

# **Communications in Computer and Information Science**

## **1182**

*Commenced Publication in 2007*

Founding and Former Series Editors:

Phoebe Chen, Alfredo Cuzzocrea, Xiaoyong Du, Orhun Kara, Ting Liu, Krishna M. Sivalingam, Dominik Ślęzak, Takashi Washio, Xiaokang Yang, and Junsong Yuan

### **Editorial Board Members**

Simone Diniz Junqueira Barbosa 

*Pontifical Catholic University of Rio de Janeiro (PUC-Rio),  
Rio de Janeiro, Brazil*

Joaquim Filipe 

*Polytechnic Institute of Setúbal, Setúbal, Portugal*

Ashish Ghosh

*Indian Statistical Institute, Kolkata, India*

Igor Kotenko 

*St. Petersburg Institute for Informatics and Automation of the Russian  
Academy of Sciences, St. Petersburg, Russia*

Lizhu Zhou

*Tsinghua University, Beijing, China*

More information about this series at <http://www.springer.com/series/7899>

Ana Paula Cláudio · Kadi Bouatouch ·  
Manuela Chessa · Alexis Paljic ·  
Andreas Kerren · Christophe Hurter ·  
Alain Tremeau · Giovanni Maria Farinella (Eds.)

# Computer Vision, Imaging and Computer Graphics Theory and Applications

14th International Joint Conference, VISIGRAPP 2019  
Prague, Czech Republic, February 25–27, 2019  
Revised Selected Papers



Springer

*Editors*

Ana Paula Cláudio  
University of Lisbon  
Lisbon, Portugal

Manuela Chessa  
University of Genoa  
Genoa, Italy

Andreas Kerren  
Linnaeus University  
Växjö, Sweden

Alain Tremeau  
University Jean Monnet  
Saint-Etienne, France

Kadi Bouatouch  
University of Rennes 1  
Rennes, France

Alexis Paljic  
Mines ParisTech  
Paris, France

Christophe Hurter  
French Civil Aviation University (ENAC)  
Toulouse, France

Giovanni Maria Farinella  
University of Catania  
Catania, Italy

ISSN 1865-0929

ISSN 1865-0937 (electronic)

Communications in Computer and Information Science

ISBN 978-3-030-41589-1 ISBN 978-3-030-41590-7 (eBook)

<https://doi.org/10.1007/978-3-030-41590-7>

© Springer Nature Switzerland AG 2020

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Preface

The present book includes extended and revised versions of a set of selected papers from the 14th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2019), held in Prague, Czech Republic, during February 25–27, 2019.

The purpose of VISIGRAPP is to bring together researchers and practitioners interested in both theoretical advances and applications of Computer Vision, Computer Graphics, Information Visualization, and Human-Computer Interaction. VISIGRAPP is composed of four co-located conferences, each specialized in at least one of the aforementioned main knowledge areas.

VISIGRAPP 2019 received 396 paper submissions from 49 countries, of which 6% were included in this book. The papers were selected by the event chairs and their selection was based on a number of criteria that included the classifications and comments provided by the Program Committee members, the session chairs' assessment, and also the program chairs' global view of all papers included in the technical program. The authors of selected papers were then invited to submit a revised and extended version of their papers, having at least 30% innovative material.

The papers selected to be included in this book contribute to the understanding of relevant trends of current research on Computer Vision, Imaging, and Computer Graphics Theory and Applications, including: network visualization, visual data analysis and knowledge discovery, volume rendering, visualization applications and technologies, 3D reconstruction and animation, virtual and augmented reality, image and video understanding, deep learning, first person (egocentric) vision, multi-modal, human-computer interaction, and user evaluation.

We would like to thank all the authors for their contributions and also the reviewers who helped ensure the quality of this publication.

February 2019

Ana Paula Cláudio  
Kadi Bouatouch  
Manuela Chessa  
Alexis Paljic  
Andreas Kerren  
Christophe Hurter  
Alain Tremeau  
Giovanni Maria Farinella

# Organization

## Conference Chair

José Braz

Escola Superior de Tecnologia de Setúbal, Portugal

## Program Co-chairs

### GRAPP

Ana Paula Cláudio  
Kadi Bouatouch

BioISI, Universidade de Lisboa, Portugal  
IRISA, University of Rennes 1, France

### HUCAPP

Manuela Chessa  
Alexis Paljic

University of Genoa, Italy  
Mines Paristech, France

### IVAPP

Andreas Kerren  
Christophe Hurter

Linnaeus University, Sweden  
French Civil Aviation University (ENAC), France

### VISAPP

Alain Tremeau  
Giovanni Maria Farinella

Université Jean Monnet, France  
Università di Catania, Italy

## GRAPP Program Committee

Francisco Abad  
Marco Agus

Universidad Politécnica de Valencia, Spain  
King Abdullah University of Science and Technology,  
Saudi Arabia

