

Intelligent Robots and Computer Vision XXIX: Algorithms and Techniques

Juha Röning David P. Casasent Editors

23–24 January 2012 Burlingame, California, United States

Sponsored and Published by IS&T—The Society for Imaging Science and Technology SPIE

Volume 8301

Proceedings of SPIE, 0277-786X, v. 8301

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publishers are not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in Intelligent Robots and Computer Vision XXIX: Algorithms and Techniques, edited by Juha Röning, David P. Casasent, Proceedings of SPIE-IS&T Electronic Imaging, SPIE Vol. 8301, Article CID Number (2012).

ISSN 0277-786X ISBN 9780819489487

Copublished by SPIE P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445 SPIE.org and IS&T—The Society for Imaging Science and Technology 7003 Kilworth Lane, Springfield, Virginia, 22151 USA Telephone +1 703 642 9090 (Eastern Time) · Fax +1 703 642 9094

imaging.org

Copyright © 2012, Society of Photo-Optical Instrumentation Engineers and The Society for Imaging Science and Technology.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by the publishers subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/12/\$18.00.

Printed in the United States of America.

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

vii Conference Committee

SESSION 1 INVITED PAPERS ON INTELLIGENT ROBOTICS

- 8301 02 Software-based neural network assisted movement compensation for nanoresolution piezo actuators (Invited Paper) [8301-01]
 M. Kauppinen, J. Röning, Univ. of Oulu (Finland)
- 8301 03 Traffic monitoring with distributed smart cameras (Invited Paper) [8301-02]
 O. Sidla, M. Rosner, SLR Engineering OG (Austria); M. Ulm, Austrian Institute of Technology (Austria); G. Schwingshackl, SensoTech GmbH (Austria)
- 8301 04 The 19th Annual Intelligent Ground Vehicle Competition: student built autonomous ground vehicles (Invited Paper) [8301-03]
 B. L. Theisen, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (United States)

SESSION 2 STEREO VISION AND APPLICATIONS

- Accurate dense 3D reconstruction of moving and still objects from dynamic stereo sequences based on temporal modified-RANSAC and feature-cut [8301-04]
 N. Tatematsu, J. Ohya, Waseda Univ. (Japan)
- 8301 06 Efficient hybrid monocular-stereo approach to on-board video-based traffic sign detection and tracking [8301-05]
 J. Marinas, L. Salgado, J. Arróspide, M. Camplani, Univ. Politécnica de Madrid (Spain)
- A general model and calibration method for spherical stereoscopic vision [8301-06]
 W. Feng, Tianjin Univ. (China); J. Röning, J. Kannala, Univ. of Oulu (Finland); X. Zong,
 B. Zhang, Tianjin Univ. (China)
- 8301 08 An approach to stereo-point cloud registration using image homographies [8301-07] S. D. Fox, D. M. Lyons, Fordham Univ. (United States)
- 8301 09 Hazardous sign detection for safety applications in traffic monitoring [8301-08]
 W. Benesova, M. Kottman, Slovak Univ. of Technology (Slovakia); O. Sidla, SLR Engineering OG (Austria)
- 8301 0A PRoViScout: a planetary scouting rover demonstrator [8301-09]
 G. Paar, JOANNEUM RESEARCH (Austria); M. Woods, SciSys Ltd. (United Kingdom);
 C. Gimkiewicz, CSEM Zurich Ctr. (Switzerland); F. Labrosse, Aberystwyth Univ. (United Kingdom); A. Medina, GMV S.A. (Spain); L. Tyler, D. P. Barnes, Aberystwyth Univ. (United Kingdom); G. Fritz, JOANNEUM RESEARCH (Austria); K. Kapellos, Trasys (Belgium)

SESSION 3 NOVEL PEOPLE AND VEHICLE TRACKING APPROACHES

- 8301 0B **Red-light traffic enforcement at railway crossings** [8301-10] O. Sidla, G. Loibner, SLR Engineering OG (Austria)
- 8301 0C Image projection clues for improved real-time vehicle tracking in tunnels [8301-11] V. Jelača, J. O. Niño Castañeda, A. Pižurica, W. Philips, Univ. Gent (Belgium)
- Bassing a camera network [8301-12]
 S. Gruenwedel, V. Jelača, J. O. Niño-Castañeda, P. Van Hese, D. Van Cauwelaert, P. Veelaert, W. Philips, Univ. Gent (Belgium)
- Real-time detection of traffic events using smart cameras [8301-13]
 M. Macesic, Tehnomobil-Protech Ltd. (Serbia); V. Jelaca, J. O. Niño-Castaneda, Univ. Gent (Belgium); N. Prodanovic, M. Panic, Univ. of Novi Sad (Serbia); A. Pizurica, Univ. Gent (Belgium); V. Crnojevic, Univ. of Novi Sad (Serbia); W. Philips, Univ. Gent (Belgium)
- 8301 OF Vehicle tracking data for calibrating microscopic traffic simulation models [8301-14]
 R. Schönauer, mobimera Fairkehrstechnologien (Austria); Y. Lipetski, SLR Engineering OG (Austria); H. Schrom-Feiertag, Austrian Institute of Technology (Austria)

