

EG 3DOR 2018

Eurographics Workshop on 3D Object Retrieval

**Delft, The Netherlands
April 16, 2018**

Workshop Chair

Remco Veltkamp, Utrecht University, The Netherlands

Programme Chairs

Alex Telea, RijksUniversiteit Groningen, The Netherlands

Theoharis Theoharis, Norwegian University of Science and Technology, Norway

SHREC Contest Chair

Remco Veltkamp, Utrecht University, The Netherlands

Proceedings Production Editor

Dieter Fellner (TU Darmstadt & Fraunhofer IGD, Germany)

Sponsored by EUROGRAPHICS Association

Dieter W. Fellner, Werner Hansmann, Werner Purgathofer, François Sillion
Series Editors

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 978-3-03868-053-6

ISSN 1997-0471 (online)

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 |
| Preface | v |
| Co-Organizers | vi |
| International Programme Committee | vii |
| Author Index | viii |
| Keynote | x |
| Papers I | |
| Edge-based LBP Description of Surfaces with Colorimetric Patterns | 1 |
| <i>Elia Moscoso Thompson and Silvia Biasotti</i> | |
| Microshapes: Efficient Querying of 3D Object Collections based on Local Shape | 9 |
| <i>Bart Iver van Blokland and Theoharis Theoharis</i> | |
| Automatic Extraction of Complex 3D Structures Application to the Inner Ear Segmentation from Cone Beam CT Digital Volumes | 17 |
| <i>Florian Beguet, Jean-Luc Mari, Thierry Cresson, Matthieu Schmittbuhl, and Jacques A. de Guise</i> | |
| Geodesic-based 3D Shape Retrieval Using Sparse Autoencoders | 21 |
| <i>Lorenzo Luciano and Abdessamad Ben Hamza</i> | |
| SHREC Tracks | |
| 2D Scene Sketch-Based 3D Scene Retrieval | 29 |
| <i>Juefei Yuan, Bo Li, Yijuan Lu, Song Bai, Xiang Bai, Ngoc-Minh Bui, Minh N. Do, Trong-Le Do, Anh-Duc Duong, Xinwei He, Tu-Khiem Le, Wenhui Li, Anan Liu, Xiaolong Liu, Khac-Tuan Nguyen, Vinh-Tiep Nguyen, Weizhi Nie, Van-Tu Ninh, Yuting Su, Vinh Ton-That, Minh-Triet Tran, Shu Xiang, Heyu Zhou, Yang Zhou, and Zhichao Zhou</i> | |
| 2D Image-Based 3D Scene Retrieval | 37 |
| <i>Hameed Abdul-Rashid, Juefei Yuan, Bo Li, Yijuan Lu, Song Bai, Xiang Bai, Ngoc-Minh Bui, Minh N. Do, Trong-Le Do, Anh-Duc Duong, Xinwei He, Tu-Khiem Le, Wenhui Li, Anan Liu, Xiaolong Liu, Khac-Tuan Nguyen, Vinh-Tiep Nguyen, Weizhi Nie, Van-Tu Ninh, Yuting Su, Vinh Ton-That, Minh-Triet Tran, Shu Xiang, Heyu Zhou, Yang Zhou, and Zhichao Zhou</i> | |
| RGB-D Object-to-CAD Retrieval | 45 |
| <i>Quang-Hieu Pham, Minh-Khoi Tran, Wenhui Li, Shu Xiang, Heyu Zhou, Weizhi Nie, Anan Liu, Yuting Su, Minh-Triet Tran, Ngoc-Minh Bui, Trong-Le Do, Tu V. Ninh, Tu-Khiem Le, Anh-Vu Dao, Vinh-Tiep Nguyen, Minh N. Do, Anh-Duc Duong, Binh-Son Hua, Lap-Fai Yu, Duc Thanh Nguyen, and Sai-Kit Yeung</i> | |