Lilian Aveneau  
Gérard Bailly  
Maria Beatriz Carmo  
Gonzalo Besuievsky  
Carla Binucci  
Venceslas Biri  
Fernando Birra  
Kristopher Blom  
Stephen Brooks  
Dimitri Bulatov  
Patrick Callet  
L. G. Casado

University of Poitiers, France  
GIPSA-Lab, Université Grenoble Alpes, CNRS, France  
Universidade de Lisboa, Portugal  
Universitat de Girona, Spain  
Università degli Studi di Perugia, Italy  
University of Paris-Est, France  
UNL, Portugal  
Virtual Human Technologies, Czech Republic  
Dalhousie University, Canada  
Fraunhofer IOSB, Germany  
Centre Français de la Couleur, France  
University of Almeria, Spain

Eva Cerezo	University of Zaragoza, Spain
Teresa Chambel	Lasige, University of Lisbon, Portugal
Parag Chaudhuri	Indian Institute of Technology Bombay, India
Hwan-gue Cho	Pusan National University, South Korea
Teodor Cioaca	AID GmbH, Germany
António Coelho	Universidade do Porto, Portugal
Sabine Coquillart	Inria, France
Vasco Costa	INESC-ID, Portugal
Rémi Cozot	LISIC, University of Littoral, France
Luiz Henrique de Figueiredo	Impa, Brazil
Bailin Deng	Cardiff University, UK
Paulo Dias	Universidade de Aveiro, Portugal
John Dingliana	Trinity College Dublin, Ireland
Jean-Michel Dischler	Université de Strasbourg, France
Anastasios Drosou	Centre for Research and Technology, Hellas, Greece
Thierry Duval	IMT Atlantique, France
Elmar Eisemann	Delft University of Technology, The Netherlands
Marius Erdt	Fraunhofer IDM@NTU, Singapore
Petros Faloutsos	University of California, Los Angeles, USA
Jean-Philippe Farrugia	LIRIS Lab, France
Pierre-Alain Fayolle	University of Aizu, Japan
Francisco R. Feito	University of Jaén, Spain
Dirk Feldmann	University of Münster, Germany
Jie Feng	Peking University, China
Jie-Qing Feng	State Key Lab of CAD&CG, Zhejiang University, China
Leandro Fernandes	Universidade Federal Fluminense, Brazil
Carla Freitas	Universidade Federal do Rio Grande do Sul, Brazil
Ioannis Fudos	University of Ioannina, Greece
Alejandro García-Alonso	University of the Basque Country, Spain
Miguel Gea	University of Granada, Spain
Djamchid Ghazanfarpour	Xlim Laboratory (UMR CNRS 7252), University of Limoges, France
Enrico Gobbetti	CRS4, Italy
Stephane Gobron	HES-SO, Arc, Switzerland
Alexandrino Gonçalves	Polytechnic Institute of Leiria, Portugal
Marcelo Guimarães	Federal University of São Paulo, Brazil
James Hahn	George Washington University, USA
Vlastimil Havran	Czech Technical University in Prague, Czech Republic
Nancy Hitschfeld	University of Chile, Chile
Ludovic Hoyet	Inria Rennes, Centre Bretagne Atlantique, France
Andres Iglesias	University of Cantabria, Spain
Juan José Jiménez-Delgado	Universidad de Jaén, Spain
Xiaogang Jin	Zhejiang University, China
Robert Joan-Ariño	Universitat Politècnica de Catalunya, Spain

Chris Joslin	Carleton University, Canada
Cláudio Jung	Universidade Federal do Rio Grande do Sul, Brazil
Mubbasis Kapadia	Rutgers University, USA
Josef Kohout	University of West Bohemia, Czech Republic
Maciej Kot	Tokyo Institute of Technology, Japan
Torsten Kuhlen	RWTH Aachen University, Germany
Richard Kulpa	Université Rennes 2, France
Won-sook Lee	University of Ottawa, Canada
Alejandro León	University of Granada, Spain
Marco Livesu	CNR, Italy
Hélio Lopes	PUC-Rio, Brazil
Joaquim Madeira	University of Aveiro, Portugal
Claus Madsen	Aalborg University, Denmark
Stephen Mann	University of Waterloo, Canada
Michael Manzke	Trinity College Dublin, Ireland
Ricardo Marroquim	Delft University of Technology, The Netherlands
Belen Masia	Universidad de Zaragoza, Spain
Oliver Mattausch	Siemens, Switzerland
Nelson Max	University of California, USA
Eder Miguel	Universidad Rey Juan Carlos, Spain
José Molina Massó	Universidad de Castilla-la Mancha, Spain
Ramon Molla	Universitat Politècnica de València, Spain
David Mould	Carleton University, Canada
Afonso Paiva	USP, Brazil
Georgios Papaioannou	Athens University of Economics and Business, Greece
Daniel Patel	University of Bergen, Norway
Sumanta Pattanaik	UCF, USA
Félix Paulano-Godino	University of Jaén, Spain
Aruquia Peixoto	CEFET/RJ, Brazil
João Pereira	INESC-ID at IST, Portugal
João Pereira	Instituto Superior de Engenharia do Porto, Portugal
Sinésio Pesco	PUC-Rio Institute, Brazil
Christopher Peters	KTH Royal Institute of Technology, Sweden
Ruggero Pintus	Center for Advanced Studies, Research and Development in Sardinia (CRS4), Italy
Paulo Pombinho	Universidade de Lisboa, Portugal
Tomislav Pribanic	University of Zagreb, Croatia
Anna Puig	University of Barcelona, Spain
Inmaculada Remolar	Universitat Jaume I, Spain
Mickael Ribardière	University of Poitiers, XLIM, France
María Rivara	Universidad de Chile, Chile
Nuno Rodrigues	Polytechnic Institute of Leiria, Portugal
Rui Rodrigues	INESC Porto, Universidade do Porto, Portugal
Inmaculada Rodríguez	University of Barcelona, Spain
Przemyslaw Rokita	Warsaw University of Technology, Poland
Teresa Romão	Universidade Nova de Lisboa, Portugal

