

EG 3DOR 2016

Eurographics 2016 Workshop on 3D Object Retrieval

Lisbon, Portugal

May 8, 2016

Workshop Chair

Alfredo Ferreira, INESC-ID Lisboa, Instituto Superior Técnico, University of Lisbon, Portugal

Programme Chairs

Andrea Giachetti, Università degli Studi di Verona, Italy

Daniela Giorgi, ISTI-CNR Institute of Information Science and Technologies, Italy

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 ©2016 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 978-3-03868-004-8
ISSN 1997-0471 (online)

The electronic version of the proceedings is available from the Eurographics Digital Library at
<http://diglib.eg.org>

Table of Contents

Table of Contents	iii
Preface	v
Co-Organizers and Supporter	vi
International Programme Committee	vii
Author Index	viii
Keynote	x

Position Papers

Shape Retrieval and 3D Gestural Interaction	1
<i>Andrea Giachetti, Fabio Marco Caputo, Alessandro Carcangiu, Riccardo Scateni, and Lucio Davide Spano</i>	
Towards an Observer-oriented Theory of Shape Comparison	5
<i>Patrizio Frosini</i>	
3D Objects Exploration: Guidelines for Future Research	9
<i>Silvia Biasotti, Bianca Falcidieno, Daniela Giorgi, and Michela Spagnuolo</i>	

Full Papers

A Descriptor for Voxel Shapes Based on the Skeleton Cut Space	13
<i>Cong Feng, Andrei C. Jalba, and Alexandru C. Telea</i>	
An Experimental Shape Matching Approach for Protein Docking	21
<i>Francisco Fernandes and Alfredo Ferreira</i>	
An Edit Distance for Reeb Graphs	27
<i>Ulrich Bauer, Barbara Di Fabio, and Claudia Landi</i>	
An Evaluation of Local Feature Encodings for Shape Retrieval	35
<i>Flora Ponjou Tasse, Jiri Kosinka, and Neil A. Dodgson</i>	

SHREC'16 Tracks

Retrieval of Human Subjects from Depth Sensor Data	41
<i>Andrea Giachetti, Francesco Fornasa, Federico Parezzan, Alessandro Saletti, Leonardo Zambaldo, Luisa Zanini, Felix Achilles, Alexandru-Eugen Ichim, Federico Tombari, Nassir Navab, and Santiago Velasco-Forero</i>	
3D Sketch-Based 3D Shape Retrieval	47
<i>Bo Li, Yijuan Lu, Fuqing Duan, Shuilong Dong, Yachun Fan, Lu Qian, Hamid Laga, Haisheng Li, Yuxiang Li, Peng Liu, Maks Ovsjanikov, Hedi Tabia, Yuxiang Ye, Huanpu Yin, and Ziyu Xue</i>	

