# **Lecture Notes in Computer Science**

8815

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

#### **Editorial Board**

David Hutchison

Lancaster University, Lancaster, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Alfred Kobsa

University of California, Irvine, CA, USA

Friedemann Mattern

ETH Zurich, Zürich, Switzerland

John C. Mitchell

Stanford University, Stanford, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max Planck Institute for Informatics, Saarbruecken, Germany

More information about this series at http://www.springer.com/series/7412

## Aurélio Campilho · Mohamed Kamel (Eds.)

# Image Analysis and Recognition

11th International Conference, ICIAR 2014 Vilamoura, Portugal, October 22–24, 2014 Proceedings, Part II



Editors
Aurélio Campilho
Faculty of Engineering
University of Porto
Porto
Portugal

Mohamed Kamel
Department of Electrical and Computer
Engineering
University of Waterloo
Waterloo, ON
Canada

ISSN 0302-9743 ISBN 978-3-319-11754-6 DOI 10.1007/978-3-319-11755-3 ISSN 1611-3349 (electronic) ISBN 978-3-319-11755-3 (eBook)

Library of Congress Control Number: 2014950801

LNCS Sublibrary: SL6 - Image Processing, Computer Vision, Pattern Recognition, and Graphics

Springer Cham Heidelberg New York Dordrecht London

#### © Springer International Publishing Switzerland 2014

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. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

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.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

#### **Preface**

This is the 11th edition of the ICIAR series of annual conferences offering an opportunity for the participants to interact and present their latest research in theory, methodology, and applications of image analysis and recognition. ICIAR 2014, the International Conference on Image Analysis and Recognition, was held in Vila Moura, Portugal, October 22–24, 2014. ICIAR is organized by AIMI – Association for Image and Machine Intelligence, a not-for-profit organization registered in Ontario, Canada.

For ICIAR 2014, we received a total of 177 full papers from 39 countries. Before the review process all the papers were checked for similarity using a comparison database of scholarly work. The review process was carried out by members of the Program Committee and other reviewers. Each paper was reviewed by at least two reviewers, and checked by the conference chairs. A total of 107 papers were finally accepted and appear in the two volumes of this proceedings. We would like to sincerely thank the authors for responding to our call, and we thank the reviewers for the careful evaluation and feedback provided to the authors. It is this collective effort that resulted in the strong conference program and high-quality proceedings.

Each year we attempt to focus on a specific topic for the keynote speeches and conduct a panel discussion on the topic.

This year, the conference theme was focused on the topic "Sparse Representations for Image Analysis and Recognition." We were very pleased to include three outstanding keynote talks on this topic: "Optimization Algorithms for Sparse Representations: Some History and Recent Developments" by Mário Figueiredo, Instituto Superior Técnico Portugal; "Morphological Diversities in Astrophysics" by Jean-Luc Starck, CosmoStat Laboratory, France; and "Sparse Stochastic Processes with Application to Biomedical Imaging" by Michael Unser, Ecole Polytechnique Fédérale de Lausanne, Switzerland. The keynote speakers also participated in the panel "Sparse Representation for Image Analysis and Recognition: Trends and Applications." We would like to express our gratitude to the keynote speakers for accepting our invitation to share their vision and recent advances in their areas of expertise, which are at the core of the topics of the conference.

We would like to thank Khaled Hammouda, the webmaster of the conference, for maintaining the Web pages, interacting with the authors, and preparing the proceedings.

As all conferences, the success of ICIAR 2014 is attributed to the effort and work of many people, including members of the Organizing Committee, staff, and volunteers. We gratefully acknowledge their support and efforts.

We are also grateful to Springer's editorial staff for supporting this publication in the LNCS series. We also would like to acknowledge the professional service of Viagens Abreu in taking care of the registration process and the special events of the conference.

#### VI Preface

Finally, we are very pleased to welcome all the participants to ICIAR 2014. For those who were not able to attend, we hope this publication provides a good view into the research presented at the conference, and we look forward to meeting you at the next ICIAR conference.

