

Symposium on Geometry Processing 2022

Hosted online
July 4 – 6, 2022

Technical Program Co-Chairs

Marcel Campen, Osnabrück University, Germany
Michela Spagnuolo, CNR, Italy

Graduate School Co-Chairs

Ruizhen Hu, Shenzhen University, China
Teseo Schneider, University of Victoria, Canada

Software & Dataset Awards Chair

Marc Alexa, Technische Universität Berlin, Germany

Steering Committee

Leif Kobbelt, RWTH Aachen University, DE
Marc Alexa, TU Berlin, DE
Pierre Alliez, INRIA, FR
Mirela Ben-Chen, Technion-IIT, IL
Hui Huang, Shenzhen University, CN
Niloy Mitra, University College London, GB
Daniele Panozzo, New York University, US

Sponsors



International Programme Committee

Noam Aigerman

Adobe Research, US

Marc Alexa

TU Berlin, DE

Pierre Alliez

INRIA, FR

Marco Attene

CNR IMATI, IT

Omri Azencot

Ben-Gurion Univeristy, IL

Alexander Belyaev

Heriot-Watt University, GB

Mirela Ben-Chen

Technion-IIT, IL

Bedrich Benes

Purdue University, US

David Bommes

University of Bern, CH

Mario Botsch

TU Dortmund, DE

Tamy Boubekeur

Adobe 3D&Immersive, FR

Raphaëlle Chaine

Université Lyon, FR

Siddhartha Chaudhuri

Adobe Research, IN

Renjie Chen

USTC, CN

Edward Chien

MIT, US

Paolo Cignoni

CNR ISTI, IT

David Cohen-Steiner

INRIA, FR

Tamal Dey

Purdue University, US

Olga Diamanti

TU Graz, AT

Julie Digne

LIRIS - CNRS, Fr

John A. Evans

University of Colorado Boulder, US

Xifeng Gao

Florida State University, US

Yotam Gingold

Georges Mason University, US

Daniela Giorgi

CNR - ISTI, IT

Eitan Grinspun

University of Toronto, CA

Paul Guerrero

Adobe Research, GB

Rana Hanocka

Tel-Aviv University, IL

Ying He

Nanyang Technological University, CN

Philipp Herholz

ETH Zurich, CH

Klaus Hildebrandt

TU Delft, NL

Hugues Hoppe

US

Kai Hormann

Università della Svizzera italiana, CH

Jin Huang

Zhejiang University, CN

Alec Jacobson

University of Toronto, CA

Tao Ju

Washington University in St. Louis, US

Misha Kazhdan

Johns Hopkins University, US

John Keyser

Texas A&M University, US

Vladimir Kim

Adobe Research, US

Leif Kobbelt

RWTH Aachen University, DE

Mina Konaković Luković

MIT, US

Jiri Kosinka

University of Groningen, NL

Isaak Lim

RWTH Aachen University, DE

International Programme Committee

Ligang Liu

University of Science and Technology of China, CN

Yang Liu

Microsoft Research Asia, CN

Marco Livesu

CNR IMATI, IT

Luigi Malomo

CNR ISTI, IT

Nicolas Mellado

CNRS, FR

Pooran Memari

CNRS, FR

Przemyslaw Musialski

New Jersey Institute of Technology, US

Maks Ovsjanikov

Ecole Polytechnique, FR

Julian Panetta

UC Davis, US

Daniele Panozzo

NYU, US

Giuseppe Patane

CNR IMATI, IT

Jorg Peters

University of Florida, US

Konrad Polthier

Freie Universität Berlin, DE

Roi Poranne

University of Haifa, IL

Reinhold Preiner

TU Graz, AT

Enrico Puppo

University of Genoa, IT

Emanuele Rodola

Sapienza University of Rome, IT

Martin Rumpf

Bonn University, DE

Leonardo Sacht

Universidade Federal de Santa Catarina, BR

Scott Schaefer

Texas A&M University, US

Ryan Schmidt

Autodesk Research, CA

Teseo Schneider

University of Victoria, CA

Peter Schröder

Caltech, US

Nicholas Sharp

Carnegie Mellon University, US

Justin Solomon

MIT, US

Olga Sorkine-Hornung

ETH Zürich, CH

Oded Stein

MIT, US

Hao Su

UC San Diego, US

Kenshi Takayama

National Institute of Informatics, JP

Chengcheng Tang

Facebook, US

Jean-Marc Thiery

Télécom ParisTech, FR

Bernhard Thomaszewski

University of Montreal, CA