Table of Contents

| | |
|---|-----|
| Protein Shape Retrieval | 53 |
| <i>Florent Langenfeld, Apostolos Axenopoulos, Anargyros Chatzitofis, Daniela Craciun, Petros Daras, Bowen Du, Andrea Giachetti, Yu-kun Lai, Haisheng Li, Yingbin Li, Majid Masoumi, Yuxu Peng, Paul L. Rosin, Jeremy Sirugue, Li Sun, Spyridon Thermos, Matthew Toews, Yang Wei, Yujuan Wu, Yujia Zhai, Tianyu Zhao, Yanping Zheng, and Matthieu Montes</i> | |
| Retrieval of Gray Patterns Depicted on 3D Models | 63 |
| <i>E. Moscoso Thompson, C. Tortorici, N. Werghi, S. Berretti, S. Velasco-Forero, and S. Biasotti</i> | |
| Recognition of Geometric Patterns Over 3D Models | 71 |
| <i>S. Biasotti, E. Moscoso Thompson, L. Barthe, S. Berretti, A. Giachetti, T. Lejembre, N. Mellado, K. Moustakas, Iason Manolas, Dimitrios Dimou, C. Tortorici, S. Velasco-Forero, N. Werghi, M. Polig, G. Sorrentino, and S. Hermon</i> | |
| Papers II | |
| Non-rigid 3D Model Classification Using 3D Hahn Moment Convolutional Neural Networks | 79 |
| <i>Abderrahim Mesbah, Aissam Berrahou, Hicham Hammouchi, Hassan Berbia, Hassan Qjidaa, and Mohamed Daoudi</i> | |
| Completion of Cultural Heritage Objects with Rotational Symmetry | 87 |
| <i>Ivan Sipiran</i> | |
| Person Re-Identification from Depth Cameras using Skeleton and 3D Face Data | 95 |
| <i>Pietro Pala, Lorenzo Seidenari, Stefano Berretti, and Alberto Del Bimbo</i> | |
| Experimental Similarity Assessment for a Collection of Fragmented Artifacts | 103 |
| <i>Silvia Biasotti, Elia Moscoso Thompson, and Michela Spagnuolo</i> | |
| Posters | |
| Performing Image-like Convolution on Triangular Meshes | 111 |
| <i>Claudio Tortorici, Naoufel Werghi, and Stefano Berretti</i> | |
| The MLSTree for Protein Docking | 115 |
| <i>Francisco Fernandes and Alfredo Ferreira</i> | |

Preface

The increase of 3D media as a key player across the wealth of information sources in the digital arena has continued its upwards trend in the last years. On the one hand, increasingly more powerful, fast, accurate, and affordable technologies and techniques for acquiring 3D content from the physical world, such as 3D scanners, 3D sensors, and depth cameras, have become available to both researchers and the grand public. On the other hand, the importance and interest in analyzing large databases of 3D shapes has spread from traditional applications in computer graphics to a wider spectrum of domains including medicine, bioinformatics, chemistry, security, serious gaming, and urban planning.

3D content-based retrieval has evolved from a niche technical area to a multidisciplinary application area involving researchers at the crossroads of computer graphics, shape modelling and processing, computer vision, machine learning, information systems, and practitioners in application-specific domains. Since 2008, Eurographics has hosted the 3D Object Retrieval (3DOR) workshop series dedicated to topics in the above field.

The eleventh edition of the 3DOR workshop was organized in 2018 on April 16th in Delft, Netherlands, in co-location with the Eurographics annual conference on Computer Graphics. Following the call for papers, the workshop has received 11 submissions and 6 track reports. All these have been reviewed by at least three members of the International Program Committee (IPC). Following the reviews, 8 submissions have been accepted as full presentations, and 2 papers have been accepted as short (poster) presentations. The papers cover a wide range of topics including mixed-modality retrieval, retrieval based on partial local shape information, and the usage of machine learning techniques to support shape retrieval. All accepted contributions will be included in the Eurographics Digital Library.

3DOR 2018 also hosts the 13th Shape Retrieval Contest (SHREC'18). The contest continues the effort of earlier editions for the creation of comprehensive benchmarks including retrieval methods, datasets, and related methodology for various types of 3D shape retrieval. SHREC'18 proposed six different tracks covering sketch-based and image based 3D scene retrieval, RGBD based object retrieval, protein shape retrieval, retrieval of color patterns from 3D models, and geometric pattern recognition over 3D models. All track reports contribute with detailed information on the state-of-the-art of the rapidly evolving and expanding 3D retrieval field.

As during the past edition, a special issue in a mainstream journal is planned based on extended versions of selected full papers from 3DOR 2018.

The one-day programme of 3DOR 2018 contains all above full paper, poster, and SHREC track presentations, as well as a keynote talk from Adrian Hilton (University of Surrey, UK) on 4D Vision for Human Animation and Shape Retrieval.