October 2014

Aurélio Campilho Mohamed Kamel

# ICIAR 2014 – International Conference on Image Analysis and Recognition

#### **General Chairs**

Aurélio Campilho University of Porto, Portugal Mohamed Kamel University of Waterloo, Canada

#### **Local Organizing Committee**

Ana Maria Mendonça

Jorge Alves Silva

University of Porto, Portugal

University of Porto, Portugal

University of the Algarve, Portugal

José Rouco Maseda Biomedical Engineering Institute, Portugal Jorge Novo Buján Biomedical Engineering Institute, Portugal

#### **Conference Secretariat**

Viagens Abreu SA, Portugal

#### Webmaster

Khaled Hammouda Waterloo, Ontario, Canada

#### **Advisory Committee**

M. Ahmadi University of Windsor, Canada P. Bhattacharya Concordia University, Canada T.D. Bui Concordia University, Canada M. Cheriet University of Quebec, Canada E. Dubois University of Ottawa, Canada Z. Duric George Mason University, USA G. Granlund Linköping University, Sweden Ryerson University, Canada L. Guan

M. Haindl Institute of Information Theory and Automation,

Czech Republic

E. Hancock University of York, UK

J. Kovacevic Carnegie Mellon University, USA

M. Kunt Swiss Federal Institute of Technology (EPFL),

Switzerland

#### VIII ICIAR 2014

J. Padilha University of Porto, Portugal K.N. Plataniotis University of Toronto, Canada

Technical University of Catalonia, Spain A. Sanfeliu University of Central Florida, USA M. Shah University of Windsor, Canada M. Sid-Ahmed Concordia University, Canada C.Y. Suen

A.N. Venetsanopoulos University of Toronto, Canada Utrecht University, Netherlands M. Viergever Carnegie Mellon University, USA B. Vijayakumar R. Ward University of British Columbia, Canada

Hong Kong Polytechnic University, Hong Kong D. Zhang

#### **Program Committee**

R. Bernardes

G. Freeman

A. Abate University of Salerno, Italy

Wilfrid Laurier University, Canada M. Ahmed University of Beira Interior, Portugal L. Alexandre Ryerson University, Canada I Alirezaie

Universitat Politècnica de València, Spain G. Andreu-Garcia

H. Araújo University of Coimbra, Portugal Bournemouth University, UK Emilio Balaguer-Ballester University of Coimbra, Portugal T. Barata University of Porto, Portugal J. Barbosa University of Coimbra, Portugal J. Batista

University of Coimbra, Portugal National University of Singapore, Singapore A. Bezerianos

Technical University of Lisbon, Portugal J. Bioucas Télécom ParisTech, France I. Bloch

Concordia University, Canada T.D. Bui C. Busch Gjøvik University College, Norway University of Naples Parthenope, Italy F. Camastra

University of Porto, Portugal J. Cardoso University of Adelaide, Australia G. Carneiro University of Porto, Portugal M. Coimbra University of Porto, Portugal M. Correia

Ecole Nationale Supérieure des Mines J. Debayle

de Saint-Étienne, France University of Coimbra, Portugal J. Dias West Virginia University, USA G. Doretto University of the Algarve, Portugal H. du Buf

Centro Nacional de Biotecnología - CSIC, Spain J. Fernandez

University of Seville, Spain I. Fondón

A. Fred Technical University of Lisbon, Portugal

University of Waterloo, Canada

D. Frejlichowski West Pomeranian University of Technology, Poland University of Cagliari, Italy G. Giacinto University of Chicago, USA M. Giger University of Mons, Belgium B. Gosselin University of Milan, Italy G. Grossi University of Siegen, Germany M. Grzegorzek Institute of Information Theory and Automation, M. Haindl Czech Republic A. Hernandez Universitat Autònoma de Barcelona, Spain L. Heutte Université de Rouen, France C. Hong Hong Kong Polytechnic University, Hong Kong University of Barcelona, Spain L. Igual King Saud University, Saudi Arabia M. Khan Nanyang Technological University, Singapore A. Kong Aalto University, Finland M. Koskela Fraunhofer IGD and TU Darmstadt, Germany A. Kuijper Simon Fraser University, Canada J. Liang McGill University, Canada L. Liu N. Lomenie Paris Descartes University, France University of Aveiro, Portugal L. Lopes