SESSION 4 UAVS AND AERIAL APPLICATIONS

- AR.Drone: security threat analysis and exemplary attack to track persons [8301-15]
 F. Samland, J. Fruth, M. Hildebrandt, T. Hoppe, J. Dittmann, Otto-von-Guericke-Univ. of Magdeburg (Germany)
- Bate and extraction of unknown targets from aerial camera and extraction of simple object fingerprints for the purpose of target reacquisition [8301-16]
 T. N. Mundhenk, K.-Y. Ni, Y. Chen, K. Kim, Y. Owechko, HRL Labs., LLC (United States)
- 8301 OJ Super-resolution terrain map enhancement for navigation based on satellite imagery [8301-18]
 J. Straub, The Univ. of North Dakota (United States)

SESSION 5 ROBOT MANIPULATION AND APPLICATION

- 8301 0K
 3D positional control of magnetic levitation system using adaptive control: improvement of positioning control in horizontal plane [8301-19]
 T. Nishino, Toshiba Industrial Products Manufacturing Corp. (Japan); Y. Fujitani, N. Kato, Mie Univ. (Japan); N. Tsuda, Wakayama National College of Technology (Japan); Y. Nomura, H. Matsui, Mie Univ. (Japan)
- 8301 0M The magic glove: a gesture-based remote controller for intelligent mobile robots [8301-21] C. Luo, Y. Chen, M. Krishnan, M. Paulik, Univ. of Detroit Mercy (United States)
- 8301 0N **Way-point navigation for a skid-steer vehicle in unknown environments** [8301-22] P. Chen, A. Das, P. Mukherjee, S. Waslander, Univ. of Waterloo (Canada)

SESSION 6 VISION NAVIGATION AND ACTIVITY RECOGNITION

- Integrated field testing of planetary robotics vision processing: the PRoVisG campaign in Tenerife 2011 [8301-23]
 G. Paar, JOANNEUM RESEARCH (Austria); L. Waugh, EADS Astrium Ltd. (United Kingdom);
 D. P. Barnes, Aberystwyth Univ. (United Kingdom); T. Pajdla, Czech Technical Univ. in Prague (Czech Republic); M. Woods, SciSys Ltd. (United Kingdom); H.-R. Graf, CSEM Zurich Ctr. (Switzerland); Y. Gao, Surrey Space Ctr. (United Kingdom); K. Willner, Technical Univ. of Berlin (Germany); J.-P. Muller, Univ. College London (United Kingdom); R. Li, The Ohio State Univ. (United States)
- 8301 OP Hierarchical loop detection for mobile outdoor robots [8301-24] D. Lang, C. Winkens, M. Häselich, D. Paulus, Univ. Koblenz-Landau (Germany)
- A novel margin-based linear embedding technique for visual object recognition [8301-25]
 F. Dornaika, Univ. of the Basque Country (Spain) and Basque Foundation for Science (Spain); A. Assoum, Lebanese Univ. (Lebanon)
- Real-time two-level foreground detection and person-silhouette extraction enhanced by body-parts tracking [8301-26]
 R. Deeb, E. Desserée, S. Bouakaz, LIRIS, CNRS, Univ. Claude Bernard Lyon 1 (France)
- 8301 0S Activity recognition from video using layered approach [8301-27]
 C. A. McPherson, J. M. Irvine, M. Young, Draper Lab. (United States); A. Stefanidis, George Mason Univ. (United States)

SESSION 7 VISUAL ALGORITHMS

- 8301 0T Method for fast detecting the intersection of a plane and a cube in an octree structure to find point sets within a convex region [8301-28]
 K. Fujimoto, N. Kimura, T. Moriya, Hitachi, Ltd. (Japan)
- 8301 0V
 Lucas-Kanade image registration using camera parameters [8301-30]
 S. Cho, H. Cho, POSTECH (Korea, Republic of); Y.-W. Tai, KAIST (Korea, Republic of);
 Y. S. Moon, J. Cho, S. Lee, Samsung Electronics (Korea, Republic of); S. Lee, POSTECH (Korea, Republic of)
- 8301 0W Object tracking with adaptive HOG detector and adaptive Rao-Blackwellised particle filter [8301-31]
 S. Rosa, M. Paleari, P. Ariano, Italian Institute of Technology (Italy); B. Bona, Politecnico di Torino (Italy)
- 8301 0X A modular real-time vision system for humanoid robots [8301-32] A. Trifan, A. J. R. Neves, N. Lau, B. Cunha, Univ. de Aveiro (Portugal)

