

Editorial

Foreword to the Special Issue on Shape Modeling International 2021 (SMI2021)



This special section of Computers & Graphics (C&G), features the full papers presented at the Shape Modeling International conference – SMI 2021 (<https://smi2021.github.io/>). Due to the pandemic, and for the second year in a row, SMI was convened online, and this year was hosted by Texas on November 14–16, 2021 (see Fig. 1).

Shape Modeling International (SMI 2021) provides an international forum for the dissemination of new mathematical theories and computational techniques for modeling, simulating, and processing digital representations of shapes and their properties to a community of researchers, developers, students, and practitioners across a wide range of fields. SMI 2021 also organized a panel session called “Subdivision History Day”, where the invited pioneers discussed important milestones of subdivision techniques and introduced the human element and insights behind the discoveries. The panel session received high praise from the attendees. The Fabrication and Sculpting Event FASE (2021) was organized in co-location with SMI 2021. It presents original research at the intersection of theory and practice in shape modeling, fabrication, and sculpting.

This year, we were pleased to have two keynote speakers at SMI2021. Prof. Siddhartha Chaudhuri (*Adobe Research*) and Prof. Lining Yao (*Human-Computer Interaction Institute at Carnegie Mellon University*). SMI 2021 also featured two award talks, namely, the TOOSiyasu Kunii award and the SMI young investigator award. Dr. Bianca Falcidieno (*Istituto di Matematica Applicata e Tecnologie Informatiche E. Magenes’ - CNR*) and Dr. Méline Skouras (*Inria Grenoble, France*). These excellent keynotes and talks cover the latest advances and novel applications of shape modeling and computational design.

The full paper submission track followed a 2-stage review process and each paper was assessed by 4 reviewers averagely. The accepted papers were published directly in Computers & Graphics. 40 papers were submitted to the full paper track, out of which 14 were accepted for publication in Computers & Graphics; one of these papers applied and received the *Replicability Badge* issued by the Graphics Replicability Stamp Initiative (GRSI).

Full papers are available at <https://www.sciencedirect.com/journal/computers-and-graphics/special-issue/1039SHD9R8N>.

These works cover a variety of topics, including geometric modeling, inverse solid and surface modeling, surface and scene reconstruction, dynamic surface and deformation, 3D registration, geometric computing, 3D retrieval, 3D analysis, and generation. All accepted papers and invited talks were orally presented online and grouped into the following themed sessions. A best paper

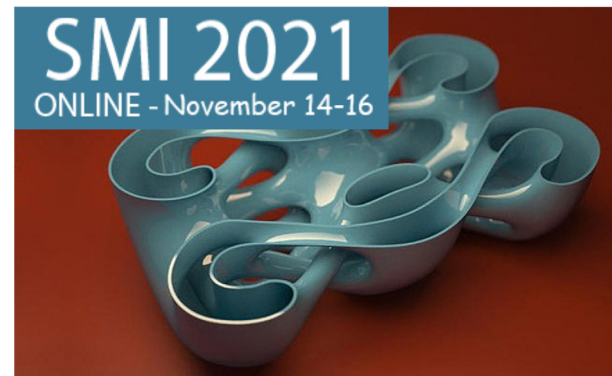


Fig. 1. The Special Section contains the papers selected among those presented at the SMI2021 conference.

award and two honourable mention awards were presented during the closing ceremony.

Modeling & Reconstruction

- [Real-timeskeletonizationforsketchn-basedmodeling](#), Jing Ma, Jin Wang, Jituo Li, Dongliang Zhang, [1]. **[Replicability Badge]**
- [Accuratefloorplanreconstructionusinggeometricpriors](#), Ruifan Cai, Honglin Li, Jun Xie, Xiaogang Jin, [2].
- [Enhanced narrow band surface reconstruction with anisotropic kernel](#), Qiaorui Chen, Shuai Zhang, Yao Zheng, [3].

Learning-based Reconstruction

- [Learningmodifiedindicatorfunctionsforsurface reconstruction](#), Dong Xiao, Siyou Lin, Zuoqiang Shi, Bin Wang, [4].
- [Learningpersistenthomologyof3Dpointclouds](#), Chi Zhou, Zhetong Dong, Hongwei Lin, [5].
- [Unsupervisedrecursivedeepfitting3Dprimitivestopoints](#), Tsahi Saporta, Andrei Sharf, [6].

