

# electronic IMAGING 2021

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PROCEEDINGS

## Intelligent Robotics and Industrial Applications using Computer Vision 2021

Editors: Kurt Niel, Upper Austria University of Applied Sciences (Austria),  
Juha Röning, University of Oulu (Finland)

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## Intelligent Robotics and Industrial Applications using Computer Vision 2021

### Conference overview

This conference brings together real-world practitioners and researchers in intelligent robots and computer vision to share recent applications and developments. Topics of interest include the integration of imaging sensors supporting hardware, computers, and algorithms for intelligent robots, manufacturing inspection, characterization, and/or control.

The decreased cost of computational power and vision sensors has motivated the rapid proliferation of machine vision technology in a variety of industries, including aluminum, automotive, forest products, textiles, glass, steel, metal casting, aircraft, chemicals, food, fishing, agriculture, archaeological products, medical products, artistic products, etc. Other industries, such as semiconductor and electronics manufacturing, have been employing machine vision technology for several decades. Machine vision supporting handling robots is another main topic. With respect to intelligent robotics another approach is sensor fusion – combining multi-modal sensors in audio, location, image and video data for signal processing, machine learning and computer vision, and additionally other 3D capturing devices.

There is a need of accurate, fast, and robust detection of objects and their position in space. Their surface, the background, and illumination is uncontrolled; in most cases the objects of interest are within a bulk of many others. For both new and existing industrial users of machine vision, there are numerous innovative methods to improve productivity, quality, and compliance with product standards. There are several broad problem areas that have received significant attention in recent years. For example, some industries are collecting enormous amounts of image data from product monitoring systems. New and efficient methods are required to extract insight and to perform process diagnostics based on this historical record. Regarding the physical scale of the measurements, microscopy techniques are nearing resolution limits in fields such as semiconductors, biology, and other nano-scale technologies. Techniques such as resolution enhancement, model-based methods, and statistical imaging may provide the means to extend these systems beyond current capabilities. Furthermore, obtaining real-time and robust measurements in-line or at-line in harsh industrial environments is a challenge for machine vision researchers, especially when the manufacturer cannot make significant changes to their facility or process.

*Paper authors listed as of 1 January 2021; refer to manuscript for final authors. Titles that are not listed with the proceedings files were presentation-only.*

**Conference Chairs:** Kurt Niel, Upper Austria University of Applied Sciences (Austria); and Juha Röning, University of Oulu (Finland)

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# Intelligent Robotics and Industrial Applications using Computer Vision 2021

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).*

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.*

## THURSDAY 28 JANUARY 2021

### COMPUTER VISION APPLICATIONS I

**Moderator:** Kurt Niel, University of Applied Sciences Upper Austria (Austria) / **Session Chair:** Juha Rönning, University of Oulu (Finland)

10:15 – 11:15

10:15

IRIACV-310

Towards large-scale evaluation of mental stress and biomechanical strain in manufacturing environments using 3D-referenced gaze and wearable-based analytics, *Lucas Paletta, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria)*

10:35

IRIACV-311

Vision-based machine learning worker assistance system for people with disabilities on low cost hardware, *Micha Christ, Christian Jauch, Julia Denecke, and Saskia Wiedenroth, Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA (Germany)*

## COMPUTER VISION APPLICATIONS II

**Moderator:** Kurt Niel, University of Applied Sciences Upper Austria (Austria) / **Session Chair:** Juha Röning, University of Oulu (Finland)

11:45 – 12:45

11:45 IRIACV-313  
**Evaluating deep semi-supervised learning methods for computer vision applications**, *Habib Ullah<sup>1</sup>, Sultan Daud Khan<sup>2</sup>, Mohib Ullah<sup>3</sup>, and Faouzi Alaya Cheikh<sup>3</sup>*; <sup>1</sup>UiT The Arctic University of Norway (Norway), <sup>2</sup>National University of Technology (Pakistan), and <sup>3</sup>Norwegian University of Science and Technology (Norway)