Luís Romero	Instituto Politecnico de Viana do Castelo, Portugal
Isaac Rudomin	BSC, Spain
Wang Rui	Zhejiang University, China
Beatriz Santos	University of Aveiro, Portugal
Basile Sauvage	University of Strasbourg, France
Vladimir Savchenko	Hose University, Japan
Rafael J. Segura	Universidad de Jaen, Spain
Ari Shapiro	University of Southern California, USA
Frutuoso Silva	University of Beira Interior, Portugal
A. Augusto Sousa	FEUP/INESC TEC, Portugal
Jie Tang	Nanjing University, China
Gabriel Taubin	Brown University, USA
Matthias Teschner	University of Freiburg, Germany
Daniel Thalmann	École Polytechnique Fédérale de Lausanne, Switzerland
Juan Carlos Torres	Universidad de Granada, Spain
Alain Tremeau	Université Jean Monnet, France
Torsten Ullrich	Fraunhofer Austria Research GmbH, Austria
Kuwait University	Kuwait University, Kuwait
Anna Ursyn	University of Northern Colorado, USA
Cesare Valenti	Università degli Studi di Palermo, Italy
Thales Vieira	Universidade Federal de Alagoas, Brazil
Andreas Weber	University of Bonn, Germany
Burkhard Wuensche	University of Auckland, New Zealand
Ling Xu	University of Houston-Downtown, USA
Lihua You	Bournemouth University, UK
Jian Zhang	Bournemouth University, UK

## GRAPP Additional Reviewers

Simone Balocco	University of Barcelona, Spain
Renan Bela	PUC-Rio, Brazil
Ehtzaz Chaudhry	Bournemouth University, UK
Joao Marcos da Costa	PUC-Rio, Brazil
Andrea Lins	PUC-Rio, Brazil
Franziska Lippoldt	Fraunhofer Singapore, Singapore
Francisco Daniel Pérez Cano	University of Jaén, Spain
Meili Wang	Northwest A&F University, China

## HUCAPP Program Committee

Andrea Abate	University of Salerno, Italy
Leena Arhippainen	University of Oulu, Finland
Mirjam Augstein	University of Applied Sciences Upper Austria, Austria
Federica Bazzano	Politecnico di Torino, Italy

Yacine Bellik	LIMSI-CNRS Orsay, France
Cigdem Beyan	Istituto Italiano di Tecnologia, Italy
Leon Bodenhagen	University of Southern Denmark, Denmark
Rodrigo Bonacin	CTI Renato Archer, Brazil
Federico Botella	Miguel Hernandez University of Elche, Spain
Jessie Chen	U.S. Army Research Laboratory, USA
Manuela Chessa	University of Genoa, Italy
Yang-Wai Chow	University of Wollongong, Australia
José Coelho	University of Lisbon, Portugal
Cesar Collazos	Universidad del Cauca, Colombia
Alma Culén	University of Oslo, Norway
Damon Daylamani-Zad	University of Greenwich, UK
Lucia Filgueiras	Escola Politécnica da USP, Brazil
Juan Garrido Navarro	University of Lleida, Spain
Toni Granollers	University of Lleida, Spain
Barry Hughes	University of Auckland, New Zealand
Francisco Iniesto	The Open University and Centre for Research in Education and Educational Technology, UK
Jean-François Jégo	University of Paris 8, France
Chee Weng Khong	Multimedia University, Malaysia
Uttam Kokil	Kennesaw State University, USA
Heidi Krömker	Technische Universität Ilmenau, Germany
Fabrizio Lamberti	Politecnico di Torino, Italy
Chien-Sing Lee	Sunway University, Malaysia
Tsai-Yen Li	National Chengchi University, Taiwan, China
Régis Lobjois	IFSTTAR, France
Flamina Luccio	Università Ca' Foscari Venezia, Italy
Sergio Luján-Mora	University of Alicante, Spain
Malik Mallem	Université Paris Saclay, France
Santiago Martínez	University of Agder, Norway
Vincenzo Moscato	Università degli Studi di Napoli Federico II, Italy
Andreas Nearchou	University of Patras, Greece
Keith Nesbitt	University of Newcastle, Australia
Radoslaw Niewiadomski	University of Genoa, Italy
Nuno Otero	Linnaeus University, Sweden
Evangelos Papadopoulos	NTUA, Greece
James Phillips	Auckland University of Technology, New Zealand
Otniel Portillo-Rodriguez	Universidad Autónoma del Estado de México, Mexico
Nitendra Rajput	IBM Research New Delhi, India
Maria Lili Ramírez	Universidad del Quindío, Colombia
Juha Röning	University of Oulu, Finland
Paul Rosenthal	Germany
Andrea Sanna	Politecnico di Torino, Italy
Corina Sas	Lancaster University, UK
Berglind Smaradottir	University of Agder, Norway
Fabio Solari	University of Genoa, Italy