We would like to thank the IPC members for their reviewing effort which helped us to create a high-quality and exciting programme. We also thank the Eurographics Association for their continued support of this event, Delft University for providing all co-location facilities, and last but not least, Stefanie Behnke for her excellent support in managing the production of the workshop proceedings.

Workshop Chair:

Remco Veltkamp, Utrecht University, Netherlands

Programme Chairs:

Theoharis Theoharis, NTNU, Norway

Alexandru Telea, University of Groningen, Netherlands

SHREC Contest Chair:

Remco Veltkamp, Utrecht University, Netherlands

Co-Organizers



Utrecht University



International Programme Committee

Yiannis Aloimonos (UMIACS, USA)
A. Ben Hamza (Concordia University, Montreal, Canada)
Igor Barros Barbosa (NTNU, Norway)
Benjamin Bustos (University of Chile, Chile)
Halim Benhabiles (ISEN, Yncréa Hauts-de-France)
Stefano Berretti (University of Florence, Italy)
Silvia Biasotti (IMATI - CNR Genoa, Italy)
Michael Bronstein (Universita' della Svizzera Italiana, Switzerland)
Umberto Castellani (University of Verona, Italy)
Joao Comba (Federal University of Rio Grande do Sul, Brazil)
Mohamed Daoudi (Télécom Lille 1 / Institut Mines-Télécom, France)
Petros Daras (Informatics and Telematics Institute, Greece)
Alberto Del Bimbo (University of Florence, Italy)
Alexandre X. Falcao (University of Campinas, Brazil)
Bianca Falcidieno (IMATI-CNR, Italy)
Alfredo Ferreira (Technical University of Lisbon, Portugal)
Maria Cristina Ferreira de Oliveira (University of Sao Paulo, Brazil)
Andrea Giachetti (University of Verona, Italy)
Daniela Giorgi (ISTI-CNR, Italy)
Afzal Godil (National Institute of the Standards and Technology, USA)
Luis Gustavo Nonato (University of Sao Paulo, Brazil)
Nina Hirata (University of Sao Paulo, Brazil)
Andrei Jalba (Eindhoven University of Technology, The Netherlands)
Ron Kimmel (Technion, Israel)
Jiri Kosinka (University of Groningen, The Netherlands)
Zhouhui Lian (Peking University, Beijing, China)
Lars Linsen (University of Münster, Germany)
Ryutarou Ohbuchi (University of Yamanashi, Japan)
Georgios Papaioannou (AUEB, Greece)
David Picard (ETIS-ENSEA, France)
Ioannis Pratikakis (Democritus University of Thrace (Greece)
Herindrasana Ramampiaro (NTNU, Norway)
Raif M. Rustamov (AT&T Labs Research, USA)
Nickolas S. Sapidis (University of Western Macedonia, Greece)
Ivan Sipiran (Pontificia Universidad Católica del Perú)
Tobias Schreck (Graz University of Technology, Germany)
Michela Spagnuolo (IMATI - CNR, Italy)
Hedi Tabia (ETIS-ENSEA, France)
Oliver van Kaick (Simon Fraser University, Canada)
Jean-Philippe Vandeborre (Télécom Lille / Institut Mines-Télécom, LIFL, France)
Hazem Wannous (University Lille1 / LIFL, France)
Kevin (Kai) Xu (National University of Defense Technology, China)