J. Lorenzo-Ginori Universidad Central "Marta Abreu" de Las Villas, Cuba

R. LukacA. MarcalFoveon, Inc., USAUniversity of Porto, Portugal

F. Marcelloni University of Pisa, Italy

U. Markowska-Kaczmar
 J. Marques
 M. Melkemi
 A. Mendonça
 Wroclaw University of Technology, Poland Technical University of Lisbon, Portugal Université de Haute Alsace, France University of Porto, Portugal

A. Mendonça

J. Meunier

University of Porto, Portugal

University of Montreal, Canada

M. Mignotte

University of Montreal, Canada

University of Bristol, UK

A. Mohammed Imam Muhammad Ibn Saud Islamic University,

Saudi Arabia

A. Monteiro

M. Nappi

M. Nixon

H. Ogul

M. Pelillo

M. Penedo

University of Porto, Portugal

University of Salerno, Italy

University of Southampton, UK

Başkent University, Turkey

University of Venice, Italy

Universidade da Coruña, Spain

F. Pereira Technical University of Lisbon, Portugal
 E. Petrakis Technical University of Crete, Greece
 P. Pina Technical University of Lisbon, Portugal

A. Pinho University of Aveiro, Portugal

Q. Zhang H. Zhou

R. Zwiggelaar

L. Piras University of Cagliari, Italy L. Prevost University of the French West Indies and Guiana. France University of Beira Interior, Portugal H. Proenca Biomedical Engineering Institute, Portugal P. Quelhas Technical University of Lisbon, Portugal M. Queluz P. Radeva Autonomous University of Barcelona, Spain Computer Vision Center, Spain B. Raducanu Florida Institute of Technology, USA E. Ribeiro University of Perugia, Italy E. Ricci Fondazione Bruno Kessler, Italy S. Rota Bulò A. Ruano University of the Algarve, Portugal University of the Algarve, Portugal G. Ruano Technical University of Lisbon, Portugal J. Sanches University of Aveiro, Portugal B. Santos Compute Vision Center, Spain A. Sappa F. Sattar University of Waterloo, Canada Loughborough University, UK G. Schaefer P. Scheunders University of Antwerp, Belgium University of Porto, Portugal J. Silva Silesian University of Technology, Poland B. Smolka Z. Sun Institute of Automation, Chinese Academy of Sciences (CASIA), China S. Sural Indian Institute of Technology, India Universidad Central "Marta Abreu" de las Villas. A. Taboada-Crispí Cuba X. Tan Nanjing University of Aeronautics and Astronautics, China J. Tavares University of Porto, Portugal Computer Vision Center, Spain O. Terrades University of Campinas (UNICAMP), Brazil R. Torres Università Ca' Foscari Venezia, Italy A. Torsello A. Uhl University of Salzburg, Austria University of Salerno, Italy M. Vento Aalto University, Finland R. Vigário Université de Bourgogne, France Y. Voisin University of Waterloo, Canada E. Vrscay Z. Wang University of Waterloo, Canada University of Guelph, Canada M. Wirth University of Windsor, Canada J. Wu P. Yan Philips Research, USA Brno University of Technology, Czech Republic P. Zemcik

Waseda University, Japan

Queen's University Belfast, UK

Aberystwyth University, UK

#### Reviewers

H. Haberdar

M. Al-Rawi University of Aveiro, Portugal University of Waterloo, Canada R. Araujo South Asian University, India E. Bhullar M. Camplani University of Bristol, UK