Daniel Thalmann	École Polytechnique Fédérale de Lausanne, Switzerland
Godfried Toussaint	New York University Abu Dhabi, UAE
Pauliina Tuomi	Tampere University of Technology, Finland
Kostas Vlachos	University of Ioannina, Greece
Gualtiero Volpe	Università degli Studi di Genova, Italy

## IVAPP Program Committee

Vladan Babovic	National University of Singapore, Singapore
Juhee Bae	University of Skovde, Sweden
Maria Beatriz Carmo	Universidade de Lisboa, Portugal
Till Bergmann	Max Planck Society, Germany
David Borland	University of North Carolina at Chapel Hill, USA
Massimo Brescia	Istituto Nazionale di AstroFisica, Italy
Ross Brown	Queensland University of Technology, Australia
Guoning Chen	University of Houston, USA
Yongwan Chun	University of Texas at Dallas, USA
António Coelho	INESC-TEC, Universidade do Porto, Portugal
Danilo B. Coimbra	Federal University of Bahia, Brazil
Christoph Dalitz	Niederrhein University of Applied Sciences, Germany
Mihaela Dinsoreanu	Technical University of Cluj-Napoca, Romania
Georgios Dounias	University of the Aegean, Greece
Achim Ebert	University of Kaiserslautern, Germany
Danilo Eler	São Paulo State University, Brazil
Maria Ferreira de Oliveira	University of São Paulo, ICMC, Brazil
Chi-Wing Fu	The Chinese University of Hong Kong, Hong Kong
Mohammad Ghoniem	Luxembourg Institute of Science and Technology, Luxembourg
Randy Goebel	University of Alberta, Canada
Martin Graham	University of Edinburgh, UK
Naeemul Hassan	University of Mississippi, USA
Torsten Hopp	Karlsruhe Institute of Technology, Germany
Jie Hua	University of Technology Sydney, Australia
Jusufi Ilir	Linnaeus University, Sweden
Stefan Jänicke	University of Southern Denmark, Denmark
Mark Jones	Swansea University, UK
Bijaya Karki	Louisiana State University, USA
Jörn Kohlhammer	Fraunhofer Institute for Computer Graphics Research, Germany
Martin Kraus	Aalborg University, Denmark
Haim Levkowitz	University of Massachusetts Lowell, USA
Chun-Cheng Lin	National Chiao Tung University, Taiwan, China
Giuseppe Liotta	University of Perugia, Italy
Rafael Martins	Linnaeus University, Sweden
Krešimir Matkovic	VRVis Research Center, Austria

Kazuo Misue	University of Tsukuba, Japan
Steffen Oeltze-Jafra	Otto-von-Guericke-Universität Magdeburg, Germany
Benoît Otjacques	Luxembourg Institute of Science and Technology (LIST), Luxembourg
Jinah Park	KAIST, South Korea
Fernando Paulovich	Dalhousie University, Canada
Torsten Reiners	Curtin University, Australia
Philip Rhodes	University of Mississippi, USA
Patrick Riehmann	Bauhaus-Universität Weimar, Germany
Maria Riveiro	University of Skövde, Sweden
Adrian Rusu	Fairfield University, USA
Filip Sadlo	Heidelberg University, Germany
Beatriz Santos	University of Aveiro, Portugal
Giuseppe Santucci	University of Roma, Italy
Angel Sappa	ESPOL Polytechnic University, Ecuador, and Computer Vision Center, Spain
Falk Schreiber	University of Konstanz, Germany, and Monash University, Australia
Hans-Jörg Schulz	Aarhus University, Denmark
Celmar Silva	University of Campinas, Brazil
Juergen Symanzik	Utah State University, USA
Sidharth Thakur	Renaissance Computing Institute (RENCI), USA
Roberto Theron	Universidad de Salamanca, Spain
Günter Wallner	University of Applied Arts Vienna, Austria
Jinrong Xie	eBay Inc., USA
Anders Ynnerman	Linköping University, Sweden
Hongfeng Yu	University of Nebraska-Lincoln, USA
Lina Yu	Intel Corporation, USA
Jianping Zeng	Microsoft, USA
Yue Zhang	Oregon State University, USA
Jianmin Zheng	Nanyang Technological University, Singapore

