# IS&T International Symposium on

# Electronic Imaging

## SCIENCE AND TECHNOLOGY

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## The Engineering Reality of Virtual Reality 2017

Editors: **Margaret Dolinsky,** Indiana Univ. (United States),
**Ian E. McDowall,** Fakespace Labs, Inc. (United States)

# The Engineering Reality of Virtual Reality 2017

## Symposium Chairs
**Nitin Sampat,** Rochester Institute of Technology (United States)
**Joyce Farrell,** Stanford University (United States)

## Symposium Short Course Chairs
**Mohamed-Chaker Larabi,** University of Poitiers (France)
**Jonathan B. Phillips,** Google, Inc. (United States)

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## Past Symposium Chair
**Choon-Woo Kim,** Inha University (Republic of Korea)

## Conference Chairs
**Margaret Dolinsky,** Indiana Univ. (United States)
**Ian E. McDowall,** Fakespace Labs, Inc. (United States)

## Introduction

The Engineering Reality of Virtual Reality 2017 conference was held in Burlington, California during the IS&T International Symposium on Electronic Imaging January 29 - February 2, 2017. This year's conference spanned two days with keynotes by Gregory Dawe, Industrial Designer from the Qualcomm Institute (also known as Cal IT2) and Todd Margolis, Qlik Product Manager. Greg spoke about the history of projection display systems describing how the first CAVE Automatic Virtual Environment was designed to the new multi-panel stereo displays such as then CAVE2 and the WAVE Augmented Virtual Environment. Todd presented research and deployment at Qlik about state of the art collaborative visual analytics. The conference ended with a tour at the Qlik headquarters with demonstrations.

Virtual and augmented reality systems are evolving. In addition to research, the trend toward content building continues and practitioners find that technologies and disciplines must be tailored and integrated for specific visualization and interactive applications. This conference serves as a forum where advances and practical advice toward both creative activity and scientific investigation are presented and discussed. Research results can be presented and applications can be demonstrated.

ERVR 2017 began with several case studies. One of these examined AR use in medical training. AR devices have been around for many decades but are finally becoming affordable and viable as a consumer device. Through direct representation of 3D space and integration with haptic controls, AR brings many benefits to a user during training scenarios, namely increased knowledge acquisition and direct applicability.

Subsequent presentations explored head-mounted displays and CAVE environments, augmented reality registration challenges, use of natural body gestures in VR environments, and artistic expression and creative experiences in VR, among other topics.

The joint session on Visualization Facilities with the Stereoscopic Displays and Applications Conference brought together researchers from Newcastle University's Digital Institute, the Electronic Visualization Laboratory (EVL) at The University of Illinois at Chicago, the Advanced Visualization Lab at Indiana University, UC San Diego's Calit2, the Immersive Analytics initiative of Monash University and the University of Konstanz, and the Curtin University HIVE visualization facility, in a rare world-spanning discussion of recent advances and current challenges.

The conference included a field trip to a local company, Qlik, a business software firm that provides solutions for data visualization and visual analytics. We were hosted by Todd Margolis who delivered a keynote address on visual analytics and collaboration. At Qlik, we saw demonstrations that are real world solutions using graphical outputs, flat panel displays, and virtual reality systems.

— Margaret Dolinsky, Indiana Univ.
Ian E. McDowall, Fakespace Labs, Inc.

# The Engineering Reality of Virtual Reality 2017

## Wednesday, February 1, 2017

### The Real World Meets VR: Case Studies

Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)

**9:10 – 10:10 am**
Sandpebble A

9:10     5
**Oculus rift with stereo camera for augmented reality medical intubation training,** *Kyung yul Kevin Lim, Preetham Suresh, and Jürgen Schulze, University of California, San Diego (United States)* [ERVR-089]

9:30     11
**Virtual reality instructional modules in education based on gaming metaphor,** *Sharad Sharma and Emmanuel Ossuetta, Bowie State University (United States)* [ERVR-090]

9:50     19
**Soft robotic glove for kinesthetic haptic feedback in virtual reality environments,** *Saurabh Jadhav, Vikas Kannanda, Bocheng Kang, Michael Tolley, and Jürgen Schulze, University of California, San Diego (United States)* [ERVR-102]

10:00 am – 4:00 pm     Industry Exhibition
10:10 – 10:50 am     Coffee Break

### Positioning the Body in VR

Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)

**10:50 am – 12:30 pm**
Sandpebble A

10:50     25
**The Destiny-class CyberCANOE- a surround screen, stereoscopic, cyber-enabled collaboration analysis navigation and observation environment,** *Noel Kawano, Ryan Theriot, Jack Lam, Eric Wu, Andrew Guagliardo, Dylan Kobayashi, Alberto Gonzalez, Ken Uchida, and Jason Leigh, University of Hawai'i at Manoa (United States)* [ERVR-093]

11:10     31
**CAVE versus head-mounted displays: On-going thoughts,** *Daniel Mestre, CNRS (France)* [ERVR-094]

11:30     36
**Distributed VR rendering using NVIDIA OptiX,** *Dylan McCarthy and Jürgen Schulze, University of California, San Diego (United States)* [ERVR-095]

11:50     42
**Laser illuminated projectors and the technological advancements brought forth to immersive environments,** *Dirk Reiners[1], Danielle Rose Rains[1], Walter Burgess[2], and Carolina Cruz-Neira[1]; [1]University of Arkansas at Little Rock and [2]Power Technology Inc. (United States)* [ERVR-096]