Amir Vaxman

Utrecht University, NL

Etienne Vouga

University of Texas at Austin, US

Johannes Wallner

TU Graz, AT

Michael Wand

University of Mainz, DE

Ofir Weber

Bar-Ilan University, IL

Kai Xu

National University of Defense Technology, CN

Yong-Liang Yang

University of Bath, GB

Eugene Zhang

Oregon State University, US

Hao Zhang

Simon Fraser University, CA

Qingnan Zhou

Adobe Research, US

TABLE OF CONTENTS

Modeling and Mapping

- Harmonic Shape Interpolation on Multiply-connected Planar Domains* 1
Dongbo Shi and Renjie Chen
- Localized Shape Modelling with Global Coherence: An Inverse Spectral Approach* 13
Marco Pegoraro, Simone Melzi, Umberto Castellani, Riccardo Marin, and Emanuele Rodolà

Curves and Features

- Smooth Interpolating Curves with Local Control and Monotone Alternating Curvature* 25
Alexandre Binninger and Olga Sorkine-Hornung

Learning and Creating

- PRIFIT: Learning to Fit Primitives Improves Few Shot Point Cloud Segmentation* 39
Gopal Sharma, Bidya Dash, Aruni RoyChowdhury, Matheus Gadelha, Marios Loizou, Lian-
gliang Cao, Rui Wang, Erik G. Learned-Miller, Subhransu Maji, and Evangelos Kalogerakis
- SDF-StyleGAN: Implicit SDF-Based StyleGAN for 3D Shape Generation* 51
Xinyang Zheng, Yang Liu, Pengshuai Wang, and Xin Tong
- MendNet: Restoration of Fractured Shapes Using Learned Occupancy Functions* 65
Nikolas Lamb, Sean Banerjee, and Natasha K. Banerjee

Meshes and Partitions

- Precise High-order Meshing of 2D Domains with Rational Bézier Curves* 79
Jinlin Yang, Shibo Liu, Shuangming Chai, Ligang Liu, and Xiao-Ming Fu
- Rational Bézier Guarding* 89
Payam Khanteimouri, Manish Mandad, and Marcel Campen

Tools and Data

- Deterministic Linear Time for Maximal Poisson-Disk Sampling using Chocks without Rejec-
tion or Approximation* 101
Scott A. Mitchell
- TinyAD: Automatic Differentiation in Geometry Processing Made Simple* 113
Patrick Schmidt, Janis Born, David Bommes, Marcel Campen, and Leif Kobbelt
- Hex Me If You Can* 125
Pierre-Alexandre Beaufort, Maxence Reberol, Denis Kalmykov, Heng Liu, Franck Ledoux,
and David Bommes

Tiling and Nesting

- Constructing L_∞ Voronoi Diagrams in 2D and 3D* 135
Dennis R. Bukenberger, Kevin Buchin, and Mario Botsch
- Fabricable Multi-Scale Wang Tiles* 149
Xiaokang Liu, Chenran Li, Lin Lu, Oliver Deussen, and Changhe Tu
- Topological Simplification of Nested Shapes* 161
Dan Zeng, Erin Chambers, David Letscher, and Tao Ju

Author Index

Banerjee, Natasha K.	65	Li, Chenran	149
Banerjee, Sean	65	Liu, Heng	125
Beaufort, Pierre-Alexandre	125	Liu, Ligang	79
Binninger, Alexandre	25	Liu, Shibo	79
Bommes, David	113, 125	Liu, Xiaokang	149
Born, Janis	113	Liu, Yang	51
Botsch, Mario	135	Loizou, Marios	39
Buchin, Kevin	135	Lu, Lin	149
Bukenberger, Dennis R.	135	Maji, Subhansu	39
Campen, Marcel	89, 113	Mandad, Manish	89
Cao, Liangliang	39	Marin, Riccardo	13
Castellani, Umberto	13	Melzi, Simone	13
Chai, Shuangming	79	Mitchell, Scott A.	101
Chambers, Erin	161	Pegoraro, Marco	13
Chen, Renjie	1	Reberol, Maxence	125
Dash, Bidya	39	Rodolà, Emanuele	13
Deussen, Oliver	149	RoyChowdhury, Aruni	39
Fu, Xiao-Ming	79	Schmidt, Patrick	113
Gadelha, Matheus	39	Sharma, Gopal	39
Ju, Tao	161	Shi, Dongbo	1
Kalmykov, Denis	125	Sorkine-Hornung, Olga	25
Kalogerakis, Evangelos	39	Tong, Xin	51
Khanteimouri, Payam	89	Tu, Changhe	149
Kobbelt, Leif	113	Wang, Pengshuai	51
Lamb, Nikolas	65	Wang, Rui	39
Learned-Miller, Erik G.	39	Yang, Jinlin	79
Ledoux, Franck	125	Zeng, Dan	161
Letscher, David	161	Zheng, Xinyang	51