C. Caridade Instituto Superior de Engenharia de Coimbra,

**Portugal** 

J. Chen Lehigh University, USA University of León, Spain L. Fernandez University of Porto, Portugal J. Ferreira E. Fidalgo University of León, Spain University of Toronto, Canada M. Gangeh M. Garcia University of León, Spain

Ecole Nationale Supérieure des Mines V. Gonzalez

> de Saint-Étienne, France University of Houston, USA

M. Hortas Universidade da Coruña, Spain N. Lori University of Coimbra, Portugal University of Waterloo, Canada S. Mahmoud J. Marcos

Spanish National Research Council, Spain

Y. Miao University of Waterloo, Canada

F. Monteiro IPB - Instituto Politécnico de Braganca, Portugal

P. Moreno Instituto Superior Técnico, Portugal

J. Novo INESC TEC - INESC Technology and Science,

Portugal

INESC TEC, Portugal H. Oliveira

A. Ragab University of Waterloo, Canada L. Reis University of Minho, Portugal

INESC TEC - INESC Technology and Science, R. Rocha

**Portugal** 

J. Rodrigues University of the Algarve, Portugal N. Rodriguez Universidade da Coruña, Spain

J. Rouco INESC TEC - INESC Technology and Science,

**Portugal** 

Polytechnic Institute of Porto, Portugal P. Trigueiros

#### Supported by



#### AIMI - Association for Image and Machine Intelligence



Center for Biomedical Engineering Research INESC TEC – INESC Technology and Science Portugal



Department of Electrical and Computer Engineering Faculty of Engineering University of Porto Portugal



CPAMI – Centre for Pattern Analysis and Machine Intelligence University of Waterloo Canada

## **Contents – Part II**

Action, Gestures and Audio-Visual Recognition	
Audio-Visual Emotion Analysis Using Semi-Supervised Temporal Clustering with Constraint Propagation	3
Exemplar-Based Human Action Recognition with Template Matching from a Stream of Motion Capture	12
A New Visual Speech Recognition Approach for RGB-D Cameras	21
2D Appearance Based Techniques for Tracking the Signer Configuration in Sign Language Video Recordings	29
Computer Aided Hearing Assessment: Detection of Eye Gesture Reactions as a Response to the Sound	39
Multi-sensor Acceleration-Based Action Recognition	48
Incremental Learning of Hand Gestures Based on Submovement Sharing Ryo Kawahata, Yanrung Wang, Atsushi Shimada, Takayoshi Yamashita, and Rin-ichiro Taniguchi	58
Gait Analysis from Video: Camcorders vs. Kinect	66
Biometrics	
Person Re-identification Using Region Covariance in a Multi-feature Approach	77
Multi-biometric Score-Level Fusion and the Integration of the Neighbors Distance Ratio	85

Adaptive Haar-Like Features for Head Pose Estimation	94
Face and Palmprint Recognition Using Hierarchical Multiscale Adaptive LBP with Directional Statistical Features	102
Multispectral Iris Recognition Using Patch Based Game Theory Foysal Ahmad, Kaushik Roy, and Khary Popplewell	112
Medical Image Processing and Analysis	
Periodic Background Pattern Detection and Removal for Cell Tracking Tiago Esteves, Ângela Carvalho, Fernando Jorge Monteiro, and Pedro Quelhas	123
Nerve Detection in Ultrasound Images Using Median Gabor Binary Pattern Oussama Hadjerci, Adel Hafiane, Pascal Makris, Donatello Conte, Pierre Vieyres, and Alain Delbos	132
Automatic Localization of Skin Layers in Reflectance Confocal Microscopy <i>Eduardo Somoza, Gabriela Oana Cula, Catherine Correa,</i> <i>and Julie B. Hirsch</i>	141
Thermal Signature Using Non-redundant Temporal Local Binary-Based Features	151
Image Warping in Dermatological Image Hair Removal	159
3D Multimodal Visualization of Subdural Electrodes with Cerebellum Removal to Guide Epilepsy Resective Surgery Procedures	167
Medical Image Segmentation	
On the Automatic Normalization of Plaque Regions in Ultrasound Images of the Carotid	177
Automatic Tear Film Segmentation Based on Texture Analysis and Region Growing	185
Beatriz Remeseiro, Katherine M. Oliver, Eilidh Martin, Alan Tomlinson, Daniel G. Villaverde, and Manuel G. Penedo	