Author Index

- Abdul-Rashid, Hameed 37
Axenopoulos, Apostolos 53
Bai, Song 29, 37
Bai, Xiang 29, 37
Barthe, L. 71
Beguet, Florian 17
Berbia, Hassan 79
Berrahou, Aissam 79
Berretti, Stefano 63, 71, 95, 111
Biasotti, Silvia 1, 63, 71, 103
Bimbo, Alberto Del 95
Blokland, Bart Iver van 9
Bui, Ngoc-Minh 29, 37, 45
Chatzitofis, Anargyros 53
Craciun, Daniela 53
Cresson, Thierry 17
Dao, Anh-Vu 45
Daoudi, Mohamed 79
Daras, Petros 53
Dimou, Dimitrios 71
Do, Minh N. 29, 37, 45
Do, Trong-Le 29, 37, 45
Du, Bowen 53
Duong, Anh-Duc 29, 37, 45
Fernandes, Francisco 115
Ferreira, Alfredo 115
Giachetti, Andrea 53, 71
Guise, Jacques A. de 17
Hammouchi, Hicham 79
Hamza, Abdessamad Ben 21
He, Xinwei 29, 37
Hermon, S. 71
Hua, Binh-Son 45
Lai, Yu-kun 53
Langenfeld, Florent 53
Le, Tu-Khiem 29, 37, 45
Lejemble, T. 71
Li, Bo 29, 37
Li, Haisheng 53
Li, Wenhui 29, 37, 45
Li, Yingbin 53
Liu, Anan 29, 37, 45
Liu, Xiaolong 29, 37
Lu, Yijuan 29, 37
Luciano, Lorenzo 21
Manolas, Iason 71
Mari, Jean-Luc 17
Masoumi, Majid 53
Mellado, N. 71
Mesbah, Abderrahim 79
Montes, Matthieu 53
Moustakas, K. 71
Nguyen, Duc Thanh 45
Nguyen, Khac-Tuan 29, 37
Nguyen, Vinh-Tiep 29, 37, 45
Nie, Weizhi 29, 37, 45
Ninh, Van-Tu 29, 37, 45
Pala, Pietro 95
Peng, Yuxu 53
Pham, Quang-Hieu 45
Polig, M. 71
Qjidaa, Hassan 79
Rosin, Paul L. 53
Schmittbuhl, Matthieu 17
Seidenari, Lorenzo 95
Sipiran, Ivan 87
Sirugue, Jeremy 53
Sorrentino, G. 71
Spagnuolo, Michela 103
Su, Yuting 29, 37, 45
Sun, Li 53
Theoharis, Theoharis 9
Thermos, Spyridon 53
Thompson, Elia Moscoso 1, 63, 71, 103
Toews, Matthew 53
Ton-That, Vinh 29, 37
Tortorici, Claudio 63, 71, 111
Tran, Minh-Khoi 45
Tran, Minh-Triet 29, 37, 45
Velasco-Forero, S. 63, 71
Wei, Yang 53
Werghi, Naoufel 63, 71, 111
Wu, Yajuan 53
Xiang, Shu 29, 37, 45
Yeung, Sai-Kit 45
Yu, Lap-Fai 45

Author Index

| | | | |
|----------------------|--------|---------------------|------------|
| Yuan, Juefei | 29, 37 | Zhou, Heyu | 29, 37, 45 |
| Zhai, Yujia | 53 | Zhou, Yang | 29, 37 |
| Zhao, Tianyu | 53 | Zhou, Zhichao | 29, 37 |
| Zheng, Yanping | 53 | | |

Keynote

4D Vision for Human Animation and Shape Retrieval

Adrian Hilton

University of Surrey, UK

Abstract

Recent advances in 4D Vision have enabled the capture of temporally coherent volumetric shape representations. This talk will present recent advances in shape 4D reconstruction from multiple moving cameras and their use in animation content production. Temporally coherent 4D reconstruction and animation leverage shape matching across sequences to enable consistency and retrieval of frames with similar shape and motion. This talk will present the methods used for temporal shape matching based on the 4D shape trees and the matching of partial 4D surfaces. Recent advances in 4D shape super-resolution from a minimal set of camera views will also be presented.

Short Biography

Adrian Hilton, BSc(hons), DPhil, CEng, is Professor of Computer Vision and Graphics and Director of the Centre for Vision, Speech and Signal Processing at the University of Surrey, UK. He leads research investigating the use of computer vision for applications in entertainment content production, visual interaction and clinical analysis.

His interest is in robust computer vision to model and understand real world scenes, bridging-the-gap between real and computer generated imagery. This combines the fields of computer vision, machine learning, graphics and animation to investigate new methods for reconstruction, modelling and understanding of the real world from images and video. Applications include: sports analysis (soccer, rugby and athletics), 3D TV and film production, visual effects, character animation for games, digital doubles for film and facial animation for visual communication.

Contributions include technologies for the first hand-held 3D scanner, modeling of people from images and 3D video for games, broadcast and film production. Current research is focused on video-based measurement in sports, multiple camera systems in film and TV production, and 4D video for highly realistic animation of people and faces. Research is conducted in collaboration with UK companies and international institutions in the creative industries. Adrian is currently the Principal Investigator of the EPSRC Programme Grant S3A: 'Future Spatial Audio for Immersive Listener Experience at Home' (2013-2018) and EPSRC Platform Grant 'Audio-Visual Media Research', he also leads several EU and UK/ industry projects. Adrian currently holds a 5-year Royal Society Wolfson Research Merit Award (2013-2018).