electronic IMAGING 2021

IS&T International Symposium on Electronic Imaging Science and Technology

11–28 January 2021 • Online

PROCEEDINGS

Material Appearance 2021

Editors: **Mathieu Hebert**, Université Jean Monnet de Saint Etienne (France);
Lionel Simonot, Université de Poitiers (France);
Aditya Suneel Sole, Norwegian University of Science and Technology (Norway); and
Ingeborg Tastl, HP Labs, HP Inc. (United States)

These papers represent the program of Electronic Imaging 2021, held online 11–28 January 2021

Material Appearance 2021

Conference overview

The rapid and continuous development of rendering simulators and devices such as displays and printers offers interesting challenges related to how the appearance of materials is understood. Over the years, researchers from different disciplines, including metrology, optical modeling, and digital simulation, have studied the interaction of incident light with the texture and surface geometry of a given object, as well as the optical properties of distinct materials. Thanks to those efforts, we have been able to propose methods for characterizing the optical and visual properties of many materials, propose affordable measurement methods, predict optical properties or appearance attributes, and render 2.5D and 3D objects and scenes with high accuracy.

This conference offers the possibility to share research results and establish new collaborations between academic and industrial researchers from these related fields.

Conference Chairs: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France); Lionel Simonot, Université de Poitiers (France); Aditya Suneel Sole, Norwegian University of Science and Technology (Norway); and Ingeborg Tastl, HP Inc. (United States)

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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.

Material Appearance 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).

KEYNOTE: CULTURAL HERITAGE   JOINT SESSION
Moderator: Reiner Eschbach, Norwegian University of Science and Technology (Norway) and Monroe Community College (United States) / Session Chair: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France)
13:30 – 14:30

This session is jointly sponsored by: Color Imaging XXVI: Displaying, Processing, Hardcopy, and Applications, and Material Appearance 2021.

MAAP-086

KEYNOTE: Imaging sciences for cultural heritage, *Clotilde Boust, Centre for Research and Restoration of the Museums of France (C2RMF) (France)*

Keynote speaker Clotilde Boust is assistant professor in color and digital imaging, Center for Research and Restoration for French Museums (C2RMF). Boust received her engineering degree in photography from the Ecole Nationale Supérieure Louis Lumière, France (1998). After working for two years as a color consultant in the press industry and one year as a researcher in the vision laboratory of the Museum National d'Histoire Naturelle, she began a PhD in image quality with Océ Print Logic Technologies and Paris VI University. She is now a researcher in visual appearance since 2006 at C2RMF and works on color, gloss, and roughness measurements for different cultural heritage objects.

WEDNESDAY 20 JANUARY 2021

KEYNOTE: COMPUTER GRAPHICS

Session Chair: Lionel Simonot, Université de Poitiers (France) /
Moderator: Aditya Sole, NTNU - Norwegian University of Science and Technology (Norway)
10:15 – 11:15

10:15   MAAP-129

KEYNOTE: Rendering the appearance of fine-scale surface detail, *Steve Marschner, Cornell University (United States)*

In material appearance, detail is an important part of the big picture. The eye uses fine detail in images to learn about materials, and leaving this structure out lends surfaces a too-smooth appearance that makes them look synthetic. This talk looks at a series of techniques that focus on getting the details right and find that surprisingly small features matter. They start with the straightforward problem of rendering rough surfaces, which are covered with details much smaller than pixels. Techniques for filtering out the too-small details are good at getting the right average color, but we show that they lose glittery, glinty effects that are important to the appearance. We have developed new methods that make it practical to render these details accurately, by generating them randomly or representing them explicitly and by modeling their effects using geometric or wave optics models. This is collaborative work with students and colleagues at Cornell, UCSD, and Autodesk. Keynote speaker Steve Marschner is a professor in the computer science department, Graphics & Vision Group, at Cornell University.

