

# Eurographics Symposium on Rendering 2018

## Experimental Ideas & Implementations

Karlsruhe, Germany

1 – 4 July 2018

---

Organized by



EUROGRAPHICS  
THE EUROPEAN ASSOCIATION  
FOR COMPUTER GRAPHICS



---

### Program Co-Chairs

Wenzel Jakob  
Toshiya Hachisuka

### Conference Chair

Carsten Dachsbacher

### Proceedings Production Editor

Dieter Fellner (TU Darmstadt & Fraunhofer IGD, Germany)

Sponsored by EUROGRAPHICS Association

This work is subject to copyright.

All rights reserved, whether the whole or part of the material is concerned, specifically those of translation, reprinting, re-use of illustrations, broadcasting, reproduction by photocopying machines or similar means, and storage in data banks.

Copyright ©2018 by the Eurographics Association  
Postfach 2926, 38629 Goslar, Germany

Published by the Eurographics Association  
–Postfach 2926, 38629 Goslar, Germany–  
in cooperation with  
Institute of Computer Graphics & Knowledge Visualization at Graz University of Technology  
and  
Fraunhofer IGD (Fraunhofer Institute for Computer Graphics Research), Darmstadt

ISBN 978-3-03868-068-0  
ISSN 1727-3463

The electronic version of the proceedings is available from the Eurographics Digital Library at  
<https://diglib.eg.org>

## Table of Contents

Table of Contents .....	iii
International Programme Committee .....	iv
Author Index .....	v
Keynotes .....	vi
<b>Acquisition</b>	
Diffuse-Specular Separation using Binary Spherical Gradient Illumination .....	1
<i>Christos Kampouris, Stefanos Zafeiriou, and Abhijeet Ghosh</i>	
Approximate svBRDF Estimation From Mobile Phone Video .....	11
<i>Rachel A. Albert, Dorian Yao Chan, Dan B. Goldman, and James F. O'Brien</i>	
<b>Rendering Techniques I</b>	
Matrix Bidirectional Path Tracing .....	23
<i>Chakravarty Reddy Alla Chaitanya, Laurent Belcour, Toshiya Hachisuka, Simon Premoze, Jacopo Pantaleoni, and Derek Nowrouzezahrai</i>	
$P_N$ -Method for Multiple Scattering in Participating Media .....	33
<i>David Koerner, Jamie Portsmouth, and Wenzel Jakob</i>	
A Unified Manifold Framework for Efficient BRDF Sampling based on Parametric Mixture Models .....	41
<i>Sebastian Herholz, Oskar Elek, Jens Schindel, Jaroslav Křivánek, and Hendrik P. A. Lensch</i>	
<b>Image-based Techniques</b>	
Deep Hybrid Real and Synthetic Training for Intrinsic Decomposition .....	53
<i>Sai Bi, Nima Khademi Kalantari, and Ravi Ramamoorthi</i>	
<b>Rendering Techniques II</b>	
An Improved Multiple Importance Sampling Heuristic for Density Estimates in Light Transport Simulations ..	65
<i>Johannes Jendersie and Thorsten Grosch</i>	
Primary Sample Space Path Guiding .....	73
<i>Jerry Jinfeng Guo, Pablo Bauszat, Jacco Bikker, and Elmar Eisemann</i>	
<b>Real-time Rendering</b>	
Scalable Real-Time Shadows using Clustering and Metric Trees .....	83
<i>François Deves, Frédéric Mora, Lilian Aveneau, and Djamchid Ghazanfarpour</i>	
Soft Transparency for Point Cloud Rendering .....	95
<i>Patrick Seemann, Gianpaolo Palma, Matteo Dellepiane, Paolo Cignoni, and Michael Goesele</i>	
<b>Screen-space Methods</b>	
Screen Space Approximate Gaussian Hulls .....	107
<i>Julian Meder and Beat Brüderlin</i>	

## International Programme Committee

Miika Aittala (MIT)  
Pascal Barla (Inria)  
Pablo Bauszat (TU Delft)  
Tamy Boubekeur (Telecom ParisTech)  
Per Christensen (Pixar)  
Chun-Fa Chung (National Taiwan Normal University)  
George Drettakis (INRIA)  
Jonathan Dupuy (Unity)  
Philip Dutre (KU Leuven)  
Elena Garces (Technicolor)  
Iliyan Georgiev (Solid Angle)  
Xavier Granier (Institut d'Optique)  
Gael Guennebaud (Inria)  
Eric Heitz (Unity)  
Hendrik Lensch (Tübingen University)  
Steve Marschner (Cornell)  
Belen Masia (University of Zaragoza)  
Bochang Moon (GIST)  
Adolfo Munoz (University of Zaragoza)  
Diego Nehab (IMPA)  
Jan Novak (Disney Research)  
Derek Nowouzezahrai (McGill)  
Marta Ortín Obón (University of Zaragoza)  
Mathias Paulin (Université Toulouse)  
Pieter Peers (College of William & Mary)  
Voicu Popescu (Purdue University)  
Fabrice Rousselle (Disney Research)  
Holly Rushmeier (Yale University)  
Pradeep Sen (UC Santa Barbara)  
Philipp Slusallek (Saarland University)  
Xin Sun (Adobe Research)  
Min Tang (Zhejiang University)  
Xin Tong (Microsoft Research Asia)  
Rui Wang (U Amherst)  
Li-Yi Wei (Univ. of Hong Kong)  
Tim Weyrich (University College London)  
Alexander Wilkie (Charles University)  
Michael Wimmer (TU Wien)  
Hongzhi Wu (Zhejiang University)  
Lei Yang (Nvidia)  
Cem Yuksel (Utah)  
Shuang Zhao (UC Irvine)