Table of Contents

Matching of Deformable Shapes with Topological Noise	55
<i>Zorah Löhner, Emanuele Rodolà, Michael M. Bronstein, Daniel Cremers, Oliver Burghard, Luca Cosmo, Alexander Dieckmann, Reinhard Klein, and Yusuf Sahillioğlu</i>	
Partial Matching of Deformable Shapes	61
<i>Luca Cosmo, Emanuele Rodolà, Michael M. Bronstein, Andrea Torsello, Daniel Cremers, and Yusuf Sahillioğlu</i>	
Shape Retrieval of Low-Cost RGB-D Captures	69
<i>Pedro B. Pascoal, Pedro Proença, Filipe Gaspar, Miguel Sales Dias, Alfredo Ferreira, Atsushi Tatsuma, Masaki Aono, K. Berker Logoglu, Sinan Kalkan, Alptekin Temizel, Bo Li, Henry Johan, Yijuan Lu, Viktor Seib, Norman Link, and Dietrich Paulus</i>	
Partial Shape Queries for 3D Object Retrieval	79
<i>Ioannis Pratikakis, Michalis A. Savelonas, Fotis Arnaoutoglou, George Ioannakis, Anestis Koutsoudis, Theoharis Theoharis, Minh-Triet Tran, Vinh-Tiep Nguyen, V.-K. Pham, Hai-Dang Nguyen, Hoang-An Le, Ba-Huu Tran, Huu-Quan To, Minh-Bao Truong, Thuyen Van Phan, Minh-Duc Nguyen, Thanh-An Than, Cu-Khoi-Nguyen Mac, Minh N. Do, Anh-Duc Duong, Takahiko Furuya, Ryutarou Ohbuchi, Masaki Aono, Shoki Tashiro, David Pickup, Xianfang Sun, Paul L. Rosin, and Ralph R. Martin</i>	
Large-Scale 3D Shape Retrieval from ShapeNet Core55	89
<i>Manolis Savva, Fisher Yu, Hao Su, Masaki Aono, Baoquan Chen, Daniel Cohen-Or, Weihong Deng, Hang Su, Song Bai, Xiang Bai, Noa Fish, Jiajie Han, Evangelos Kalogerakis, Erik G. Learned-Miller, Yangyan Li, Minghui Liao, Subhransu Maji, Atsushi Tatsuma, Yida Wang, Nanhai Zhang, and Zhichao Zhou</i>	
3D Object Retrieval with Multimodal Views	99
<i>Yue Gao, Weizhi Nie, Anan Liu, Yuting Su, Qionghai Dai, Le An, Fuhai Chen, Liujuan Cao, Shuilong Dong, Yu De, Zan Gao, Jiayun Hao, Rongrong Ji, Haisheng Li, Mingxia Liu, Lili Pan, Yu Qiu, Liwei Wei, Zhao Wang, Hongjiang Wei, Yuyao Zhang, Jun Zhang, Yang Zhang, and Yali Zheng</i>	

Preface

These proceedings contain the contributions presented at the ninth Eurographics Workshop on 3D Object Retrieval (3DOR) held in Lisbon, Portugal, on May 8th, 2016, as a co-event of the Annual Conference of the European Association for Computer Graphics (Eurographics). Following the tradition of 3DOR, which has been a successful forum for interaction and discussion among researchers from all over the world since 2008, participants from countries as distant as United States and China attended the workshop.

The proceedings include seven research papers, selected according to the recommendations of an international Program Committee of 29 external experts in the area of 3D shape analysis and retrieval.

This year, the call for papers encouraged the submission of position papers to stimulate the discussion of ideas, methods, and trends in the workshop topics. The three position papers presented at the workshop deal with the role of 3D retrieval in natural interaction systems for 3D immersive virtual environments (Giachetti et al.); the definition of a general model of shape comparison, which includes both the data and the way the observer elaborates on them (Frosini); and the identification of seven research challenges for developing the future systems for 3D dataset navigation (Biasotti et al.).

Four technical papers cover the use of surface skeletons for effective 3D retrieval (Feng et al.); the description of the 3D shape of a protein for evaluating protein-protein docking (Fernandes and Ferreira); the mathematical definition of an edit distance between Reeb graphs which ensures robustness for 3D retrieval (Bauer et al); and the analysis of encoding techniques for local features, towards a happy medium between precision and computational cost in 3D retrieval (Tasse et al.).

As in the previous editions of 3DOR, this year's event hosted the SHape REtrieval Contest (SHREC'16). For many years, the fundamental contribution of SHREC to the research community has been the evaluation of the effectiveness of 3D shape retrieval algorithms. The proceedings include eight additional papers that detail the results of the competition.

The keynote talk presented by Simone Santini (Univeristy of Madrid) tackled the unsolved challenge of query specification for 3D object retrieval. He presented several possible approaches to defining what a persona wants from a collection of nameless 3D objects, from the integration of sketches and textual information to the use of linguistic games for creating a lexicon associated with 3D data.

The workshop chairs are grateful to the Eurographics Association for their support, and to all the reviewers for ensuring a high quality program despite the tight schedule. Special thanks are also due to Stefanie Behnke for her constant and timely support.

Finally, we hope that this workshop series continue to prove useful to all the participants, and keep setting the ground for long-term interaction and collaboration towards the identification of future research directions and potential problems in the field of 3D analysis and retrieval.