SESSION 8 INTELLIGENT GROUND VEHICLE COMPETITION

8301 0Y Radial polar histogram: obstacle avoidance and path planning for robotic cognition and motion control [8301-33]

P.-J. Wang, N. R. Keyawa, C. Euler, California State Univ., Northridge (United States)

- 8301 0Z **Optimizing a mobile robot control system using GPU acceleration** [8301-34] N. Tuck, M. McGuinness, F. Martin, Univ. of Massachusetts Lowell (United States)
- Basign and realization of an intelligent ground vehicle with modular payloads [8301-35]
 M. A. Akmanalp, R. M. Doherty, J. Gorges, P. Kalauskas, E. Peterson, F. Polido, S. S. Nestinger, T. Padir, Worcester Polytechnic Institute (United States)
- 8301 11 Navigating a path delineated by colored flags: an approach for a 2011 IGVC requirement [8301-36]
 A. Szmatula, M. Parrish, M. Krishnan, M. Paulik, U. Mohammad, C. Luo, Univ. of Detroit Mercy (United States)
- 8301 12 Navigating with VFH: a strategy to avoid traps [8301-37]
 C. Luo, M. Krishnan, M. Paulik, U. Mohammad, Q. Wang, Univ. of Detroit Mercy (United States)

SESSION 9 INTERACTIVE PAPER SESSION

- 8301 13 Measurement of noises and modulation transfer function of cameras used in optical-digital correlators [8301-38]
 N. N. Evtikhiev, S. N. Starikov, P. A. Cheryomkhin, V. V. Krasnov, National Research Nuclear Univ. MEPhI (Russian Federation)
- 8301 14 A phase space approach for detection and removal of rain in video [8301-39] V. Santhaseelan, V. K. Asari, Univ. of Dayton (United States)
- 8301 15 Intelligence algorithms for autonomous navigation in a ground vehicle [8301-40]
 S. Petkovsek, R. Shakya, Y. H. Shin, P. Gautam, A. Norton, D. J. Ahlgren, Trinity College (United States)
- 8301 16 Hierarchical multi-level image mosaicing for autonomous navigation of UAV [8301-41]
 S. Park, D. Ghosh, N. Kaabouch, R. A. Fevig, W. Semke, The Univ. of North Dakota (United States)
- 8301 17 A fluidic lens with reduced optical aberration [8301-42] J.-Y. Yiu, R. Batchko, S. Robinson, A. Szilagyi, Holochip Corp. (United States)

Author Index

Conference Committee

Symposium Chairs

Majid Rabbani, Eastman Kodak Company (United States) Gaurav Sharma, University of Rochester (United States)

Conference Chairs

Juha Röning, University of Oulu (Finland) David P. Casasent, Carnegie Mellon University (United States)

Program Committee

Norbert Lauinger, CORRSYS 3D Sensors AG (Germany)
Dah Jye Lee, Brigham Young University (United States)
Charles A. McPherson, Draper Laboratory (United States)
Kurt S. Niel, Fachhochschule Wels (Austria)
Yoshihiko Nomura, Mie University (Japan)
Daniel Raviv, Florida Atlantic University (United States)
Oliver Sidla, SLR Engineering OG (Austria)
Bernard L. Theisen, U.S. Army Tank Automotive Research, Development and Engineering Center (United States)
Dili Zhang, Monotype Imaging (United States)

Session Chairs

- 1 Invited Papers on Intelligent Robotics Juha Röning, University of Oulu (Finland)
- Stereo Vision and Applications
 Juha Röning, University of Oulu (Finland)
- 3 Novel People and Vehicle Tracking Approaches Oliver Sidla, SLR Engineering OG (Austria)
- 4 UAVs and Aerial Applications
 T. Nathan Mundhenk, HRL Laboratories, LLC (United States)
- Robot Manipulation and Application
 David P. Casasent, Carnegie Mellon University (United States)
- Vision Navigation and Activity Recognition
 Charles A. McPherson, Draper Laboratory (United States)

- Visual Algorithms
 David P. Casasent, Carnegie Mellon University (United States)
 Oliver Sidla, SLR Engineering OG (Austria)
- 8 Intelligent Ground Vehicle Competition Bernard L. Theisen, U.S. Army Tank Automotive Research, Development and Engineering Center (United States)