12:10     48
**New VR navigation techniques to reduce cybersickness,** *Andras Kemeny[1,2], Paul George[1], Frédéric Mérienne[1], and Florent Colombet[2]; [1]Arts et Métiers ParisTech and [2]Renault (France)* [ERVR-097]

12:30 – 2:00 pm     Lunch Break

### EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
**2:00 – 3:00 pm**
Grand Peninsula Ballroom D

**Designing VR video camera systems,** *Brian Cabral, Facebook, Inc. (United States)*

*Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.*

3:00 – 3:30 pm     Coffee Break

### Visualization Facilities Joint Session

Session Chairs: Margaret Dolinsky, Indiana University (United States), and Andrew Woods, Curtin University (Australia)

**3:30 – 5:40 pm**
Grand Peninsula Ballroom D

*This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and The Engineering Reality of Virtual Reality 2017.*

3:30
**Designing a cloud-based 3D visualization engine for smart cities,** *Nicolas Holliman, Stephen Dowsland, Mark Turner, Richard Cloete, and Tom Picton, Newcastle University (United Kingdom)* [SD&A-105]

3:50
**Interactive computer graphics, stereo and VR practice at the Electronic Visualization Laboratory University of Illinois at Chicago,** *Maxine Brown[1], Jason Leigh[2], Tom DeFanti[3], and Daniel Sandin[1]; [1]The University of Illinois at Chicago, [2]University of Hawai'i at Manoa, and [3]University of California, San Diego (United States)* [SD&A-106]

4:10

**Designing at the Advanced Visualization Lab at Indiana University,** *Margaret Dolinsky[1], Eric Wernert[2], Michael Boyles[2], and Edward J. Dambik[2]; [1]School of Art and Design, Indiana University and [2]Advanced Visualization Lab, Indiana University (United States)* [ERVR-107]

4:30

**Exploring Calit2,** *Jürgen Schulze and Gregory Dawe, University of California, San Diego (United States)* [ERVR-108]

4:50

**3D-Stereoscopic immersive analytics projects at Monash University and University of Konstanz,** *Björn Sommer[1,3], David G. Barnes[1,4], Sarah Boyd[1], Thomas Chandler[1], Maxime Cordeil[1], Karsten Klein[1,3], Toan Nguyen[4], Hieu Nim[1,5], Kingsley Stephens[1], Dany Vohl[2], Elliott Wilson[1], Jon McCormack[1], Kim Marriott[1], and Falk Schreiber[1,3]; [1]Monash University (Australia), [2]Swinburne University of Technology (Australia), [3]University of Konstanz (Germany), [4]Monash Immersive Visualization Platform at Monash University (Australia), and [5]Australian Regenerative Medicine Institute of Monash University (Australia)* [SD&A-109]

5:10

**Image distortions in large-scale immersive display systems – Cylinder and wedge displays,** *Andrew Woods[1], Joshua Hollick[1], Jesse Helliwell[1], and Paul Bourke[2]; [1]Curtin University and [2]University of Western Australia (Australia)* [SD&A-110]

5:30

**SD&A Closing Remarks,** *Nicolas Holliman, Newcastle University (United Kingdom)*

**Symposium Interactive Papers (Poster) Session
5:30 – 7:00 pm**
Atrium

# Thursday, February 2, 2017

**Keynote: Immersive Visualization Room - Design and Build**
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)
**9:10 – 10:10 am**
Sandpebble A

**VR journeys from the dark ages to a bright future,** *Gregory Dawe, University of California, San Diego (United States)* [ERVR-098]

*Gregory Dawe, the design engineer who made many iterations of CAVE systems possible, will share his perspective on the progression of virtual reality from the first CRT based CAVE system and how it was enhanced during the digital projector era to where we are now with present day flat panel systems. He will discuss the technological quest to improve brightness, resolution and contrast in the crusade to exceed human acuity.*

**Qlik Introduction**

Session Chair: Margaret Dolinsky, Indiana University (United States)

**10:10 – 10:30 am**
Sandpebble A

**The Qlik Environment,** *Todd Margolis, Qlik (United States)* [ERVR-099]

10:30 – 10:50 am     Coffee Break

**Kit and Kaboodle: VR Gear**

Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)

**10:50 am – 11:50 am**
Sandpebble A

10:50                                                                                     54

**Decoupling of real and digital content in projection-based augmented reality systems using time multiplexed image capture (JIST-first),** *Shoaib Soomro[1], Erdem Ulusoy[1], and Hakan Urey[2]; [1]Optical Microsystems Laboratory, Koc University and [2]Koç University (Turkey)* [ERVR-104]

11:10                                                                                     60

**Exploring body gestures as natural user interface for flying in a virtual reality game with Kinect,** *Xin Tong, Serkan Pekcetin, Diane Gromala, and Frederico Machuca, Simon Fraser University (Canada)* [ERVR-101]

11:30

**Drawing towards virtual reality,** *Margaret Dolinsky, Indiana University (United States)* [ERVR-092]

12:30 – 2:00 pm     Lunch Break

**Qlik Field Trip: Showcase for VR, AR, and Visual Analytics Applications**

Host: Todd Margolis, Qlik (United States)
Session Chairs: Margaret Dolinsky, Indiana University, and Ian McDowall, Intuitive Surgical / Fakespace Labs (United States)

**2:00 – 5:00 pm**
Offsite

*Todd Margolis will host the ERVR group at Qlik, located a five minute car ride or 30 min walk from the conference. Sign up in advance at the registration desk. Transportation on your own.*