Alfredo Ferreira, Andrea Giachetti, and Daniela Giorgi

Co-Organizers and Supporter



International Programme Committee

Ceyhun B. Akgul, Vistek-ISRA Vision (Turkey)
Benjamin Bustos, University of Chile (Chile)
Stefano Berretti, University of Florence (Italy)
Silvia Biasotti, IMATI - CNR Genoa (Italy)
Michael Bronstein, Università della Svizzera Italiana (Switzerland)
Umberto Castellani, University of Verona (Italy)
Mohamed Daoudi, Télécom Lille 1 / Institut Mines-Télécom (France)
Alberto Del Bimbo, University of Florence (Italy)
Miguel Sales Dias, ISCTE - University Institute of Lisbon (Portugal)
Leo Dorst, University of Amsterdam (Netherlands)
Bianca Falcidieno, IMATI - CNR Genoa (Italy)
Hamid Laga, Murdoch University (Australia)
Guillaume Lavoue, INSA Lyon (France)
Georgios Papaioannou, AUEB (Greece)
Ioannis Pratikakis, Democritus University of Thrace (Greece)
Herindrasana Ramampiaro, NTNU (Norway)
Marcos Rodrigues, University of Sheffield (UK)
Raif M. Rustamov, Stanford University (USA)
Nickolas S. Sapidis, University of Western Macedonia (Greece)
Ivan Sipiran, Pontificia Universidad Católica del Perú (Perú)
Tobias Schreck, Graz University of Technology (Austria)
Michela Spagnuolo, CNR-IMATI (Italy)
Hedi Tabia, ETIS-ENSEA (France)
Teoharis Teoharis, Norwegian University of Science and Technology (Norway)
Oliver van Kaick, Simon Fraser University (Canada)
Jean-Philippe Vandeborre, Télécom Lille 1 / Institut Mines-Télécom (France)
Remco Veltkamp, Utrecht University (Netherlands)
Hazem Wannous, University Lille1 / LIFL (France)
Stefanie Wuhler, Saarland University / Max Planck Institute (Germany)

Author Index

Achilles, Felix	41	Han, Jiajie	89
An, Le	99	Hao, Jiayun	99
Aono, Masaki	69, 79, 89	Ichim, Alexandru-Eugen	41
Arnaoutoglou, Fotis	79	Ioannakis, George	79
Bai, Song	89	Jalba, Andrei C.	13
Bai, Xiang	89	Ji, Rongrong	99
Bauer, Ulrich	27	Johan, Henry	69
Biasotti, Silvia	9	Kalkan, Sinan	69
Bronstein, Michael M.	55, 61	Kalogerakis, Evangelos	89
Burghard, Oliver	55	Klein, Reinhard	55
Cao, Liujuan	99	Kosinka, Jiri	35
Caputo, Fabio Marco	1	Koutsoudis, Anestis	79
Carcangiu, Alessandro	1	Laga, Hamid	47
Chen, Baoquan	89	Lähler, Zorah	55
Chen, Fuhai	99	Landi, Claudia	27
Cohen-Or, Daniel	89	Le, Hoang-An	79
Cosmo, Luca	55, 61	Learned-Miller, Erik G.	89
Cremers, Daniel	55, 61	Li, Bo	47, 69
Dai, Qionghai	99	Li, Haisheng	47, 99
De, Yu	99	Li, Yangyan	89
Deng, Weihong	89	Li, Yuxiang	47
Dias, Miguel Sales	69	Liao, Minghui	89
Dieckmann, Alexander	55	Link, Norman	69
Do, Minh N.	79	Liu, Anan	99
Dodgson, Neil A.	35	Liu, Mingxia	99
Dong, Shuilong	47, 99	Liu, Peng	47
Duan, Fuqing	47	Logoglu, K. Berker	69
Duong, Anh-Duc	79	Lu, Yijuan	47, 69
Fabio, Barbara Di	27	Mac, Cu-Khoi-Nguyen	79
Falcidieno, Bianca	9	Maji, Subhransu	89
Fan, Yachun	47	Martin, Ralph R.	79
Feng, Cong	13	Navab, Nassir	41
Fernandes, Francisco	21	Nguyen, Hai-Dang	79
Ferreira, Alfredo	21, 69	Nguyen, Minh-Duc	79
Fish, Noa	89	Nguyen, Vinh-Tiep	79
Fornasa, Francesco	41	Nie, Weizhi	99
Frosini, Patrizio	5	Ohbuchi, Ryutarou	79
Furuya, Takahiko	79	Ovsjanikov, Maks	47
Gao, Yue	99	Pan, Lili	99
Gao, Zan	99	Parezzan, Federico	41
Gaspar, Filipe	69	Pascoal, Pedro B.	69
Giachetti, Andrea	1, 41	Paulus, Dietrich	69
Giorgi, Daniela	9	Pham, V.-K.	79