Keynote

Towards Structured Geometric Understanding for 3D Perception

Angela Dai

Technical University of Munich

Abstract

Semantic perception of 3D environments has seen remarkable advances in recent years, with a significant focus on object-based understanding. We propose to learn structured, intermediary representations, such as object parts, in order to provide a robust understanding of diverse 3D geometric structures from observations of real-world environments. This can enable more effective geometric reconstruction of objects in 3D scenes, enabling inter- and intra-object reasoning, as well as establish efficient structured representations for reconstruction and tracking of objects undergoing complex deformations.

Keynote

Computational 3D Visual Art Design

Ligang Liu

University of Science and Technology of China

Abstract

3D visual arts are highly diverse, including sculpture, architecture, ceramics, etc., in our lives. Traditionally, artists use their rich imagination and experience to design 3D objects to give the audience a memorable experience. The design process takes a lot of trial and error, so it is often very time-consuming. It has attracted the attention of many researchers in the community of geometry processing and computer graphics, proposing various algorithms to simplify the initial complicated design process and help artists quickly realize the art in their minds. Moreover, the advent of digital modeling and 3D printing enables artists to create more complex 3D visual artworks. In this talk, we will show a few interesting 3D visual art works and propose automatic methods to solve various problems in the design process of these art works. From these examples, we reveal the close connection between geometry processing techniques and various 3D visual art design problems. Moreover, we will discuss about the current research trends and provide an outlook for future research directions and solutions.

Keynote

Geometry for Design and Construction of High-performance Architecture

Caitlin Mueller

MIT Architecture

Abstract

Design and construction in the built environment present significant challenges and opportunities for impact: Buildings contribute to about 40% of global carbon emissions through their materials and operations, often due to inefficiencies stemming from a lack of integration between architectural design, engineering, and construction processes. While this disconnect has been critiqued for decades, today's emerging techniques in computation, and in particular, geometry, can allow for a new layer of interdisciplinary communication and collaboration that transforms traditional workflows and empowers novel visual languages for high-performance architecture. In this talk, Mueller will share recent work that contributes to this goal, demonstrating new techniques for computational design that integrate engineering principles and sustainability goals without overriding creative autonomy, and new fabrication methods that can materialize efficient geometries economically. In particular, the talk will demonstrate how techniques developed in geometry processing and related fields can empower significant innovation in architectural domains, and will propose emerging problem spaces and applications for future geometry research.

Keynote

Robust Geometry Processing for Physical Simulation

Daniele Panozzo
New York University

Abstract

The numerical solution of partial differential equations (PDE) is ubiquitously used for physical simulation in scientific computing, computer graphics, and engineering. Ideally, a PDE solver should be opaque: the user provides as input the domain boundary, boundary conditions, and the governing equations, and the code returns an evaluator that can compute the value of the solution at any point of the input domain. This is surprisingly far from being the case for all existing open-source or commercial software, despite the research efforts in this direction and the large academic and industrial interest. To a large extent, this is due to lack of robustness and generality in the geometry processing algorithms used to convert raw geometrical data into a format suitable for a PDE solver. I will discuss the limitations of the current state of the art, and present a proposal for an integrated pipeline, considering data acquisition, meshing, basis design, and numerical optimization as a single challenge, where tradeoffs can be made between different phases to increase automation and efficiency. I will demonstrate that this integrated approach offers many advantages, while opening exciting new geometry processing challenges, and that a fully opaque meshing and analysis solution is already possible for heat transfer and elasticity problems with contact. I will present a set of applications enabled by this approach in reinforcement learning for robotics, force measurements in biology, shape design in mechanical engineering, stress estimation in biomechanics, and simulation of deformable objects in graphics.