MATERIALS AND LIGHTING   JOINT SESSION

Moderator: Alessandro Rizzi, Università degli Studi di Milano (Italy) / **Session Chair:** Lionel Simonot, Université de Poitiers (France)
11:45 – 12:45

This session is jointly sponsored by: Color Imaging XXVI: Displaying, Processing, Hardcopy, and Applications, and Material Appearance 2021.

11:45   MAAP-131

Why a clear coating modifies halftone color prints, *Mathieu Hebert[1] and Lionel Simonot[2]; [1]Université Jean Monnet de Saint Etienne and [2]Université de Poitiers (France)*

12:05   MAAP-132

Next best light position: A self configuring approach for the Reflectance Transformation Imaging acquisition process, *Ramamoorthy Luxman, Marvin Nurit, Gaetan Le Goic, Franck Marzani, and Alamin Mansouri, Universite de Bourgogne (France)*

12:25   MAAP-133

Objective evaluation of relighting models on translucent materials from multispectral RTI images, *Vlado Kitanovski and Jon Yngve Hardeberg, Norwegian University of Science and Technology (Norway)*

STATE OF RESEARCH ON MATERIAL APPEARANCE

Moderator: Mathieu Hebert, Université Jean Monnet de Saint Etienne (France) / **Session Chair:** Aditya Sole, NTNU - Norwegian University of Science and Technology (Norway)
13:15 – 14:15

13:15   MAAP-137

Traceable measure of BSSRDF (Invited), *Pablo Santafé, Alejandro Ferrero, Néstor Tejedor, Joaquin Campos, and José Luis Velázquez, Optics Institute of CSIC (Spain)*

Invited speaker Pablo Santafé is a student author from Optics Institute of CSIC (IC-CSIC), Spain. In the Optics Institute of CSIC, a system capable of measuring BSSRDF has been developed, the Spanish Gonio-Spectrophotometer (GEFE). In this work, the BSSRDF of 12 homogeneous cataloged samples has been measured, with uncertainties lower than 3%. The obtained results can became a standard for other measuring instruments, thus transferring the unit of BSSRDF.

13:45   MAAP-138

Artificial intelligence for appearance design and fabrication (Invited), *Vahid Babaei, Max-Planck-Institut für Informatik (Germany)*

Invited speaker Vahid Babaei, of the Max Planck Institute for Informatics, Germany, in this talk will argue that data-driven approaches have an immense capacity for accurate and efficient appearance design and fabrication. Unlike physical models that rely on the sophisticated relationship of highly specialized measurements, data-driven models count on the power of big, but simple to acquire data. Babaei will show two examples of creative use of data-driven methods for two different technologies: multi-materials 3D printing, and laser marking.

SURFACE CHARACTERIZATION
Moderator: Shuhei Watanabe, RICOH COMPANY, LTD. (Japan) / **Session Chair:** Ingeborg Tastl, HP Labs, HP Inc. (United States)
18:15 – 19:15

18:15   MAAP-139

Surface roughness estimation using structured light projection, *Marjan Shahpaski[1], Luis Ricardo Sapaico[2], and Sabine Süsstrunk[1]; [1]École Polytechnique Fédérale de Lausanne (Switzerland) and [2]Meritis Paris (France)*

18:35   MAAP-140

Study and simulations of speckle effects on BRDF measurements at very high resolution, *Thomas Labardens[1,2], Pierre Chavel[3], Mathieu Hébert[2], Lionel Simonot[4], Ana-Maria Rabal-Almazor[1], Yvan Sortais[3], and Gaël Obein[1]; [1]Conservatoire National des Arts et Metiers, [2]Universite Jean Monnet Saint-Etienne, [3]Institut d'Optique Graduate School, and [4]Université de Poitiers (France)*

18:55   MAAP-141

JIST-first: Image-based perceptual editing: Leather "authenticity" as a case study, *Shuhei Watanabe[1] and Takahiko Horiuchi[2]; [1]Ricoh Company, Ltd. and [2]Chiba University (Japan)*

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 cc-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 cc-founder, Prophesee (France)*

Luca Verre is cc-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.