Author Index

Phan, Thuyen Van	79	Than, Thanh-An	79
Pickup, David	79	Theoharis, Theoharis	79
Pratikakis, Ioannis	79	To, Huu-Quan	79
Proença, Pedro	69	Tombari, Federico	41
Qian, Lu	47	Torsello, Andrea	61
Qiu, Yu	99	Tran, Ba-Huu	79
Rodolà, Emanuele	55, 61	Tran, Minh-Triet	79
Rosin, Paul L.	79	Truong, Minh-Bao	79
Sahillioğlu, Yusuf	55, 61	Velasco-Forero, Santiago	41
Saletti, Alessandro	41	Wang, Yida	89
Savelonas, Michalis A.	79	Wang, Zhao	99
Savva, Manolis	89	Wei, Hongjiang	99
Scateni, Riccardo	1	Wei, Liwei	99
Seib, Viktor	69	Xue, Ziyu	47
Spagnuolo, Michela	9	Ye, Yuxiang	47
Spano, Lucio Davide	1	Yin, Huanpu	47
Su, Hang	89	Yu, Fisher	89
Su, Hao	89	Zambaldo, Leonardo	41
Su, Yuting	99	Zanini, Luisa	41
Sun, Xianfang	79	Zhang, Jun	99
Tabia, Hedi	47	Zhang, Nanhai	89
Tashiro, Shoki	79	Zhang, Yang	99
Tasse, Flora Ponjou	35	Zhang, Yuyao	99
Tatsuma, Atsushi	69, 89	Zheng, Yali	99
Telea, Alexandru C.	13	Zhou, Zhichao	89
Temizel, Alptekin	69		

Keynote

Where the Things Have no Name: Searching in a Lexical Vacuum

Simone Santini

Escuela Politecnica Superior
Universidad Autonoma de Madrid, Spain

Abstract

Many applications of search deal with imaging data specified by well defined lexical concepts: one searches for houses, dogs, umbrellas, . . . Searching and finding these things, that is: transforming the lexical specification in some visual description, can be horrendously complicated but, at least, we know what we are looking for.

When we search for 3D data, at least when we do so in the typical domains in which 3D data are used, we find ourselves in a different situation. On the one hand, the models that we have are more complete, and do, in principle, allow a better match with the user desires. On the other hand, specifying exactly what a persona wants is a problem in itself.

Consider a simple example: a data base of designs of mechanical parts. Standard parts have a name, but new ones don't, and it is necessary somehow to describe what we want, using suitable graphics and/or linguistic means; a task that, in itself, may be very complicated.

In some areas, like many cultural heritage areas, there is an established technical vocabulary that can be used, but in many others it is necessary to create the suitable vocabulary before we can start specifying our queries.

In this talk, we shall discuss several possible approaches to defining what we want from a data base of nameless shapes. We shall consider the integration of sketches and textual information as well as the use of linguistic games for creating a lexicon and the association to the 3D data.

In the first case, the problem is one of integration of information: somebody may draw a sketch of a face of an object and write next to it "cylinder" or "360" to indicate that it is a rotation surface. In the second case, the problem is to create an agreed-upon lexicon through interaction as well as the relevant connections with the visual features of the objects