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PROCEEDINGS

3D Imaging and Applications 2021

Editors: **Tyler Bell**, University of Iowa (United States);
William Puech, Laboratory d'Informatique de Robotique et de Microelectronique de Montpellier (France); and
Robert Sitnik, Warsaw University of Technology (Poland)

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3D Imaging and Applications 2021

Conference overview

Scientific and technological advances during the last decade in the fields of image acquisition, processing, telecommunications, and computer graphics have contributed to the emergence of new multimedia, especially 3D digital data. Nowadays, the acquisition, processing, transmission, and visualization of 3D objects are a part of possible and realistic functionalities over the internet. Confirmed 3D processing techniques exist and a large scientific community works hard on open problems and new challenges, including 3D data processing, transmission, fast access to huge 3D databases, or content security management.

The emergence of 3D media is directly related to the emergence of 3D acquisition technologies. Indeed, recent advances in 3D scanner acquisition and 3D graphics rendering technologies boost the creation of 3D model archives for several application domains. These include archaeology, cultural heritage, computer assisted design (CAD), medicine, face recognition, video games, and bioinformatics. New devices such as time-of-flight cameras open challenging new perspectives on 3D scene analysis and reconstruction.

Three-dimensional objects are more complex to handle than other multimedia data, such as audio signals, images, or videos. Indeed, only a unique and simple 2D grid representation is associated to a 2D image. All the 2D acquisition devices generate this same representation (digital cameras, scanners, 2D medical systems). Unfortunately (for the users), but fortunately (for scientists), there exist different 3D representations for a 3D object. For example, an object can be represented on a 3D grid (digital image) or in 3D Euclidian space. In the latter, the object can be expressed by a single equation (like algebraic implicit surfaces), by a set of facets representing its boundary surface, or by a set of mathematical surfaces. One can easily imagine the numerous open problems related to these different representations and their processing, a new challenge for the image processing community.

Conference Chairs: Tyler Bell, University of Iowa (United States); William Puech, Laboratory d'Informatique de Robotique et de Microelectronique de Montpellier (France); and Robert Sitnik, Warsaw University of Technology (Poland)

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3D Imaging and Applications 2021 (3DIA)

TUESDAY 19 JANUARY 2021

PLENARY: DEEP INTERNAL LEARNING—DEEP LEARNING WITH ZERO EXAMPLES

Session Chair: Charles Bouman, Purdue University (United States)

10:00 – 11:10

Deep internal learning—Deep learning with zero examples

Michal Irani, professor, Department of Computer Science and Applied Mathematics, Weizmann Institute of Science (Israel)

Michal Irani is a professor at the Weizmann Institute of Science. Her research interests include computer vision, AI, and deep learning. Irani's prizes and honors include the Maria Petrou Prize (2016), the Helmholtz "Test of Time Award" (2017), the Landau Prize in AI (2019), and the Rothschild Prize in Mathematics and Computer Science (2020). She also received the ECCV Best Paper Awards (2000 and 2002), and the Marr Prize Honorable Mention (2001 and 2005).

3D IMAGING FOR CULTURAL HERITAGE APPLICATIONS

Moderator: Robert Sitnik, Warsaw University of Technology (Poland) / **Session Chair:** Theoharis Theoharis, Norwegian University of Science and Technology (Norway)

12:00 – 13:00

12:00 3DIA-063

An automated adaptive focus pipeline for reflectance transformation imaging, *David Lewis*¹, *Marvin Nuri*¹, *Gaetan Le Goic*¹, *Fabrice Meriaudeau*², and *Alamin Mansouri*¹; ¹Universite de Bourgogne and ²Universiti Teknologi PETRONAS (France)

12:20 3DIA-064

Approach for identification of geometry change on cultural heritage surface, *Sunita Saha*¹, *Anna Duda-Maczuga*², *Athanasia Papanikolaou*¹, and *Robert Sitnik*³; ¹Politechnika Warszawska, ²Akademia Sztuk Pięknych w Warszawie, and ³Warsaw University of Technology (Poland)

12:40 3DIA-065

3D digital image correlation system for monitoring of changes induced by RH fluctuations on parchment, *Athanasia Papanikolaou*¹, *Dorota Dzik-Kruszelnicka*², *Marcin Adamczyk*¹, *Sunita Saha*¹, and *Malgorzata Kujawinska*¹; ¹Politechnika Warszawska and ²Akademia Sztuk Pięknych w Warszawie (Poland)

CONFERENCE INTERACTIVE POSTER

13:00 3DIA-069

3DIA POSTER: 3D shape estimation for smooth surfaces using double mirror system, *Yin Wang*¹, *Davi He*², *Zillion Lin*², *George Chiu*¹, and *Jan Allebach*¹; ¹Purdue University (United States) and ²SunValley Tek (China)

3D COMPRESSION AND PROCESSING

Moderator: Robert Sitnik, Warsaw University of Technology (Poland) / **Session Chair:** William Puech, University of Montpellier (France)

13:30 – 14:30

13:30 3DIA-060

Performance comparison of video encoders in light field image compression, Hadi Amirpour¹, Antonio Pinheirc^{1,2}, Manuela Pereira^{1,2}, and Mohammad Ghanbari³; ¹Universidade da Beira Interior (Austria), ²Instituto de Telecomunicacoes (Portugal), and ³University of Essex (United Kingdom)

13:50 3DIA-061

Two-channel 3D range geometry compression with virtual plane encoding, Matthew Finley and Tyler Bell, University of Iowa (United States)