## IVAPP Additional Reviewers

Aris Alisandrakis	Linnaeus University, Sweden
Xiaopei Liu	ShanghaiTech University, China
Benjamin Mora	Swansea University, UK
Wei Zeng	Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

## VISAPP Program Committee

Amr Abdel-Dayem	Laurentian University, Canada
Ilya Afanasyev	Innopolis University, Russia
Palwashha Afsar	Algorithmi Research Center, Uminho, Portugal

Sos Agaian	College of Staten Island and the Graduate Center, CUNY, USA
Vicente Alarcon-Aquino	Universidad de las Americas Puebla, Mexico
Mokhled Al-Tarawneh	Mu'tah University, Jordan
Hugo Alvarez	Vicomtech, Spain
Djamila Aouada	University of Luxembourg, Luxembourg
Karm Veer Arya	ABV - Indian Institute of Information Technology and Management
George Azzopardi	University of Groningen, The Netherlands, and University of Malta, Malta
Hichem Bannour	Pandora Media, USA
Giuseppe Baruffa	University of Perugia, Italy
Ardhendu Behera	Edge Hill University, UK
Fabio Bellavia	Università degli Studi di Firenze, Italy
Olga Bellon	IMAGO Research Group, Universidade Federal do Paraná, Brazil
Jenny Benois-Pineau	LABRI, University of Bordeaux, France
Neil Bergmann	The University of Queensland, Australia
Adrian Bors	University of York, UK
Marius Brezovan	University of Craiova, Romania
Alfred Bruckstein	Technion, Israel
Arcangelo Bruna	STMicroelectronics, Italy
Vittoria Bruni	University of Rome La Sapienza, Italy
Xianbin Cao	Beihang University, China
Alice Caplier	GIPSA-lab, France
Franco Alberto Cardillo	CNR, Italy
M. Emre Celebi	University of Central Arkansas, USA
Satish Chand	Netaji Subhas Institute of Technology and Jawaharlal Nehru University Delhi, India
Chin-Chen Chang	Feng Chia University, Taiwan, China
Jocelyn Chanussot	Grenoble Institute of Technology, France
Samuel Cheng	University of Oklahoma, USA
Manuela Chessa	University of Genoa, Italy
Chia Chong	Sunway University, Malaysia
Chien-Hsing Chou	Tamkang University, Taiwan, China
Laurent Cohen	Université Paris Dauphine, France
Sara Colantonio	ISTI-CNR, Italy
Richard Connor	University of Strathclyde, UK
Donatello Conte	Université de Tours, France
António Cunha	Universidade de Trás-os-Montes e Alto Douro (UTAD), Portugal
Christoph Dalitz	Niederrhein University of Applied Sciences, Germany
Kenneth Dawson-Howe	Trinity College Dublin, Ireland
Anselmo Cardoso de Paiva	Universidade Federal do Maranhao, Brazil
Joachim Denzler	Friedrich Schiller University of Jena, Germany
Thomas Deserno	Technische Universität Braunschweig, Germany

Sotirios Diamantas	Tarleton State University, Texas A&M System, USA
Ernst Dickmanns	UniBw Munich, Germany
Yago Diez	Yamagata University, Japan
Mariella Dimiccoli	Insitut de Robòtica i Informàtica Industrial (CSIC-UPC), Spain
Jana Dittmann	Otto-von-Guericke-Universität Magdeburg, Germany
Aijuan Dong	Hood College, USA
Ulrich Engelke	CSIRO, Australia
Shu-Kai Fan	National Taipei University of Technology, Taiwan, China
Giovanni Maria Farinella	Università di Catania, Italy
Jean-Baptiste Fasquel	University of Angers, France
Jorge Fernández-Berni	CSIC, Universidad de Sevilla, Spain
Gernot Fink	TU Dortmund, Germany
David Fofi	ImViA, France
Gian Foresti	University of Udine, Italy
Mohamed Fouad	Military Technical College, Egypt
Antonino Furnari	University of Catania, Italy
Claudio Gennaro	CNR, Italy
Przemyslaw Glomb	IITiS PAN, Poland
Seiichi Gohshi	Kogakuin University, Japan
Luiz Goncalves	Federal University of Rio Grande do Norte, Brazil
Manuel González-Hidalgo	Balearic Islands University, Spain
Levente Hajder	Eötvös Loránd University, Hungary
Xiyi Hang	California State University, USA
Daniel Harari	Weizmann Institute of Science, Israel
Walid Hariri	ETIS ENSEA, Université de Cergy-Pontoise, France
Aymeric Histace	ETIS UMR CNRS 8051, France
Wladyslaw Homenda	Warsaw University of Technology, Poland
Fay Huang	National Ilan University, Taiwan, China
Hui-Yu Huang	National Formosa University, Taiwan, China
Laura Igual	Universitat de Barcelona, Spain
Francisco Imai	Apple Inc., USA
Jiri Jan	University of Technology Brno, Czech Republic
Tatiana Jaworska	Polish Academy of Sciences, Poland
Xiaoyi Jiang	University of Münster, Germany
Luis Jiménez Linares	University of Castilla-La Mancha, Spain
Zhong Jin	Nanjing University of Science and Technology, China
Leo Joskowicz	The Hebrew University of Jerusalem, Israel
Paris Kaimakis	University of Central Lancashire, Cyprus
Martin Kampel	Vienna University of Technology, Austria
Etienne Kerre	Ghent University, Belgium
Anastasios Kesidis	National Center for Scientific Research, Greece
Nahum Kiryati	Tel Aviv University, Israel
Constantine Kotropoulos	Aristotle University of Thessaloniki, Greece

