Proceedings of the

OAGM&ARW Joint Workshop

Vision, Automation and Robotics

May 10-12, 2017
Palais Eschenbach
Vienna

OAGM - Austrian Association for Pattern Recognition
ARW - Austrian Robotics Workshop

TU Graz
Graz University of Technology

OAGM

OESTERREICHISCHE COMPUTER GESELLSCHAFT
AUSTRIAN COMPUTER SOCIETY

GMAR
Die österreichische Gesellschaft für Mess-, Automatisierungs- und Robotertechnik

Peter M. Roth, Markus Vincze, Wilfried Kubinger, Andreas Müller,
Bernhard Blaschitz and Svorad Stolc (eds.)

Proceedings of the
OAGM&ARW Joint Workshop
Vision, Automation and Robotics

May 10-12, 2017
Vienna, Austria

Austrian Association of Pattern Recognition (OAGM)
GMAR Gesellschaft für Mess-, Automatisierungs-,
und Robotertechnik

Editors

Peter M. Roth, Markus Vincze, Wilfried Kubinger, Andreas Müller, Bernhard Blaschitz and Svorad Stolc

Layout

Austrian Association of Pattern Recognition
http://aapr.at/

GMAR Gesellschaft für Mess-, Automatisierungs-, und Robotertechnik
http://www.gmar.at/

Cover

Stefan W. Schleich

Sponsors

© 2017 Verlag der Technischen Universität Graz
http://www.ub.tugraz.at/Verlag

ISBN (e-book) 978-3-85125-524-9
DOI 10.3217/978-3-85125-524-9

This work is licensed under a Creative Commons Attribution 4.0 International License.
https://creativecommons.org/licenses/by/4.0/deed.en

 DOI: 10.3217/978-3-85125-524-9-00

Contents

Preface v

Workshop Organization vi

Program Committee OAGM vii

Program Committee ARW viii

Awards 2016 ix

Index of Authors x

Keynote Talks 1

Recent Recent Achievements in Underwater Intervention Systems: the Role of Perception & Robotic Manipulation
Pedro Sanz 2

Dense & Direct Methods for 3D Reconstruction & Visual SLAM
Daniel Cremers 3

Austrian Robotics Workshop 4

A framework for cellular robots with tetrahedral structure
Michael Pieber and Johannes Gerstmayr 5

Package Delivery Experiments with a Camera Drone
Jesús Pestana, Michael Maurer, Daniel Muschick, Devesh Adlakha, Horst Bischof and Friedrich Fraundorfer 7

A Model-Based Fault Detection, Diagnosis and Repair for Autonomous Robotics systems
Stefan Loigge, Clemens Mühlbacher, Gerald Steinbauer, Stephan Gspandl and Michael Reip 9

Visual Localization System for Agricultural Vehicles in GPS-Obstructed Environments
Stefan Gadringer, Christoph Stöger and Florian Hammer 16

Development of a fully automated tuning system for organ pipes
Clemens Sulz and Markus Trenker 22

RobWood - Smart Robotics for Wood Industry
Thomas Haspl, Claudio Capovilla, Alfred Rinnhofer, Victor J. Exposito Jimenez, Stefan Maier, Matthias Völkl, Manfred Zarnhofer, Robert A. Jöbstl, Erhard Pretterhofer, Bernhard Dieber and Herwig Zeiner 26

Task-Dependent Configuration of Robotics Systems
Alexander Pagonis, Clemens Mühlbacher, Gerald Steinbauer, Stephan Gspandl and Michael Reip 32

An Autonomous Transportation Robot for Urban Environments
Konstantin Lassnig, Clemens Mühlbacher, Gerald Steinbauer, Stephan Gspandl and Michael Reip 39

User Centered Assistive Robotics for Production - Human Robot Interaction Concepts in the AssistMe project
Markus Ikeda, Gerhard Ebenhofer, Jürgen Minichberger, Andreas Pichler, Andreas Huber, Astrid Weiss and Gerald Fritz 45

Design of an Autonomous Race Car for the Formula Student Driverless (FSD)
Marcel Zeilinger, Raphael Hauk, Markus Bader and Alexander Hofmann 51

Concept and Implementation of a Tele-operated Robot For ELROB 2016
Florian Fuchslocher, Martin Rambausek, Wilfried Kubinger and Bernhard Peschak . 57