WEDNESDAY 20 JANUARY 2021

3D SCANNING AND RECONSTRUCTION

Moderator: Tyler Bell, University of Iowa (United States) / **Session Chair:** Robert Sitnik, Warsaw University of Technology (Poland)

11:45 – 12:45

11:45 3DIA-104

Development of portable and fully automated high-resolution 3D imaging device for forensic applications, Yi-Hong Liao¹, Jae-sang Hyun², and Song Zhang¹; ¹Purdue University and ²Orbbec 3D (United States)

12:05 3DIA-105

Semantic 3D indoor reconstruction with stereo camera imaging, Xin Liu, Egor Bondarev, Sander Klomp, and Peter de With, Eindhoven University of Technology (the Netherlands)

12:25 3DIA-106

7T MRI super-resolution with generative adversarial network, Huy Dc^{1,2}, Pascal Bourdon^{1,2}, David Helber^{1,2}, Mathieu Naudin^{2,3,4}, and Remy Guillevin^{2,3,4}; ¹XLIM Laboratory, University of Poitiers, ²University and Hospital of Poitiers, ³University of Poitiers, and ⁴Poitiers University Hospital, CHU (France)

HUMAN POSE ANALYSIS

Moderator: William Puech, University of Montpellier (France) / **Session Chair:** Tyler Bell, University of Iowa (United States)

13:15 – 13:55

13:15 3DIA-118

Verification and regularization method for 3D-human body pose estimation based on prior knowledge, Julia Denecke¹, Christian Jauch¹, and Norbert Link²; ¹Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA and ²Inferics GmbH (Germany)

13:35 3DIA-119

Generating a hand pose dataset for vision based manual assembly assistance systems, Christian Jauch, Julia Denecke, and Marco Huber, Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA (Germany)

CONFERENCE INTERACTIVE POSTER

19:15 3DIA-116
3DIA POSTER: Improvement of 3D point cloud alignment for super-resolution applications, *Keisuke Myosen, Tomoyuki Takanashi, Midori Tanaka, and Takahiko Horiuchi, Chiba University (Japan)*

3D CALIBRATION AND APPLICATIONS

Moderator: Tyler Bell, University of Iowa (United States) / **Session Chair:** Robert Sitnik, Warsaw University of Technology (Poland)
19:45 – 20:45

19:45 3DIA-101
3D multi-camera calibration with a fractal encoded multi-shape target, *Dominique Meyer, Pranav Verma, and Falko Kuester, University of California, San Diego (United States)*

20:05 3DIA-102
JIST-first: Application of photogrammetric 3D reconstruction to scanning electron microscopy: Considerations for volume analysis, *William Rickard, Jéssica Fernanda Ramos Coelho, Joshua Hollick, Susannah Soon, and Andrew Woods, Curtin University (Australia)*

20:25 3DIA-103
Delivering object-based immersive video experiences, *Basel Salahieh, Wayne Cochran, and Jill Boyce, Intel Corporation (United States)*

THURSDAY 21 JANUARY 2021

PLENARY: THE DEVELOPMENT OF INTEGRAL COLOR IMAGE SENSORS AND CAMERAS

Session Chair: Jonathan B. Phillips, Google Inc. (United States)
10:00 – 11:10

The development of integral color image sensors and cameras
Kenneth A. Parulski, *expert consultant: mobile imaging (United States)*

Kenneth Parulski is an expert consultant to mobile imaging companies and leads the development of ISO standards for digital photography. He joined Kodak in 1980 after graduating from MIT and retired in 2012 as research fellow and chief scientist in Kodak's digital photography division. His work has been recognized with a Technical Emmy and other major awards. Parulski is a SMPTE fellow and an inventor on more than 225 US patents.

MONDAY 25 JANUARY 2021

PLENARY: MAKING INVISIBLE VISIBLE

Session Chair: Jonathan B. Phillips, Google Inc. (United States)

10:00 – 11:10

Making invisible visible

Ramesh Raskar, *associate professor, MIT Media Lab (United States)*

Ramesh Raskar is an associate professor at MIT Media Lab and directs the Camera Culture research group. His focus is on AI and imaging for health and sustainability. They span research in physical (e.g., sensors, health-tech), digital (e.g., automated and privacy-aware machine learning), and global (e.g., geomaps, autonomous mobility) domains. He received the Lemelson Award (2016), ACM SIGGRAPH Achievement Award (2017), DARPA Young Faculty Award (2009), Alfred P. Sloan Research Fellowship (2009), TR100 Award from MIT Technology Review (2004), and Global Indus Technovator Award (2003). He has worked on special research projects at Google [X] and Facebook and co-founded/advised several companies.

WEDNESDAY 27 JANUARY 2021

PLENARY: REVEALING THE INVISIBLE TO MACHINES WITH NEUROMORPHIC VISION SYSTEMS: TECHNOLOGY AND APPLICATIONS OVERVIEW

Session Chair: Radka Tezaur, Intel Corporation (United States)

10:00 – 11:10

Revealing the invisible to machines with neuromorphic vision systems: Technology and applications overview

Luca Verre, *CEO and co-founder, Prophesee (France)*

Luca Verre is co-founder and CEO of Prophesee, the inventor of the world's most advanced neuromorphic vision systems. Verre is a World Economic Forum technology pioneer. His experience includes project and product management, marketing, and business development roles at Schneider Electric. Prior to Schneider Electric, Verre worked as a research assistant in photonics at the Imperial College of London. Verre holds a MSc in physics, electronic and industrial engineering from Politecnico di Milano and Ecole Centrale and an MBA from Institut Européen d'Administration des Affaires, INSEAD.