Arjan Kuijper	Fraunhofer Institute for Computer Graphics Research and TU Darmstadt, Germany
Mónica Larese	CIFASIS-CONICET, National University of Rosario, Argentina
Denis Laurendeau	Laval University, Canada
Sébastien Lefèvre	Université Bretagne Sud, France
Marco Leo	CNR, Italy
Daw-Tung Lin	National Taipei University, Taiwan, China
Huei-Yung Lin	National Chung Cheng University, Taiwan, China
Xiuwen Liu	Florida State University, USA
Giosue Lo Bosco	University of Palermo, Italy
Liliana Lo Presti	University of Palermo, Italy
Angeles López	Universitat Jaume I, Spain
Bruno Macchiavello	Universidade de Brasília, Brazil
Ilias Maglogiannis	University of Piraeus, Greece
Francesco Marcelloni	University of Pisa, Italy
Mauricio Marengoni	Universidade Presbiteriana Mackenzie, Brazil
Emmanuel Marilly	Nokia - Bell Labs France, France
Jean Martinet	University Cote d'Azur, CNRS, France
José Martínez Sotoca	Universitat Jaume I, Spain
Mitsuharu Matsumoto	The University of Electro-Communications, Japan
Radko Mesiar	Slovak University of Technology, Slovakia
Leonid Mestetskiy	Lomonosov Moscow State University, Russia
Cyrille Mignot	Université de Bourgogne, le2i, France
Dan Mikami	NTT, Japan
Steven Mills	University of Otago, New Zealand
Nabin Mishra	Stoecker & Associates, USA
Sanya Mitaim	Thammasat University, Thailand
Pradit Mittrapiyanuruk	Panasonic R&D Center Singapore, Singapore
Birgit Moeller	Martin Luther University Halle-Wittenberg, Germany
Thomas Moeslund	Aalborg University, Denmark
Ali Mohammad-Djafari	CNRS, France
Bartolomeo Montruccchio	Politecnico di Torino, Italy
Davide Moroni	ISTI-CNR, Italy
Kostantinos Moustakas	University of Patras, Greece
Dmitry Murashov	Federal Research Center “Computer Science and Control” of Russian Academy of Sciences, Russia
Feiping Nie	University of Texas at Arlington, USA
Mikael Nilsson	Lund University, Sweden
Nicoletta Noceti	Università di Genova, Italy
Yoshihiro Okada	Kyushu University, Japan
Gonzalo Pajares	Universidad Complutense de Madrid, Spain
Theodore Papadopoulos	Inria, France
Félix Paulano-Godino	University of Jaén, Spain
Felipe Pinage	Federal University of Paraná, Brazil
Stephen Pollard	HP Labs, UK

