relating to creative production in mixed and augmented reality environments, both for entertainment and for more meaningful endeavors. This year sees the integration of MASHD into the main program, however we will provide a small series of separate workshops during the conference. MASHD workshop will be celebrated the 22 of September with the possibility to extend to September 23. Participants will be able to attend with the option of day passes, as well as full registrations for the whole ISMAR week from the 19th to 23rd September).

## WORKSHOPS

**WS4: Standards for Mixed and Augmented Reality**      **Room Mérida 2 & 3, 09:00-12:30  
14:00-16:30**

### **Organizer:**

Gerard J. Kim (Korea University)

Website: <https://dpx.korea.ac.kr/ismar2016-workshop-standards/>

**Abstract:** Mixed and augmented reality (MAR) is on the brink of large-scale consumer level commercialization. For MAR to succeed and proliferate as an information media and new contents platform, standards will be necessary so that MAR system components can easily be plugged in and contents shared and interoperable. The workshop will be an arena to discuss and lay a foundation to many issues of standardization for MAR, including (but not limited to): proper subareas for standards and abstract levels, physical and environment object representation, content file format, standard calibration process, augmentation and display style standards, standards for non-visual and multimodal augmentation, object feature presentation, benchmarking, etc.

Despite its importance, there has been very little discussion of standards for MAR, especially from the academics and research community. It is critical that standards for MAR be developed on a sound basis with input from the academia and research community, for it to be correct, comprehensive, effective and extendible for the future.

Standardization for MAR is being pushed through few organizations, such as the ISO (International Standards Organization), OGC (Open Geospatial Consortium) and by privately organizations such as the Perey Associates. Such movements reflect the recent rise in the interest in AR and the large commercialization efforts. However, there are so many areas to cover and the efforts are still limited by the lack of areal experts.

## WORKSHOPS

**WS5: Workshop on Human Behavior Analysis and Visualization for Collective Visual Sensing**

**Room Valladolid  
10:00-13:00**

**Organizer:**

Hideo Saito (Keio University)

Yuta Itoh (Keio University)

Maki Sugimoto (Keio University)

Website: <http://www.hci.iis.u-tokyo.ac.jp/~cvs/ISMAR2016-CVSWorkshop>

**Abstract:** This workshop features Collective Visual Sensing (CVS), a developing research area that aims to understand group attention and activities by analyzing information gathered from multiple wearable devices, such as wearable cameras and eye trackers.

Understanding user's' gaze information has become a blazing topic in VR/AR community along with the recent growth of wearable display systems. Some existing systems already enable us to shoot objects by "looking" in a VR world. Not only explicit directive information, gazes contains users' implicit attention and behaviors. In the future, such systems would readily allow us to measure "what users want to do" by analyzing their gazes. Furthermore, we foresee that interactions among users in VR/AR environments will drastically change by utilizing collective visual sensing, i.e. analyzing the gaze of multiple users in a shared workspace.

To foster this upcoming research topic, this workshop focuses on: (1) developing technologies for extracting measurements through the use of collective visual sensing, (2) developing technologies for understanding group activities and intent, and (3) building assistive systems based on developed technologies for various applications in collaborative workspaces.

## WORKSHOPS

### **WS6: Perceptual Issues in Augmented Reality**

**Room Celestún**  
**10:00-13:00**  
**14:30-15:30**

#### **Organizer:**

Guillaume Moreau (Ecole Centrale Nantes)

Yue Liu (Beijing Institute of Technology)

Website: <https://sites.google.com/site/ismarhrforar/>

**Abstract:** Augmented reality (AR) is a live direct or indirect view of a real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. With the help of advanced AR technology, the information about the surrounding real world of the user becomes interactive and digitally manipulable and artificial information about the environment and its objects can be overlaid on the real world. Natural, portable and efficient AR system can be implemented by combining human computer interaction (HCI) realized with gesture inputs and wearable computing based on 3D see-through head mounted display, which possesses great application potentials. However, there are currently many human factor problems associated with AR technology. For instance, it involves the perception modeling and display quality forecast of 3D complex scenes; it requires the integration mechanism of the wearable computing devices and the HCI methods as well as the ergonomics analysis; and it suffers from the comfort evaluation and the setup of AR system.