A Robust and Flexible Software Architecture for Autonomous Robots in the Context of Industrie 4.0
Marco Wallner, Clemens Mühlbacher, Gerald Steinbauer, Sarah Haas, Thomas Ulz and Jakob Ludwiger 61

3D Vision Guided Robotic Charging Station for Electric and Plug-in Hybrid Vehicles
Justinas Miseikis, Matthias Rüther, Bernhard Walzel, Mario Hirz and Helmut Brunner 68

A Visual Servoing Approach of a Six Degrees-of-Freedom Industrial Robot by RGB-D Sensing
Thomas Varhegyi, Martin Melik-Merkumians, Michael Steinegger, Georg Halmetschlager-Funek and Georg Schitter 74

Toward Safe Perception in Human-Robot Interaction
Inka Brijacak, Saeed Yahyanejad, Bernhard Reiterer and Michael Hofbaur 80

OAGM Workshop 86

Pose Estimation of Similar Shape Objects using Convolutional Neural Network trained by Synthetic data
Kiru Park, Johann Prankl, Michael Zillich and Markus Vincze 87

Confusing Similarity between Visual Trademarks: A Dataset Based on USTTAB Examinations
Lukas Knoch and Mathias Lux 92

Feedback Loop and Accurate Training Data for 3D Hand Pose Estimation
Markus Oberweger, Vincent Lepetit, Paul Wohlhart and Gernot Riegler 97

Active contour models for individual keratin filament tracking
Dmytro Kotsur, Rudolf Leube, Reinhard Windoffer and Julian Mattes 99

Reading of an Analog Liquid Level Gauge on an Oil Platform with a Mobile Robot using 2-D Images
Peter Henoeckl 101

Novel Human Machine Interaction with Sticky Notes for Industrial Production
Gernot Stuebl, Thomas Poenitz, Harald Bauer and Andreas Pichler 107

Image Registration and Object Detection for Assessing Unexploded Ordnance Risks - A Status Report of the DeVisOR Project
Simon Brenner, Sebastian Zambanini and Robert Sablatnig 109

FORMS – Forensic Marks Search
Manuel Keglevic and Robert Sablatnig 111

Riemannian Manifold Approach to Scheimpflug Camera Calibration for Embedded Laser-Camera Application
Xiaoying Tan, Volkmar Wieser, Stefan Lustig and Bernhard A. Moser 113

On Quality Assurance of 3D Bust Reconstructions
Gernot Stuebl, Christoph Heindl, Harald Bauer and Andreas Pichler 115

An Image Analysis System for Selective Recovery of Non-ferrous Metal
Malte Philip, Alfred Rinnhofer and Martina Uray 120

Automated Quality Assessment of Remelted Steel Ingots
Daniel Gruber, Harald Ganster and Robert Tanzer 122

Fusion of Point Clouds derived from Aerial Images
Andreas Schönfelder, Roland Perko, Karlheinz Gutjahr and Mathias Schardt 128

Superresolution Alignment with Innocence Assumption: Towards a Fair Quality Measurement for Blind Deconvolution
Martin Welk 134

Generative Adversarial Network based Synthesis for Supervised Medical Image Segmentation
Thomas Neff, Christian Payer, Darko Stern and Martin Urschler 140

Using a U-Shaped Neural Network for minutiae extraction trained from refined, synthetic fingerprints
Thomas Pinetz, Daniel Soukup, Reinhold Huber-Mörk and Robert Sablatnig 146

Photometric Stereo in Multi-Line Scan Framework under Complex Illumination via Simulation and Learning
Dominik Hirner, Svorad Štolc and Thomas Pock 152

3D Localization in Urban Environments from Single Images
Anil Armagan, Martin Hirzer, Peter M. Roth and Vincent Lepetit 158

Depth-guided Disocclusion Inpainting for Novel View Synthesis
Thomas Rittler, Matej Nezveda, Florian Seitner and Margrit Gelautz 160

Line Processes for Highly Accurate Geometric Camera Calibration
Manfred Klopschitz, Gerald Lodron, Gerhard Paar and Niko Benjamin 165

Bilateral Filters for quick 2.5 D Plane Segmentation
Simon Schreiberhuber, Thomas Mörwald and Markus Vincze 167

Preface

The second OAGM and ARW Joint Workshop on "Vision, Automation and Robotics" held in Vienna, at Palais Eschenbach, from May 10 to 12, 2017, provides a platform bringing together researchers, students, professionals and practitioners from both research directions to discuss new and emerging technologies in the field of machine driven perception and automated manipulation/autonomous movement. The OAGM and ARW workshops have a long tradition since 1980 and 2011, respectively, also stimulated by the Austrian RoboCup workshops (since 2006). Due to the highly overlapping interests of both communities the first joint event was organized in 2016. This second joint workshop will further strengthen the interaction of scientists working in vision, automation and robotics.