Registration & Animation

- [Hierarchicalmesh-to-pointsas-rigid-as-possible registration](#), Pierre Bourquat, Guillaume Damiand, David Coeurjolly, Florent Dupont, [7].
- [As-rigid-as-possible volumetric tracking for time-varying surfaces](#), Jan Dvořák, Zuzana Káčereková, Petr Vaněček, Lukáš Hruša, Libor Vasa, [8].
- [Automaticshapeadjustmentatjointsfortheimplicit skinning](#), Olivier Hachette, Florian Canezin, Rodolphe Vaillant, Nicolas Melado, Loïc Barthe, [9].

Synthesis & Surfaces

- [Synthesis of 3D jigsaw puzzles over freeform 2-manifolds](#), Gershon Elber, Myung-Soo Kim, [10]. **[Honorable Mention]**
- [A multigrid approach for harmonic measured foliations](#), Shaodong Wang, Shuai Ma, Hui Zhao, Wencheng Wang, [11]. **[Honorable Mention]**
- [Projection-based classification of surfaces for 3D human mesh sequence retrieval](#), Emery Pierson, Juan-Carlos Alvarez-Paiva, Mohamed Daoudi, [12].

Reconstruction & Representation

- [Extracting Datums to reconstruct CSG models from 2D engineering sketches of polyhedral shapes](#), Raquel Plumed, Peter Ashley, Clifford Varley, Pedro Company, Ralph Martin, [13].
- [An Improved Refinement Rule for Multi-sided Faces](#), Kestutis Karciuskas, Jörg Peters, [14]. **[Best paper]**

Keynotes

- Siddhartha Chaudhuri, Adobe Research & IIT Bombay, *Data-driven 3D modeling*.
- Lining Yao, Carnegie Mellon University, *Computational geometry for morphing matter design*.

Award Talks

- Bianca Falcidieno, national research council, Italy, *Shape modeling: From geometry to semantics*.
- Mélina Skouras, Inria Grenoble, France, *On the computational design of deformable objects*.

Subdivision History Day

- Early days of Subdivision. Panelists: Ergun Akleman, Ed Catmull, Elaine Cohen, Tony DeRose, Jeff Lane, Richard Riesenfeld, Malcolm Sabin.
- Subdivision Becomes Mainstream in Graphics. Panelists: Malcolm Sabin, Ed Catmull, Nira Dyn, Tony DeRose, David Levin, Charles Loop, Jan Pinkava, Jörg Peters, Ulrich Reif, Jos Stam.
- Beyond. Panelists: Jörg Peters, Ergun Akleman, Leif Kobbelt, Ahmad Nasri, Peter Schröder, Luiz Velho, Joe Warren, Denis Zorin.

We would like to thank the 72 IPC members and 2 external reviewers for their reviewing efforts, which helped us to create a high-quality programme and led to the success of this special section. We are grateful to all panelists, our conference co-chairs Ergun Akleman, Stefanie Hahmann, and Jörg Peters, FASE paper chairs Carlo H. Séquin and Oleg Fryazinov, for their help and support in numerous aspects. We also thank the Eurographics and ACM Associations for their continued support, Texas A&M University for hosting the virtual event, and Joaquim Jorge, editor-in-chief of C&G and the Elsevier CAG Team for making this C&G Special Section possible. Finally, we greatly appreciate all authors for their interest and support to SMI 2021.

International program committee

Melinos Averkiou, University of Cyprus, Cyprus
Gill Barequet, Technion Israel Institute of Technology, Israel
Loic Barthe, Université de Toulouse, France
Alexander Belyaev, Heriot-Watt University, UK
David Bommes, University of Bern, Germany
Georges-Pierre Bonneau, University Grenoble Alpes, France
Marcel Campen, Osnabrück University, Germany
Raphaëlle Chaine, Université de Lyon, France
Zhonggui Chen, Xiameng University, P.R. China
Edward Chien, MIT, USA
Tao Du, MIT, USA
Jeremie Dumas, New York University, USA
Ye Duan, University of Missouri, USA
Anastasia Dubrovina, Lyft, USA
Gershon Elber, Technion, Israel
Bianca Falcidieno, CNR-IMATI, Italy
Leila De Floriani, University of Maryland, USA

