

Symposium on Geometry Processing 2015

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Organized by



EUROGRAPHICS
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FOR COMPUTER GRAPHICS



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Preface

The Eurographics Symposium on Geometry Processing (SGP) is the premier venue for disseminating new research ideas and cutting-edge results in geometry processing. In this research area, concepts from mathematics, computer science, and engineering are studied and applied to offer new insights and design efficient algorithms for acquisition, modeling, analysis, manipulation, simulation, and transmission of complex 3D models.

SGP 2015 received 72 complete paper submissions, of which 22 were accepted. The accepted papers will be presented by the authors at the SGP conference and published in a special issue of *Computer Graphics Forum*. Additionally, 7 papers submitted to SGP were accepted as short papers for poster presentations, and 7 were recommended for submission with major revisions to the *Computer Graphics Forum* journal.

The SGP conference will be held at Graz University of Technology (Austria) from July 6 until July 8, 2015. The main conference will comprise of a series of paper presentations and a poster session. The topics of the papers range from shape analysis, correspondence and registration, to fabrication, image processing, shape synthesis, numerical methods and quad mesh processing. Three invited speakers: Robert J. Lang (Origami), Amit Singer (Princeton) and Mark Pauly (EPFL), further round out the program. Additionally, there will be a “graduate school” with tutorials intended for graduate students during the two days prior to the conference.

The SGP program could not have been possible without the hard work of a large community of volunteers. We are grateful to the paper authors and all the members of the program committee for their extraordinary efforts to produce, review, and refine excellent research papers. We also are thankful to the Conference Co-Chairs, Johannes Wallner and Ursula Augsdörfer, and the manager of SRM, Stefanie Behnke, for their assistance and support.

We hope the readers will enjoy this special issue and greatly benefit from its contents.

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Author Index

Alexa Marc	211	Martin Sebastian	39
Basri Ronen	115	Masci Jonathan	13
Boscaini Davide	13	Melzi Simone	13
Botsch Mario	101	Mewes Daniel	141
Bouaziz Sofien	101	Mitra Niloy J.	53, 177, 191
Bronstein Michael M.	13	Oudot Steve Y.	1
Carrière Mathieu	1	Ovsjanikov Maks	1, 129
Castellani Umberto	13	Panozzo Daniele	65
Chambolle Antonin	129	Paris Sylvain	65
Corman Etienne	129	Pauly Mark	101
Diamanti Olga	65	Peters Jörg	229
Dym Nadav	239	Polthier Konrad	219
Feng Jieqing	77	Prada Fabian	201
Gross Markus	39	Razafindrazaka Faniry H.	219
Guibas Leonidas	141	Reitebuch Ulrich	219
Hennessey James W.	191	Roveri Riccardo	39
Herholz Philipp	211	Schröder Matthias	101
Herzog Robert	141	Seidel Hans-Peter	141
Huang Haibin	25	Shtengel Anna	239
Kalogerakis Evangelos	25	Solenthaler Barbara	39
Karčiauskas Keštutis	229	Sorkine-Hornung Olga	65
Kazhdan Misha	153, 201	Sorkine Evgeni	65
Kezurer Itay	115	Tagliasacchi Andrea	101
Kim Theodore	167	Tang Yizhi	77
Kohli Pushmeet	177	Tarini Marco	65
Kovalsky Shahar Z.	115	Tkach Anastasia	101
Kurlin Vitaliy	253	Vandergheynst Pierre	13
Kyprianidis Jan Eric	211	Wand Michael	141
Lai Yu-Kun	89	Wang Jun	53
Lipman Yaron	115, 239	Wang Tuanfeng Y.	177
Li Ke	89	Yang Jingyu	89
Li Kun	89	Yang Yong-Liang	53
Marlin Benjamin	25	Öztireli A. Cengiz	39

TABLE OF CONTENTS

Descriptors and Shape Synthesis

- Stable Topological Signatures for Points on 3D Shapes* 1
Mathieu Carrière, Steve Y. Oudot, and Maks Ovsjanikov
- Learning Class-specific Descriptors for Deformable Shapes Using Localized Spectral Convolutional Networks* 13
Davide Boscaini, Jonathan Masci, Simone Melzi, Michael M. Bronstein, Umberto Castellani, and Pierre Vandergheynst
- Analysis and Synthesis of 3D Shape Families via Deep-learned Generative Models of Surfaces* 25
Haibin Huang, Evangelos Kalogerakis, and Benjamin Marlin
- Example Based Repetitive Structure Synthesis* 39
Riccardo Roveri, A. Cengiz Öztireli, Sebastian Martin, Barbara Solenthaler, and Markus Gross

Fabrication

- Reforming Shapes for Material-aware Fabrication* 53
Yong-Liang Yang, Jun Wang, and Niloy J. Mitra
- Texture Mapping Real-World Objects with Hydrographics* 65
Daniele Panozzo, Olga Diamanti, Sylvain Paris, Marco Tarini, Evgeni Sorkine, and Olga Sorkine-Hornung

Registration

- Hierarchical Multiview Rigid Registration* 77
Yizhi Tang and Jieqing Feng
- Sparse Non-rigid Registration of 3D Shapes* 89
Jingyu Yang, Ke Li, Kun Li, and Yu-Kun Lai
- Robust Articulated-ICP for Real-Time Hand Tracking* 101
Andrea Tagliasacchi, Matthias Schröder, Anastasia Tkach, Sofien Bouaziz, Mario Botsch, and Mark Pauly