Automatic Optic Disc Detection in Retinal Fundus Images Based on Geometric Features	285
Optic Nerve Head Detection via Group Correlations in Multi-Orientation Transforms	293
A Robust Algorithm for Optic Disc Segmentation from Colored Fundus Images	303
Coupled Parallel Snakes for Segmenting Healthy and Pathological Retinal Arteries in Adaptive Optics Images	311
Automatic Arteriovenous Nicking Identification by Color Fundus Images Analysis	321
Detection of Hemorrhages in Colored Fundus Images Using Non Uniform Illumination Estimation	329
Automatic Robust Segmentation of Retinal Layers in OCT Images with Refinement Stages	337
3D Imaging	
Accurate Multi-View Stereo 3D Reconstruction for Cost-Effective Plant Phenotyping	349
Truncated Signed Distance Function: Experiments on Voxel Size Diana Werner, Ayoub Al-Hamadi, and Philipp Werner	357
Human Activity Analysis in a 3D Bird's-eye View	365
3D Spatial Layout Propagation in a Video Sequence	374

Contents – Part II	XVII
SASCr3: A Real Time Hardware Coprocessor for Stereo Correspondence Luca Puglia, Mario Vigliar, and Giancarlo Raiconi	383
Motion Analysis and Tracking	
Adaptive Feature Selection for Object Tracking with Particle Filter Darshan Venkatrayappa, Désiré Sidibé, Fabrice Meriaudeau, and Philippe Montesinos	395
Exploiting Color Constancy for Robust Tracking Under Non-uniform Illumination	403
Wavelet Subspace Analysis of Intraoperative Thermal Imaging	
for Motion Filtering	411
A Spatio-temporal Approach for Multiple Object Detection in Videos Using Graphs and Probability Maps	421
Robot Vision	
Adopting Feature-Based Visual Odometry for Resource-Constrained  Mobile Devices	431
Strategy for Folding Clothing on the Basis of Deformable Models Yasuyo Kita, Fumio Kanehiro, Toshio Ueshiba, and Nobuyuki Kita	442
Multiple Camera Approach for SLAM Based Ultrasonic Tank Roof Inspection Christian Freye, Christian Bendicks, Erik Lilienblum, and Ayoub Al-Hamadi	453
On Tracking and Matching in Vision Based Navigation	461
Biologically Inspired Vision for Indoor Robot Navigation	469
Author Index	479

# **Contents – Part I**

Image Representation and Models	
Path Descriptors for Geometric Graph Matching and Registration Miguel Amável Pinheiro and Jan Kybic	3
A Method to Detect Repeated Unknown Patterns in an Image	12
Some "Weberized" $L^2$ -Based Methods of Signal/Image Approximation Ilona A. Kowalik-Urbaniak, Davide La Torre, Edward R. Vrscay, and Zhou Wang	20
A New Compressor for Measuring Distances among Images	30
Perceptual Evaluation of Demosaicing Artefacts  Tomasz Sergej and Radosław Mantiuk	38
Multiscale Shape Description with Laplacian Profile and Fourier Transform <i>Evanthia Mavridou, James L. Crowley, and Augustin Lux</i>	46
Structural Similarity-Based Approximation over Orthogonal Bases: Investigating the Use of Individual Component Functions $S_k(\mathbf{x}, \mathbf{y}) \dots Paul Bendevis and Edward R. Vrscay$	55
2D Thinning Algorithms with Revised Endpixel Preservation	65
Sparse Representation	
A New Landmark-Independent Tool for Quantifying and Characterizing Morphologic Variation	75
Low Light Image Enhancement via Sparse Representations	84
Incremental and Multi-feature Tensor Subspace Learning Applied for Background Modeling and Subtraction	94