Hongbo Fu, City University of Hong Kong, P.R. China
Eric Galin, University of Lyon, France
Xifeng Gao, Florida State University, USA
Yotam Gingold, George Mason University, USA
Daniela Giorgi, ISTI-CNR, Italy
Eric Guerin, INSA de Lyon, France
Xiaoguang Han, The Chinese University of Hong Kong, P.R. China
Franck Hetroy-Wheeler, University of Strasbourg, France
Klaus Hildebrandt, TU Delft, Netherlands
Haibin Huang, Kwai Inc., USA
Qixing Huang, UT Austin, USA
Hui Huang, Shenzhen University, P.R. China
Bert Jüttler, Johannes Kepler University, Austria
Takashi Kanai, University of Tokyo, Japan
Myung-Soo Kim, Seoul National University, Korea
Hamid Laga, Murdoch University, Australia
Xin Li, Louisiana State University, USA
Peter Lindstrom, Lawrence Livermore National Laboratory, USA
Hsueh-Ti Derek Liu, University of Toronto, Canada
Ligang Liu, University of Science and Technology of China, P.R. China
Yongjin Liu, Tsinghua University, P.R. China
Lin Lu, Shandong University, P.R. China
Chongyang Ma, Kuaishou Technology, P.R. China
Luigi Malomo, ISTI-CNR, Italy
Martin Marinov, Autodesk, USA
Geraldine Morin, University Toulouse, France
Ramanathan Muthuganapathy, Indian Institute of Technology Madras, India
Ahmad Nasri, Boulder Graphics LLC, USA
Yutaka Ohtake, University of Tokyo, Tokyo
Julian Panetta, UC Davis, USA
Amal Dev Parakkat, Indian Institute of Technology Guwahati, India
Giuseppe Patanè, CNR-IMATI, Italy
Nico Pietroni, University Of Technology Sydney, Australia
Konrad Polthier, Freie Universität Berlin, Germany
Hong Qin, Stony Brook University, USA
Damien Rohmer, Ecole Polytechnique, France
Camille Schreck, INRIA Nancy, France
Carlo Sequin, UC Berkeley, USA
Mélina Skouras, INRIA Grenoble, France
Justin Solomon, MIT, USA
Michela Spagnuolo, CNR-IMATI, Italy
Daniel Thalmann, Swiss Federal Institute of Technology, Switzerland
Nobuyuki Umetani, University of Tokyo, Japan
Georg Umlauf, HTWG Konstanz, Germany
Amir Vaxman, Utrecht University, Netherlands
Remco Veltkamp, Utrecht University, Netherlands
Wenping Wang, University of Hong Kong, P.R. China
Yu Wang, MIT, USA
Pengshuai Wang, Microsoft Research Asia, P.R. China
Kui Wu, Tencent North America, USA
Kai Xu, National University of Defense Technology, P.R. China
Cedric Zanni, University of Lorraine, France
Juyong Zhang, University of Science and Technology of China, P.R. China
Xiaoting Zhang, Boston University, USA