## Author Index

Albert, Rachel A. ....	11	Herholz, Sebastian .....	41
Aveneau, Lilian .....	83	Jakob, Wenzel .....	33
Bauszat, Pablo .....	73	Jendersie, Johannes .....	65
Belcour, Laurent .....	23	Kalantari, Nima Khademi .....	53
Bi, Sai .....	53	Kampouris, Christos .....	1
Bikker, Jacco .....	73	Koerner, David .....	33
Brüderlin, Beat .....	107	Křivánek, Jaroslav .....	41
Chaitanya, Chakravarty Reddy Alla .....	23	Lensch, Hendrik P. A. ....	41
Chan, Dorian Yao .....	11	Meder, Julian .....	107
Cignoni, Paolo .....	95	Mora, Frédéric .....	83
Dellepiane, Matteo .....	95	Nowrouzezahrai, Derek .....	23
Deves, François .....	83	O'Brien, James F. ....	11
Eisemann, Elmar .....	73	Palma, Gianpaolo .....	95
Elek, Oskar .....	41	Pantaleoni, Jacopo .....	23
Ghazanfarpour, Djamchid .....	83	Portsmouth, Jamie .....	33
Ghosh, Abhijeet .....	1	Premoze, Simon .....	23
Goesele, Michael .....	95	Ramamoorthi, Ravi .....	53
Goldman, Dan B. ....	11	Schindel, Jens .....	41
Grosch, Thorsten .....	65	Seemann, Patrick .....	95
Guo, Jerry Jinfeng .....	73	Zafeiriou, Stefanos .....	1
Hachisuka, Toshiya .....	23		

## Keynote

### **Gambling in the Depths of High-Dimensional Spaces**

*Michael Betancourt*

#### **Abstract**

Integration is a ubiquitous mathematical tool, and modern applications require integration across increasingly higher dimensional spaces. Unfortunately most of the intuitions that we take for granted in our low-dimensional, routine experiences don't persist to these high-dimensional spaces which makes the development of scalable computational methodologies and algorithms all the more challenging. In this talk I will discuss the counterintuitive behavior of high-dimensional spaces and the consequences for statistical computation, in particular the unique advantages of Hamiltonian Monte Carlo.

#### **Short Biography**

Michael Betancourt is the principal research scientist with Symplectomorphic, LLC where he develops theoretical and methodological tools to support practical Bayesian inference. He is also a core developer of Stan, where he implements and tests these tools. In addition to hosting tutorials and workshops on Bayesian inference with Stan he also collaborates on analyses in epidemiology, pharmacology, and physics, amongst others. Before moving into statistics, Michael earned a B.S. from the California Institute of Technology and a Ph.D. from the Massachusetts Institute of Technology, both in physics.

## Keynote

### Interactive and Off-Line Path Tracing with RenderMan

*Per Christensen*

#### Abstract

RenderMan is a modern extensible and programmable path tracer with many features essential to handling the fiercely complex scenes in movie production. RenderMan has traditionally been focused on off-line rendering of high-quality final movie frames, but has recently been overhauled, targeting interactive rendering during modeling, texturing, lay-out, animation, and lighting. Path tracing has gone from being a pure research technique to now being the main rendering technique in many production renderers. In this talk Per Christensen will describe the use of path tracing for animated movies and visual effects, and will also describe advanced path tracing techniques such as bidirectional path tracing, progressive photon mapping, and vertex connection and merging (VCM). He will also touch upon current rendering projects at Pixar such as mixed CPU and GPU rendering and high-dimensional sample sequences specifically targeted at path tracing.

#### Short Biography

Per Christensen is a principal software developer in Pixar's RenderMan group in Seattle. His main research interests are efficient ray tracing and global illumination in very complex scenes. He received an M.Sc. degree in electrical engineering from the Technical University of Denmark and a Ph.D. in computer science from the University of Washington. Prior to joining Pixar, he worked at ILM in San Rafael, Mental Images in Berlin, and Square USA in Honolulu. He has movie credits in Pixar movies since "Finding Nemo", and has received an Academy Award for his contributions to efficient point-based global illumination and ambient occlusion.