Correspondence and Matching

- Tight Relaxation of Quadratic Matching* 115
Itay Kezurer, Shahar Z. Kovalsky, Ronen Basri, and Yaron Lipman
- Continuous Matching via Vector Field Flow* 129
Etienne Corman, Maks Ovsjanikov, and Antonin Chambolle
- LeSSS: Learned Shared Semantic Spaces for Relating Multi-Modal Representations of 3D Shapes* 141
Robert Herzog, Daniel Mewes, Michael Wand, Leonidas Guibas, and Hans-Peter Seidel

TABLE OF CONTENTS

Numerical Methods for Geometry Processing

- Fast and Exact (Poisson) Solvers on Symmetric Geometries* 153
Misha Kazhdan
- Quaternion Julia Set Shape Optimization* 167
Theodore Kim

Geometry and Images

- Dynamic SfM: Detecting Scene Changes from Image Pairs* 177
Tuanfeng Y. Wang, Pushmeet Kohli, and Niloy J. Mitra
- An Image Degradation Model for Depth-augmented Image Editing* 191
James W. Hennessey and Niloy J. Mitra
- Unconditionally Stable Shock Filters for Image and Geometry Processing* 201
Fabian Prada and Misha Kazhdan

Quads and Polygons

- Perfect Laplacians for Polygon Meshes* 211
Philipp Herholz, Jan Eric Kyprianidis, and Marc Alexa
- Perfect Matching Quad Layouts for Manifold Meshes* 219
Faniry H. Razafindrazaka, Ulrich Reitebuch, and Konrad Polthier
- Can Bi-cubic Surfaces be Class A?* 229
Keštutis Karčiauskas and Jörg Peters

Curves and Graphs

- Homotopic Morphing of Planar Curves* 239
Nadav Dym, Anna Shtengel, and Yaron Lipman
- A One-dimensional Homologically Persistent Skeleton of an Unstructured Point Cloud in any Metric Space* 253
Vitaliy Kurlin

Keynote

From Flapping Birds to Space Telescopes: The Art and Science of Origami

Robert J. Lang

langorigami.com

Abstract

The last decade of this past century has been witness to a revolution in the development and application of mathematical techniques to origami, the centuries-old Japanese art of paper-folding. The techniques used in mathematical origami design range from the abstruse to the highly approachable. In this talk, I will describe how geometric concepts led to the solution of a broad class of origami folding problems - specifically, the problem of efficiently folding a shape with an arbitrary number and arrangement of flaps, and along the way, enabled origami designs of mind-blowing complexity and realism, some of which you'll see, too. As often happens in mathematics, theory originally developed for its own sake has led to some surprising practical applications. The algorithms and theorems of origami design have shed light on long-standing mathematical questions and have solved practical engineering problems. I will discuss examples of how origami has enabled safer airbags, Brobdingnagian space telescopes, and more.

Short Biography

Robert J. Lang is an American physicist who is also one of the foremost origami artists and theorists in the world. He has authored 13 books and numerous articles on origami art and design. His work has been exhibited in the US, Europe and Japan, and is noted for combining the Western school of mathematical origami design with the Eastern emphasis on line and form.

Keynote

The Beauty of Geometry

Mark Pauly

EPFL Lausanne

Abstract

In this talk, I want to convey what fascinates me about geometry. I will exemplify how nature and art can provide inspiration for research and how research in turn can inspire artists or lead to unexpected means for design. The core of the talk will be a personal and highly subjective speculation on the beauty of geometry. In the course of this discussion, I will reflect on several of our past and current projects to highlight how the same fundamental geometry processing problems re-occur in many guises. Connecting the dots between seemingly disparate research projects can hopefully provide insights into the general nature of these problems, but also reveal when specialized solutions are called for. The talk will conclude with a discussion of potential future challenges for geometry processing, both in terms of open problems, but also in the way we operate as a research community.

Short Biography

Mark Pauly is a professor at the CS department of EPFL Lausanne. His research interests include computer graphics and animation, geometry processing, shape modeling and analysis, and digital fabrication. Besides a great many significant contributions to these topics he has also published on the art of caustics and shadows, and is a co-founder of *faceshift AG*, an EPFL spin-off that specializes on face tracking and animation

Keynote

Solving the 3-D Puzzle of Rotation Assignment in Single Particle Cryo-Electron Microscopy

Amit Singer

Princeton University

Abstract

Single particle cryo-electron microscopy (EM) recently joined X-ray crystallography and nuclear magnetic resonance (NMR) spectroscopy as a high-resolution structural method for biological macromolecules. In single particle cryo-EM, the 3-D structure needs to be determined from many noisy 2-D projection images of individual, ideally identical frozen-hydrated macromolecules whose orientations and positions are random and unknown (i.e., random X-ray transform). This lecture will explore algorithms for estimating the unknown pose parameters. The main focus will be on semidefinite programming relaxations that are based on the Fourier transform over the group $SO(3)$. Such semidefinite programs can be viewed as extensions to existing approximation algorithms to max-cut and unique games, two fundamental problems in theoretical computer science. The approach is quite general and can be used to handle other groups of transformations that arise in other applications in signal processing, image analysis, computer vision and computer graphics.

Short Biography

Amit Singer is professor of applied and computational mathematics at Princeton University. His research is focused on massive data sets and structural biology, in particular on developing algorithms for 3D structuring of macromolecules using cryo-electron microscopy. His mathematical interests include dimensionality reduction, signal and image processing, spectral methods convex optimization and semidefinite programming. In 2010 he received the presidential early career award for scientists and engineers.