Computer Vision tries to perceive the physical world from image or video data resulting in applications such as scene understanding, object detection and tracking and 3D reconstruction. Thus, the main problems are to find suitable representations and to design and implement efficient (learning) algorithms. In contrast, Robotics aims at dealing with moving arms, graspers, and eventually moving vehicles. There are one or more actuators which have to be controlled accordingly in a planned matter for fulfilling given jobs. Some of them consist of additional sensors, e.g., graspers get some feedback for they can correctly catch and hold object without losing or destroying it; or the mobile device stops in front of an obstacle. These examples clearly demonstrate the relations between both fields. The outer world/the actual scenery is perceived by cameras; a consistent set of knowledge is modeled for the actuator for operating successfully either in a planned or even in an unplanned – standalone – strategy. Thus, there is a considerable interest in describing approaching features and possibilities and how the combination of different technologies could be beneficial.

The aim of the joint workshop is to discuss latest academic and industrial approaches and to demonstrate the recent progress. The call for papers resulted in 43 submissions, where finally according to the reviews of an international programme committee 37 contributions (23 talks, 14 posters) have been selected for presentation at the workshop. To highlight outstanding contributions, there prizes will be awarded during the joint workshop: The *OAGM Best Paper Award* sponsored by the *Austrian Computer Society (OCG)* and the *IEEE RAS Austria Best Student Paper Award*.

The goal of the workshop, bridging the gap between the Austrian Visual Computing and Robotics communities, is also supported by inviting three internationally established researchers representing both field:,Daniel Cremers (TU Munich, Germany), Pedro Sanz (Universitat Jaume I, Spain) and Herold Artés (RobArt GmbH, Austria), representing both areas.

Markus Vincze (General chair of the workshop)
Wilfried Kubinger (Chairman ARW)
Peter M. Roth (Chairman OAGM)
Vienna, May 2017

General Chair

Markus Vincze (TU Wien)

Programme Chairs OAGM

Bernhard Blaschitz (AIT)
Peter M. Roth (TU Graz)
Svorad Štolc (AIT)

Programme Chairs ARW

Wilfried Kubinger (UAS Technikum Vienna)
Andreas Müller (Johannes Kepler University Linz)
Markus Vincze (TU Wien)

Web Chair

Friedrich Praus (UAS Technikum Vienna)

Programme Committee OAGM

Helmut Ahammer (Medical University of Graz)
Nicole Artner (TU Wien)
Csaba Beleznai (AIT)
Horst Bischof (TU Graz)
Kristian Bredies (University of Graz)
Wilhelm Burger (Upper Austria University of Applied Sciences)
Christia Eitzinger (Profactor)
Cornelia Fermüller (University of Maryland)
Friedrich Fraundorfer (TU Graz)
Harald Ganster (Joanneum Research)
Margrit Gelautz (TU Wien)
Martin Hirzer (TU Graz)
Florian Kleber (TU Wien)
Reinhold Huber-Mörk (AIT)
Walter G. Kropatsch (TU Wien)
Arjan Kuijper (Fraunhofer IGD)
Roland Kwitt (University of Salzburg)
Christoph Lampert (IST Austria)
Mathias Lux (Alpen-Adria-Universität Klagenfurt)
Hubert Mara (Heidelberg University)
Martin Humenberger (AIT)
Bernhard Moser (Software Competence Center Hagenberg)
Gerhard Paar (Joanneum Research)
Roland Perko (Joanneum Research)
Thomas Pock (TU Graz)
Horst Possegger (TU Graz)
Hayko Riemenschneider (ETH Zurich)
Josef Scharinger (Johannes Kepler University Linz)
Roberst Sablatnig (TU Wien)
Otmar Scherzer (University Vienna)
Daniel Soukup (AIT)
Darko Stern (TU Graz)
Andreas Uhl (University of Salzburg)
Martin Welk (UMIT Hall/Tyrol)
Martin Winter (Joanneum Research)
Christopher Zach (Toshiba Research Europe)