Face Image Super-Resolution Based on Topology ICA and Sparse Representation	104
Yongtao Liu, Hua Yan, Xiushan Nie, and Zhen Liu	
Iterative Sparse Coding for Colorization Based Compression	112
Noise Modelling in Parallel Magnetic Resonance Imaging:  A Variational Approach	121
Image Restoration and Enhancement	
An Examination of Several Methods of Hyperspectral Image Denoising:  Over Channels, Spectral Functions and Both Domains	131
Towards a Comprehensive Evaluation of Ultrasound Speckle Reduction Fernando C. Monteiro, José Rufino, and Vasco Cadavez	141
An Evaluation of Potential Functions for Regularized Image Deblurring Buda Bajić, Joakim Lindblad, and Nataša Sladoje	150
Drawing Parrots with Charcoal	159
Unconstrained Structural Similarity-Based Optimization	167
Feature Detection and Image Segmentation	
Reflectance-Based Segmentation Using Photometric and Illumination	
Invariants	179
Meta-learning for Adaptive Image Segmentation	187
Dynamic Multiple View Geometry with Affine Cameras	198
Energy Minimization by $\alpha$ -Erosion for Supervised Texture Segmentation Karl Skretting and Kjersti Engan	207
ALOE: Augmented Local Operator for Edge Detection  Maria De Marsico, Michele Nappi, and Daniel Riccio	215

Automatic Classification of Human Body Postures Based on Curvelet  Transform	329
N. Zerrouki and A. Houacine	
QR Code Localization Using Boosted Cascade of Weak Classifiers	338
Document Image Analysis	
Using Scale-Space Anisotropic Smoothing for Text Line Extraction in Historical Documents	349
Multi-script Identification from Printed Words	359
Segmentation-Free Keyword Retrieval in Historical Document Images Irina Rabaev, Itshak Dinstein, Jihad El-Sana, and Klara Kedem	369
Character-Level Alignment Using WFST and LSTM for Post-processing in Multi-script Recognition Systems - A Comparative Study	379
Handwritten and Printed Text Separation: Linearity and Regularity Assessment	387
Parallel Layer Scanning Based Fast Dot/Dash Line Detection Algorithm for Large Scale Binary Document Images	395
A Hybrid CRF/HMM Approach for Handwriting Recognition	403
Image and Video Retrieval	
Exploring the Impact of Inter-query Variability on the Performance of Retrieval Systems	413
Francesco Brughi, Debora Gil, Llorenç Badiella, Eva Jove Casabella, and Oriol Ramos Terrades	
Relevance Assessment for Visual Video Re-ranking	421

Remote Sensing	
Delineation of Martian Craters Based on Edge Maps and Dynamic Programming	433
Jorge S. Marques and Pedro Pina	
Automatic Interpretation of Remotely Sensed Images for Urban Form Assessment	441
Image Mosaicing by Camera Pose Estimation Based on Extended Kalman Filter	450
Applications	
A Fast Plain Copy-Move Detection Algorithm Based on Structural Pattern and 2D Rabin-Karp Rolling Hash	461
Automatic Annotation of an Ultrasound Corpus for Studying Tongue Movement	469
Improving Fire Detection Reliability by a Combination of Videoanalytics  Rosario Di Lascio, Antonio Greco, Alessia Saggese, and Mario Vento	477
Automatic Method for Visual Grading of Seed Food Products	485
Weight Estimation of Pigs Using Top-View Image Processing  Mohammadamin Kashiha, Claudia Bahr, Sanne Ott, Christel P.H. Moons, Theo A. Niewold, Frank O. Ödberg, and Daniel Berckmans	496
An Efficient Image Self-recovery and Tamper Detection Using Fragile Watermarking	504
Author Index	515