Charalambos Poullis	Concordia University, Canada
William Puech	Université Montpellier, France
Giovanni Puglisi	University of Cagliari, Italy
Giuliana Ramella	CNR, Istituto per le Applicazioni del Calcolo “M. Picone”, Italy
Huamin Ren	Inmeta Consulting AS, Norway
Phill Rhee	Inha University, South Korea
Joao Rodrigues	University of the Algarve, Portugal
Marcos Rodrigues	Sheffield Hallam University, UK
Bart Romeny	Eindhoven University of Technology (TU/e), The Netherlands
Ramón Ruiz	Universidad Politécnica de Cartagena, Spain
Silvio Sabatini	University of Genoa, Italy
Farhang Sahba	Sheridan Institute of Technology and Advanced Learning, Canada
Joaquin Salas	CICATA-IPN, Mexico
Ovidio Salvetti	CNR, Italy
Andreja Samcovic	University of Belgrade, Serbia
K. C. Santosh	University of South Dakota, USA
Jun Sato	Nagoya Institute of Technology, Japan
Ilhem Sboui	National School of Computer Sciences, Manouba University, Tunisia
Gerald Schaefer	Loughborough University, UK
Siniša Šegvić	University of Zagreb, Croatia
Kazim Sekeroglu	Southeastern Louisiana University, USA
Shishir Shah	University of Houston, USA
Caifeng Shan	Philips Research, The Netherlands
Lik-Kwan Shark	University of Central Lancashire, UK
Désiré Sidibé	Université Évry - Paris-Saclay, France
Bogdan Smolka	Silesian University of Technology, Poland
Ferdous Sohel	Murdoch University, Australia
Ömer Soysal	Southeastern Louisiana University, USA
Tania Stathaki	Imperial College London, UK
Mu-Chun Su	National Central University, Taiwan, China
Tamás Szirányi	MTA SZTAKI, Hungary
Ryszard Tadeusiewicz	AGH University of Science and Technology, Poland
Norio Tagawa	Tokyo Metropolitan University, Japan
Hiroki Takahashi	The University of Electro-Communications, Japan
Ricardo Torres	Norwegian University of Science and Technology (NTNU), Norway
Alain Tremeau	Université Jean Monnet, France
Vinh Truong Hoang	Ho Chi Minh City Open University, Vietnam
Yulia Trusova	Federal Research Center “Computer Science and Control” of the Russian Academy of Sciences, Russia
Du-Ming Tsai	Yuan Ze University, Taiwan, China

Aristeidis Tsitiridis	Universidad Rey Juan Carlos, Spain
Cesare Valenti	Università degli Studi di Palermo, Italy
Panayiotis Vlamos	Ionian University, Greece
Frank Wallhoff	Jade University of Applied Science, Germany
Tao Wang	BAE Systems, USA
Layne Watson	Virginia Polytechnic Institute and State University, USA
Quan Wen	University of Electronic Science and Technology of China, China
Laurent Wendling	LIPADE, France
Andrew Willis	University of North Carolina at Charlotte, USA
Christian Wöhler	TU Dortmund University, Germany
Stefan Wörz	Heidelberg University, Germany
Yan Wu	Georgia Southern University, USA
Pingkun Yan	Rensselaer Polytechnic Institute, USA
Guoan Yang	Xian Jiaotong University, China
Vera Yashina	Dorodnycyn Computing Center of the Russian Academy of Sciences, Russia
Hongfeng Yu	University of Nebraska-Lincoln, USA
Pietro Zanuttigh	University of Padova, Italy
Huiyu Zhou	Queen's University Belfast, UK
Yun Zhu	UCSD, USA
Zhigang Zhu	City College of New York, USA
Peter Zolliker	Empa-Swiss Federal Laboratories for Materials Science and Technology, Switzerland
Ju Zou	University of Western Sydney, Australia

## VISAPP Additional Reviewers

Eman Ahmed	University of Luxembourg, Luxembourg
Gerasimos Arvanitis	ECE, National Technical University of Athens, Greece
Renato Baptista	University of Luxembourg, Luxembourg
Júlio Batista	Brazil
Romain Dambreville	IRISA, France
Rig Das	University of Luxembourg, Luxembourg
Konstantinos Delibasis	University of Central Greece, Greece
Enjie Ghorbel	University of Luxembourg, Luxembourg
Andrei Kopylov	Tula State University, Russia
Arnaud Mir	University of Balearic Islands, Spain
Deependra Mishra	IBM, USA
Mohammad Abdul Mukit	University of Oklahoma, USA
Konstantinos Papadopoulos	University of Luxembourg, Luxembourg
Zoltan Rozsa	Hungarian Academy of Sciences Institute for Computer Science and Control (MTA SZTAKI), Hungary
Oleg Seredin	Tula State University, Russia

Ismael Serrano  
Nikos Stagakis  
Zhihao Zhao

Vicomtech, Spain  
University of Patras, Greece  
USA

## **Invited Speakers**

Daniel McDuff  
Diego Gutierrez  
Jiri Matas  
Dima Damen

Microsoft, USA  
Universidad de Zaragoza, Spain  
Czech Technical University in Prague, Czech Republic  
University of Bristol, UK

# Contents

## Computer Graphics Theory and Applications

Synthesis and Validation of Virtual Woodcuts Generated with Reaction-Diffusion . . . . .	3
<i>Davi Padilha Mesquita and Marcelo Walter</i>	
Synthesising Light Field Volume Visualisations Using Image Warping in Real-Time . . . . .	30
<i>Seán K. Martin, Seán Bruton, David Ganter, and Michael Manzke</i>	
Motion Capture Analysis and Reconstruction Using Spatial Keyframes . . . . .	48
<i>Bernardo F. Costa and Claudio Esperança</i>	