A few papers were dedicated to human factors issues those last years in ISMAR as well as in related conferences such as IEEE VR, we strongly believe that with the democratization of AR technologies, the interest will increase. The goal of this workshop is to review the challenges of human factors in AR and the available methods that aim at solving some of those challenges and to give the audience an overview of the variety of the existing and yet to invent evaluation approaches. Beyond the classical presentations and discussions of a workshop, a particular goal of this workshop is the production of a collective document (in a publishable form?) about remaining challenges of human factors in AR. The second output will be a website including challenges, solutions to this challenges and applications pages.

This workshop aims at gathering researchers that aim at developing natural, portable and efficient AR system or who want to extend their knowledge about the human factor issues in AR. Practitioners of the field are also welcome to acquire knowledge of what is currently being done and what could be done in a near future. One of the goal of this workshop is also to be interdisciplinary by mixing researchers in computer science, psychophysics and ergonomics.

## WORKSHOPS

**WS7: Interaction Design Principles of Augmented Reality** Room Santa Lucía  
**focusing on the Ageing Population** 10:00-13:00  
14:30-16:00

### Organizer:

Chris Roast (Sheffield Hallam University)

Elizabeth Uruchurtu (Sheffield Hallam University)

Sha Liang (Sheffield Hallam University)

Website: <https://ismardesignprinciples.wordpress.com/>

**Abstract:** Augmented Reality is becoming a mature and robust technology, which combines virtual information with the real environment and real-time performance. Research priorities have shifted from tackling hardware and software issues toward the design of AR effectiveness and usefulness. With the growing ageing population, evidence shows potential trends for AR systems to support the elderly, including transport, home activities, entertainment and training. However, there is a lack of research to provide frameworks to support designers when developing AR applications for specific populations – in this case the ageing population. In this workshop, we intend to explore AR design principles in this challenging and relevant area.

Despite the relative success and acceptance of AR technology and ‘solutions’ the value of a framework to support design is important in establishing core factors that underpin AR, and in doing so helps explore the space of alternative and innovative solutions.

Globally, the ageing population is growing rapidly and presenting new challenges for society. The impairments of age, include: mental and physical deterioration, memory loss, and sensory degradation; these in turn impact upon health, mobility and quality of life. AR and related technologies have a high potential to address these challenges. Conference participants should be interested in how the needs of this significant population can be effectively addressed through productive and informed design processes.

The workshop aims to bring together experts in the fields of ageing, health and AR design and development. The proposed workshop is timely because it addresses the current crisis in meeting the needs the ageing population. This is a significant real world challenge for technology design and development. The workshop will provide a foundation for developers to identify approaches towards effective user engagement, innovation and design for this vulnerable group.

# HACKATHON

**18<sup>th</sup> – 21<sup>st</sup> September, Room Celestún**

**Organizer:**

Manuel Huber (Technische Universität München)

Renato Salas (Oculus)

Jean-Bernard Hayet (Centro de Investigacion en Matematicas)

**Goals**

This ISMAR2016 Hackathon is organized with the aim of encouraging rapid idea creation around AR technologies that will drive future applications and highlight areas of future research value, demonstrating technologies readiness/adaptability as opposed to hand-crafted demos, and promoting the fundamental role of multi-disciplinary team work.

**General Principles**

Several teams will work during 4 days towards completing an AR application designed around one theme disclosed at the beginning of the Hackathon. The participants will be given this theme as a broad topic and they are expected to implement an AR application with their own interpretation of this theme. We expect teams to organise their time spent at the Hackathon around other activities or sessions they plan to attend at ISMAR. The participants will have a special room within the ISMAR conference venue for working on their project. This room will be open from 10:00 to 19:00, depending on the day. Prior to the Hackathon, additional guidelines will be given about what to expect in the event (e.g: hardware available, venue, etc.), so team members can be prepared.

There are several technical categories in which the teams can participate. The Hackathon has a strict time schedule, without extra time allowance.

Timetables (all times in Merida local time):

- 18th September, 12 p.m.: Team assembling
- 18th September, 2 p.m.: Hackathon start
- 21st September, 2 p.m.: Hackathon end
- 21st September, afternoon: Review of the team’s deliverables
- 21st September, evening: Results announced as part of the ISMAR closing ceremony and prizing

More information please refer to the Hackathon at ISMAR2016 website.

**Register your interest**

All hackathon participants must be registered to ISMAR 2016 by sending an email to [hackathon@ismar2016.org](mailto:hackathon@ismar2016.org). Your email should include: Full name, affiliation and brief description of your AR background, hardware and software you are planning to use, the technical category you are planning to apply to.