12:05 IRIACV-314  
**Investigation of different illumination scenarios for the evaluation of thermally cut edges with convolutional neural networks using a mobile device**, *Janek Stahl, Christian Jauch, Macit Tuncel, and Marco Huber*, *Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA (Germany)*

## CONFERENCE INTERACTIVE POSTERS

12:45 – 13:15

IRIACV-317  
**IRIACV POSTER: Accelerated HOG+SVM for object recognition**, *Lilong Shi, Chunji Wang, Kwang Oh Kim, and Yibing Wang*, *Samsung Semiconductor Inc. (United States)*

IRIACV-318  
**IRIACV POSTER: Concurrent two-factor identity verification using facial identity and facial actions**, *Zheng Sun<sup>1</sup>, Dah-Jye Lee<sup>1</sup>, Dong Zhang<sup>2</sup>, and Xiao Lin<sup>2</sup>*; <sup>1</sup>Brigham Young University (United States) and <sup>2</sup>Sun Yat-Sen University (China)

## ACTION RECOGNITION & ANALYSIS

**Moderator:** Juha Röning, University of Oulu (Finland) / **Session Chair:** Kurt Niel, University of Applied Sciences Upper Austria (Austria)

13:15 – 14:15

13:15 IRIACV-301  
**High-speed inline computational imaging for area scan cameras**, *Bernhard Blaschitz<sup>1</sup>, Simon Breuss<sup>1</sup>, Lukas Traxler<sup>1</sup>, Laurin Ginne<sup>1</sup>, and Svorad Stoic<sup>2</sup>*; <sup>1</sup>Austrian Institute of Technology (Austria) and <sup>2</sup>Photoneo (Slovakia)

13:35 IRIACV-302  
**Attention-based LSTM network for action recognition in sports**, *Mohib Ullah<sup>1</sup>, Muhammad Mudassar Yamin<sup>1</sup>, Ahmed Mohammed<sup>1</sup>, Sultan Daud Khan<sup>2</sup>, Habib Ullah<sup>3</sup>, and Faouzi Alaya Cheikh<sup>1</sup>*; <sup>1</sup>Norwegian University of Science and Technology (Norway), <sup>2</sup>National University of Technology (Pakistan), and <sup>3</sup>UiT The Arctic University of Norway (Norway)

13:55 IRIACV-303  
**Automatic annotation of American football video footages for game strategy analysis**, *Jacob Newman, Jian-Wei Lin, Dah-Jye Lee, and Jen-Jui Liu*, *Brigham Young University (United States)*

## MACHINE VISION ANALYTICS

**Moderator:** Kurt Niel, University of Applied Sciences Upper Austria (Austria) / **Session Chair:** Henry Ngan, ENPS Hong Kong (Hong Kong)

18:15 – 19:15

18:15 IRIACV-333  
Experiments and analysis for measuring mechanical motion with event cameras, *Kathy Hylton, Parker Mitchell, Blake Van Hoy, and Thomas Karnowski, Oak Ridge National Laboratory (United States)*

18:35 IRIACV-334  
Methods and comparisons between computer vision and radar based vehicle location, *Deniz Aykac, Regina Ferrell, Nisha Srinivas, and Thomas Karnowski, Oak Ridge National Laboratory (United States)*

18:55 IRIACV-335  
Object alignment with refocused image using off-axis digital holography, *Fan Hei Hung and Edmund Lam, The University of Hong Kong (Hong Kong)*

## CONFERENCE INTERACTIVE POSTERS

19:15 – 19:45

IRIACV-320  
IRIACV POSTER: Stereo visual inertial navigation system with depth scale energy minimization, *Jun-Su Park and Soon-Yong Park, Kyungpook National University (Republic of Korea)*

IRIACV-321  
IRIACV POSTER: Using artificial intelligence to provide visual feedback for golf swing training, *Jen-Jui Liu, Jacob Newman, and Dah-Jye Lee, Brigham Young University (United States)*