## Human Computer Interaction Theory and Applications

Involving Hearing, Haptics and Kinesthetics into Non-visual Interaction Concepts for an Augmented Remote Tower Environment . . . . .	73
<i>Maxime Reynal, Pietro Aricò, Jean-Paul Imbert, Christophe Hurter, Gianluca Borghini, Gianluca Di Flumeri, Nicolina Sciaraffa, Antonio Di Florio, Michela Terenzi, Ana Ferreira, Simone Pozzi, Viviana Betti, Matteo Marucci, and Fabio Babiloni</i>	
Virtual Reality System for Ship Handling Simulations: A Case Study on Nautical Personnel Performance, Observed Behaviour, Sense of Presence and Sickness . . . . .	101
<i>Chiara Bassano, Manuela Chessa, Luca Fengone, Luca Isgrò, Fabio Solari, Giovanni Spallarossa, Davide Tozzi, and Aldo Zini</i>	
A Process Reference Model for UX . . . . .	128
<i>Suzanne Kieffer, Luka Rukonić, Vincent Kervyn de Meerendré, and Jean Vanderdonckt</i>	
AAT Meets Virtual Reality . . . . .	153
<i>Tanja Joan Eiler, Armin Grünwald, Michael Wahl, and Rainer Brück</i>	

## Information Visualization Theory and Applications

Orthogonal Compaction: Turn-Regularity, Complete Extensions, and Their Common Concept . . . . .	179
<i>Alexander M. Esser</i>	

A Model for the Progressive Visualization of Multidimensional Data Structure . . . . .	203
<i>Elio Ventocilla and María Riveiro</i>	
Visualization of Tree-Structured Data Using Web Service Composition . . . . .	227
<i>Willy Scheibel, Judith Hartmann, Daniel Limberger, and Jürgen Döllner</i>	
Breaking the Curse of Visual Analytics: Accommodating Virtual Reality in the Visualization Pipeline . . . . .	253
<i>Matthias Kraus, Matthias Miller, Juri Buchmüller, Manuel Stein, Niklas Weiler, Daniel A. Keim, and Mennatallah El-Assady</i>	
Designing a Visual Analytics System for Medication Error Screening and Detection . . . . .	285
<i>Tabassum Kakar, Xiao Qin, Cory M. Tapply, Oliver Spring, Derek Murphy, Daniel Yun, Elke A. Rundensteiner, Lane Harrison, Thang La, Sanjay K. Sahoo, and Suranjan De</i>	
A Layered Approach to Lightweight Toolchaining in Visual Analytics . . . . .	313
<i>Hans-Jörg Schulz, Martin Röhlig, Lars Nonnemann, Marius Hogräfer, Mario Aehnelt, Bodo Urban, and Heidrun Schumann</i>	
Fast Approximate Light Field Volume Rendering: Using Volume Data to Improve Light Field Synthesis via Convolutional Neural Networks . . . . .	338
<i>Seán Bruton, David Ganter, and Michael Manzke</i>	
A Reproducibility Study for Visual MRSI Data Analytics . . . . .	362
<i>Muhammad Jawad, Vladimir Molchanov, and Lars Linsen</i>	
<b>Computer Vision Theory and Applications</b>	
A Self-regulating Spatio-Temporal Filter for Volumetric Video Point Clouds . . . . .	391
<i>Matthew Moynihan, Rafael Pagés, and Aljosa Smolic</i>	
Modeling Trajectories for 3D Motion Analysis . . . . .	409
<i>Amani Elaoud, Walid Barhoumi, Hassen Drira, and Ezzeddine Zagrouba</i>	
Quantitative Comparison of Affine Feature Detectors Based on Quadcopter Images . . . . .	430
<i>Zoltán Pusztai, Gergő Gál, and Levente Hajder</i>	
An MRF Optimisation Framework for Full 3D Reconstruction of Scenes with Complex Reflectance . . . . .	456
<i>Gianmarco Addari and Jean-Yves Guillemaut</i>	

Robustifying Direct VO to Large Baseline Motions . . . . .	477
<i>Georges Younes, Daniel Asmar, and John Zelek</i>	
Localization and Grading of Building Roof Damages in High-Resolution Aerial Images . . . . .	497
<i>Melanie Böge, Dimitri Bulatov, and Lukas Lucks</i>	
Semantic Image Completion Through an Adversarial Strategy . . . . .	520
<i>Patricia Vitoria, Joan Sintes, and Coloma Ballester</i>	
An Enhanced Louvain Based Image Segmentation Approach Using Color Properties and Histogram of Oriented Gradients . . . . .	543
<i>Thanh-Khoa Nguyen, Jean-Loup Guillaume, and Mickael Coustaty</i>	
Vehicle Activity Recognition Using DCNN . . . . .	566
<i>Alaa AlZoubi and David Nam</i>	
Quantifying Deformation in Aegean Sealing Practices . . . . .	589
<i>Bartosz Bogacz, Sarah Finlayson, Diamantis Panagiotopoulos, and Hubert Mara</i>	
<b>Author Index . . . . .</b>	<b>611</b>