# First Augmented Reality School AR101

September 18, Room Mérida  
09:00-18:00

AR101 (An Introduction to Augmented Reality) is a unique opportunity exclusive to Students and Junior Faculty in Mexico to learn from world experts about the exciting area that is Augmented Reality. AR101 provides an opportunity to explore your research interests in this area through an interdisciplinary tutorial, under the guidance of Augmented Reality (AR)'s top researchers, our rockstARs.

AR101 will be held on Sunday 18th of September 2016, one day before the main ISMAR conference starts. Attendees will be able to interact closely with the rockstAR researchers. Furthermore, selected students will be given free registration to the ISMAR conference where they will be able to learn about the state of the art in this area. ISMAR will also offer a way to learn about PhD, internship and MSc opportunities via the Pitch Your Lab event to facilitate develop your career in this area.

## **AR101 Organising Committee:**

Javier Flavio Viguera, Universidad Autónoma de San Luis Potosí

Greg Welch, University of Central Florida

Walterio Mayol-Cuevas, University of Bristol

Anabel Martin-Gonzalez, Universidad Autónoma de Yucatán

Erick Méndez, Daqri

Edgar Arce, Universidad Autónoma de San Luis Potosí

Claudia Esteves, Universidad de Guanajuato

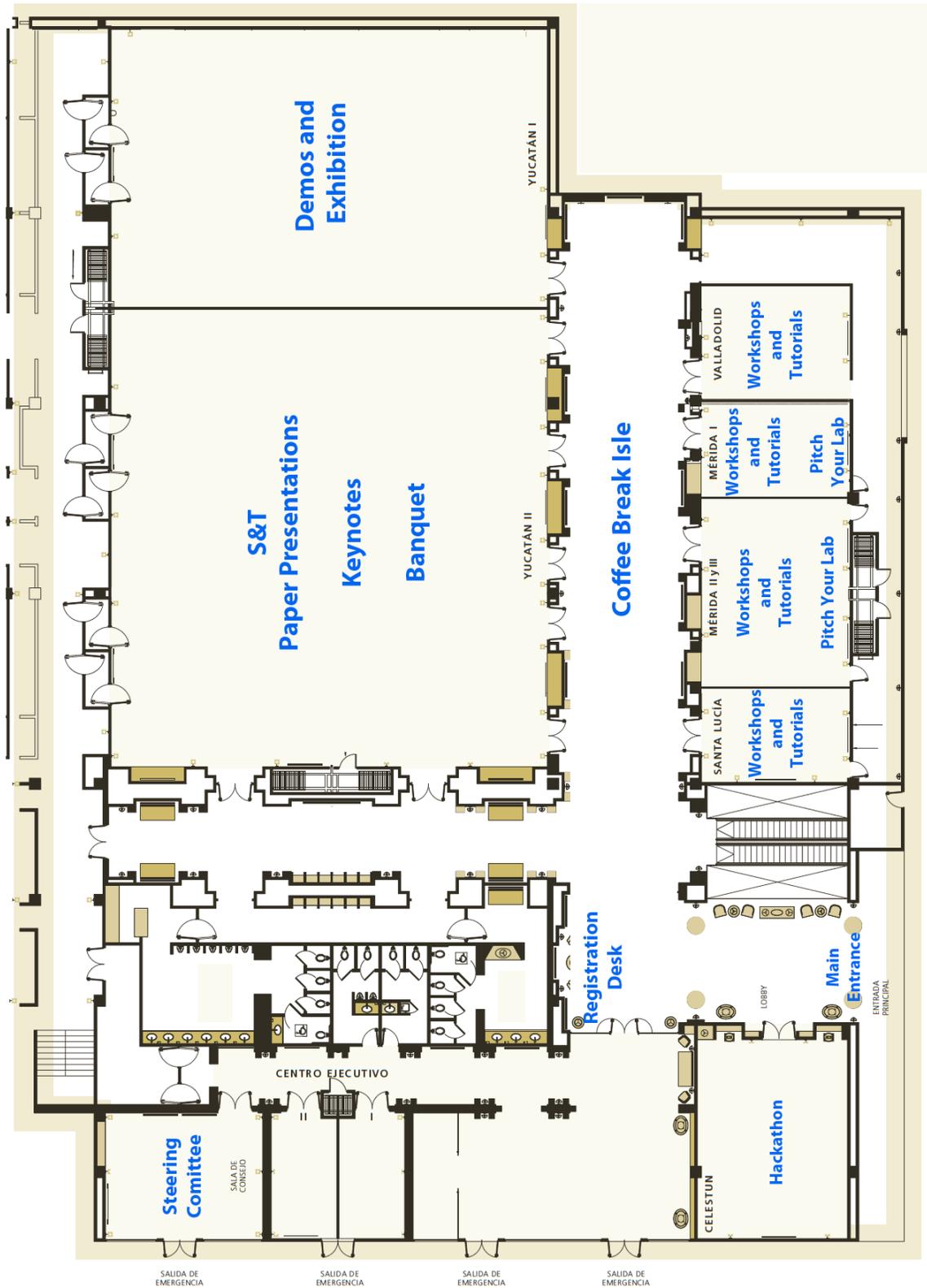
# First Augmented Reality School AR101

## AR101 Program

Time	Topic	Speaker / rockstAR	Institution
8:30	<b>Registration</b>		
9:00 - 10:00	Introduction: Historical Perspectives and Applications	Mark Billinghurst	University of South Australia
10:00 - 11:00	Overview of Primary Research Areas: Displays, Tracking, Rendering, UI Methods	Tobias Höllerer & Dieter Schmalstieg	University of California, Santa Barbara & Technische Universität Graz
11:00 - 11:15	<b>Coffee Break</b>		
11:15 - 12:00	Tracking: General & Vision-Based	Gerhard Reitmayr	Qualcomm Research
12:00 - 12:45	Rendering / Graphics for AR	Tobias Höllerer & Dieter Schmalstieg	University of California, Santa Barbara & Technische Universität Graz
12:45 - 13:30	AR Displays	Kiyoshi Kiyokawa	Osaka University
13:30	<b>Lunch at Café Montejo</b>		
14:45 - 15:30	Collaboration in AR	Steven Feiner	Columbia University
15:30 - 16:15	Projector-Based AR	Greg Welch	University of Central Florida
16:15 - 16:30	<b>Coffee Break</b>		
16:30 - 17:15	Input / Interface Techniques	Tobias Höllerer & Dieter Schmalstieg	University of California, Santa Barbara & Technische Universität Graz
17:15 - 18:00	Reconstruction	TBA	TBA
18:30	<b>AR101 Dinner at Katun Restaurant</b>		

