Symposium on Geometry Processing 2015

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July 6 – 8, 2015

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Eurographics Symposium on Geometry Processing 2015
Mirela Ben-Chen and Ligang Liu
(Guest Editors)

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Mirela Ben-Chen and Ligang Liu
(Guest Editors)

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.

Guest Editors:

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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 mathemaical origami design with the Eastern emphasis on line and form.

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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

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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.