External reviewers

Ulderico Fugacci, CNR-IMATI, Italy
Dmitriy Smirnov, MIT, USA

References

- [1] Ma J, Wang J, Li J, Zhang D. Real-time skeletonization for sketch-based modeling. *Comput Graph* 2022;102:56–66. <http://dx.doi.org/10.1016/j.cag.2021.11.005>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002478>.
- [2] Cai R, Li H, Xie J, Jin X. Accurate floorplan reconstruction using geometric priors. *Comput Graph* 2022;102:360–9. <http://dx.doi.org/10.1016/j.cag.2021.10.011>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002223>.
- [3] Chen Q, Zhang S, Zheng Y. Enhanced narrow band surface reconstruction with anisotropic kernel. *Comput Graph* 2022;102:280–8. <http://dx.doi.org/10.1016/j.cag.2021.10.021>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002326>.
- [4] Xiao D, Lin S, Shi Z, Wang B. Learning modified indicator functions for surface reconstruction. *Comput Graph* 2022;102:309–19. <http://dx.doi.org/10.1016/j.cag.2021.10.017>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002272>.
- [5] Zhou C, Dong Z, Lin H. Learning persistent homology of 3D point clouds. *Comput Graph* 2022;102:269–79. <http://dx.doi.org/10.1016/j.cag.2021.10.022>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002399>.
- [6] Saporta T, Sharf A. Unsupervised recursive deep fitting of 3D primitives to points. *Comput Graph* 2022;102:289–99. <http://dx.doi.org/10.1016/j.cag.2021.10.020>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002314>.
- [7] Bourquart P, Coeurjolly D, Dami G, Dupont F. Hierarchical mesh-to-points as-rigid-as-possible registration. *Comput Graph* 2022;102:320–8. <http://dx.doi.org/10.1016/j.cag.2021.10.016>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002260>.
- [8] Dvořák J, Káčereková Z, Vaněček P, Hruška L, Váša L. As-rigid-as-possible volume tracking for time-varying surfaces. *Comput Graph* 2022;102:329–38. <http://dx.doi.org/10.1016/j.cag.2021.10.015>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002284>.
- [9] Hachette O, Canezin F, Vaillant R, Mellado N, Barthe L. Automatic shape adjustment at joints for the implicit skinning. *Comput Graph* 2022;102:300–8. <http://dx.doi.org/10.1016/j.cag.2021.10.018>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002296>.
- [10] Elber G, Kim MS. Synthesis of 3D jigsaw puzzles over freeform 2-manifolds. *Comput Graph* 2022;102:339–48. <http://dx.doi.org/10.1016/j.cag.2021.10.014>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002259>.
- [11] Wang S, Ma S, Zhao H, Wang W. A multigrid approach for generating harmonic measured foliations. *Comput Graph* 2022;102:380–9. <http://dx.doi.org/10.1016/j.cag.2021.10.003>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002144>.
- [12] Pierson E, Álvarez Paiva JC, Daoudi M. Projection-based classification of surfaces for 3D human mesh sequence retrieval. *Comput Graph* 2022;102:45–55. <http://dx.doi.org/10.1016/j.cag.2021.10.012>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002235>.
- [13] Plumed R, Varley PA, Company P, Martin R. Extracting datums to reconstruct CSG models from 2D engineering sketches of polyhedral shapes. *Comput Graph* 2022;102:349–59. <http://dx.doi.org/10.1016/j.cag.2021.10.013>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002247>.
- [14] Karčiauskas K, Peters J. An improved refinement rule for multi-sided faces. *Comput Graph* 2022;102:370–9. <http://dx.doi.org/10.1016/j.cag.2021.10.008>, URL <https://www.sciencedirect.com/science/article/pii/S0097849321002193>.



Silvia Biasotti is a Senior Researcher at the Institute of Applied Mathematics and Information Technologies of the National Research Council of Italy (CNR-IMATI). Her research interests include: shape modeling; similarity reasoning in presence of incomplete or partial information; pattern, color and texture recognition on surfaces; change detection on 3D data; the exploration of large collections of 3D models. She was in charge of several CNR-IMATI research activities on surface similarity reasoning and is involved in the creation of datasets and benchmarks, in particular she organized several tracks of the SHape REtrieval Contest (SHREC). More details are available at <https://imati.cnr.it/mypage/people/BiasottiSilvia.htm>.



Yang Liu Dr. Yang Liu is a principal researcher in the Internet Graphics Group at Microsoft Research Asia. He received his Ph.D. degree from The University of Hong Kong in 2008, Master and Bachelor degrees in Computational Mathematics from University of Science and Technology of China in 2003 and 2000. His interests span geometric modeling and processing, learning techniques for 3D understanding and content generation, numerical optimization, and architectural geometry. He is on the editorial boards of *IEEE Transactions on Visualization and Computer Graphics* and *ACM Transactions on Graphics*, has been the program co-chair of International Conference on Geometric Modeling and Processing 2019 and served as Program Committee for many international computer graphics conferences.



Bo Zhou Bo Zhu is an assistant professor of Computer Science at Dartmouth College. Prior to joining Dartmouth, he obtained his Ph.D. from Stanford and conducted his postdoctoral research at MIT CSAIL. His research interests include computer graphics, computational physics, computational fluid dynamics, and scientific machine learning. He mainly focuses on building computational approaches to simulate complex fluid systems.

Silvia Biasotti*

Istituto di Matematica Applicata e Tecnologie Informatiche E. Magenes' - CNR, Italy

E-mail address: silvia.biasotti@ge.imati.cnr.it

Yang Liu

Microsoft Research, China

E-mail address: yangliu@microsoft.com

Bo Zhu

Department of Computer Science, Dartmouth College, United States of America

E-mail address: bo.zhu@dartmouth.edu

4 March 2022

Available online 10 March 2022

* Corresponding editor.