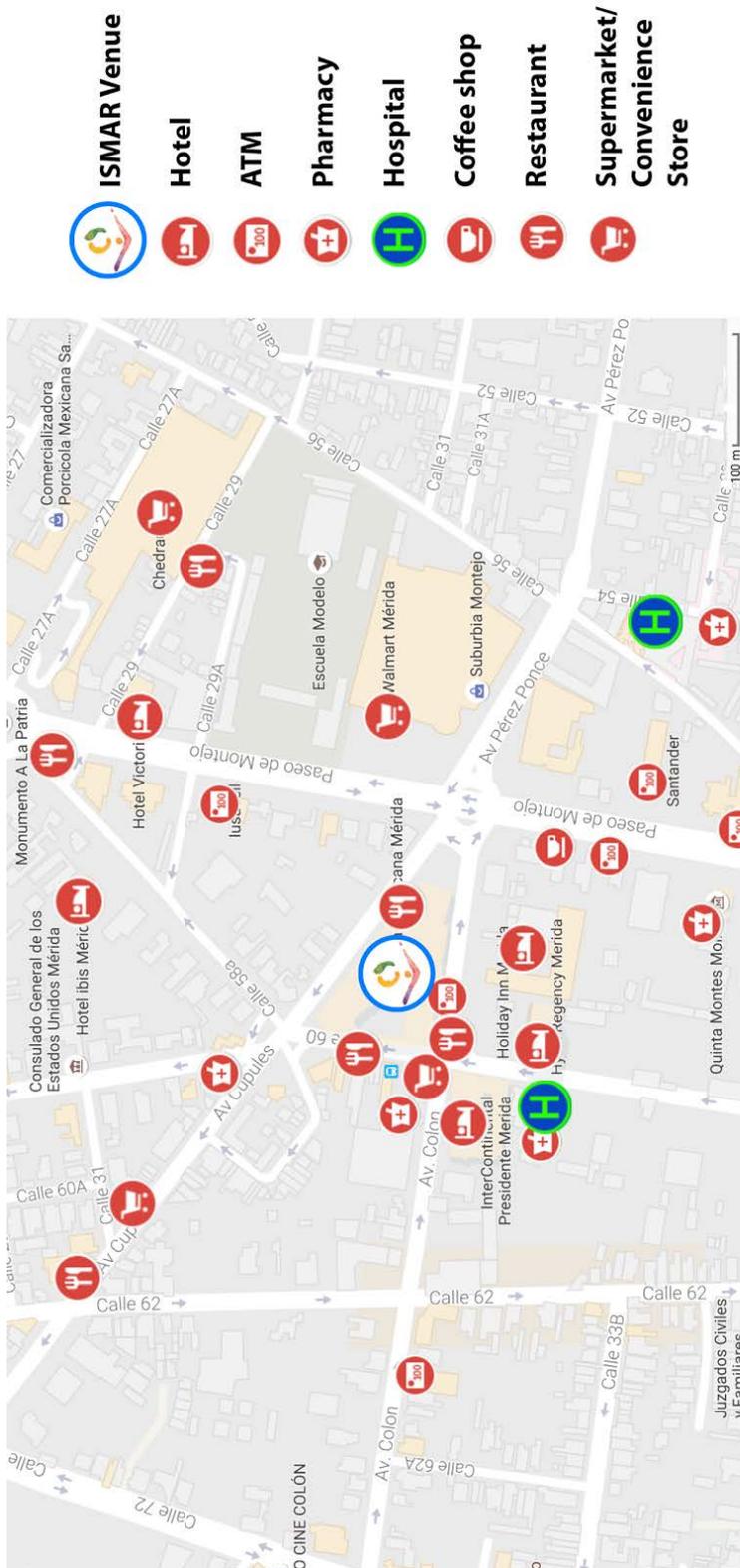
# Venue Floorplan

## Fiesta Americana Hotel - Main Conference Rooms



# Restaurants and other Services

Restaurants and other facilities in the area around the venue



Your registration may include a free lunch in one of the Fiesta Americana restaurants, please check your tickets



# A Brief Guide to Yucatan's Cuisine

Delights to the palate with flavors not traditionally prepared in other parts of Mexico.



**Cochinita Pibil** is a traditional Mexican slow-roasted pork dish from the Yucatán Península of Mayan origin. Commonly served with pickled red onion.



**Poc chuc** is a Mexican dish of meat, commonly pork, that is prepared in citrus marinade and cooked over a grill. Poc chuc is often served with a side of rice, pickled onion, refried beans, and avocado.



**Papadzules** is a traditional dish from the Yucatán Peninsula resembling enchiladas. In its simplest form it consists of corn tortillas dipped in a sauce of pepita filled with hard-boiled eggs, and garnished with a cooked tomato-pepper sauce.



**Tikin Xic**, pronounced "teekeen sheek" in Yucatec Mayan and meaning "dry fish", is a fish dish prepared in the Meso-American style.

# A Brief Guide to Yucatan's Cuisine

Delights to the palate with flavors not traditionally prepared in other parts of Mexico.



A **Panucho** is made with a refried tortilla. Stuffed with refried black beans and topped with chopped cabbage, pulled chicken or turkey, tomato, pickled red onion, avocado, and pickled jalapeño pepper.



**Escabeche Oriental**, is turkey or chicken marinated in a mixture of coriander, salt, pepper, cumin, cloves, cinnamon, vinegar and garlic. Boiled in water with onion strips and sour orange juice. The poultry is served crispy and bathed with fried onion and *xcat-ik* or blonde chilis strips. Its called oriental, as it comes from the eastern city of Valladolid.



**Stuffed Cheese**, made with a special Edam-like Cheese Ball from Holland and not available in the rest of Mexico. Stuffed with a mixture of ground pork and beef, tomatoes, raisins, capers, olives and slivered almonds.



**Lima Soup**, is a combination of Yucatan's lima, chicken or turkey meat and broth. Accompanied with fried hard tortillas. Lima is not to be confused with lime it's a totally different citrus fruit only grown in Yucatan.



# DAQRI

Handwriting practice lines consisting of 20 horizontal dashed lines.





A series of horizontal dashed lines for writing, consisting of 20 lines.

A series of 25 horizontal dashed lines spanning the width of the page, intended for writing or drawing.



The 15th IEEE International Symposium  
on Mixed and Augmented Reality - ISMAR 2016  
September 19-23 | Merida, MEXICO