Programme Committee ARW

Mathias Brandstötter (Joanneum Research)
Alexander Hofmann (UAS Technikum Vienna)
Bernhard Dieber (Joanneum Research)
Gerald Fritz (Profactor)
Stefan Gspandl (incubed IT GmbH)
Michael Hofbaur (Joanneum Research)
Gernot Kronreif (ACMIT)
Wilfried Kubinger (UAS Technikum Vienna)
Wilfried Lepuschitz (Practical Robotics Institute Austria)
Kurt Niel (FH Upper Austria)
Andreas Müller (Johannes Kepler University Linz)
Justus Piater (University of Innsbruck)
Friedrich Praus (UAS Technikum Vienna)
Bernhard Rinner (Alpen-Adria-Universität Klagenfurt)
Lukas Silberbauer (taurob OG)
Gerald Steinbauer (TU Graz)
Markus Vincze (TU Wien)
Christian Wögerer (Profactor)
Michael Zillich (TU Wien)

Awards 2016

The

OAGM Best Paper Award 2016

was awarded to the paper

On a Fast Implementation of a 2D-Variant of Weyl's Discrepancy Measure

by

Christian Motz and Bernhard Moser.

The

IEEE RAS Austria Best Student Award 2016

was awarded to the paper

Localization of an Automated Guided Vehicle (AGV) by Stereo Based Visual Odometry and Artificial Landmark Detection

by

Daniel Klingersberger and Gerald Zauner.

Index of authors

Adlakha, Devesh, 7
Armagan, Anil, 158

Bader, Markus, 51
Bauer, Harald, 107, 115
Benjamin, Niko, 165
Bischof, Horst, 7
Brenner, Simon, 109
Brijacak, Inka, 80
Brunner, Helmut, 68

Capovilla, Claudio, 26
Cremers, Daniel, 3

Dieber, Bernhard, 26

Ebenhofer, Gerhard, 45
Exposito Jimenez, Victor J., 26

Fraundorfer, Friedrich, 7
Fritz, Gerald, 45
Fuchslocher, Florian, 57

Gadringer, Stefan, 16
Ganster, Harald, 122
Gelautz, Margrit, 160
Gerstmayr, Johannes, 5
Gruber, Daniel, 122
Gspandl, Stephan, 9, 32, 39
Gutjahr, Karlheinz, 128

Haas, Sarah, 61
Halmetschlager-Funek, Georg, 74
Hammer, Florian, 16
Haspl, Thomas, 26
Hauk, Raphael, 51
Heindl, Christoph, 115
Henoeckl, Peter, 101
Hirner, Dominik, 152
Hirz, Mario, 68
Hirzer, Martin, 158
Hofbaur, Michael, 80
Hofmann, Alexander, 51
Huber, Andreas, 45
Huber-Mörk, Reinhold, 146

Ikeda, Markus, 45

Jöbstl, Robert A., 26

Keglevic, Manuel, 111
Klopschitz, Manfred, 165
Knoch, Lukas, 92
Kotsur, Dmytro, 99
Kubinger, Wilfried, 57

Lassnig, Konstantin, 39
Lepetit, Vincent, 97, 158
Leube, Rudolf, 99
Lodron, Gerald, 165
Loigge, Stefan, 9
Ludwiger, Jakob, 61
Lustig, Stefan, 113
Lux, Mathias, 92

Maier, Stefan, 26
Mattes, Julian, 99
Maurer, Michael, 7
Melik-Merkumians, Martin, 74
Minichberger, Jürgen, 45
Miseikis, Justinas, 68
Moser, Bernhard A., 113
Muschick, Daniel, 7
Mörwald, Thomas, 167
Mühlbacher, Clemens, 9, 32, 39, 61

Neff, Thomas, 140
Nezveda, Matej, 160

Oberweger, Markus, 97

Paar, Gerhard, 165
Pagonis, Alexander, 32
Park, Kiru, 87

Payer, Christian, 140
Perko, Roland, 128
Peschak, Bernhard, 57
Pestana, Jesús, 7
Philip, Malte, 120
Pichler, Andreas, 45, 107, 115
Pieber, Michael, 5
Pinetz, Thomas, 146
Pock, Thomas, 152
Poenitz, Thomas, 107
Prankl, Johann, 87
Pretterhofer, Erhard, 26

Rambausek, Martin, 57
Reip, Michael, 9, 32, 39
Reiterer, Bernhard, 80
Riegler, Gernot, 97
Rinnhofer, Alfred, 26, 120
Rittler, Thomas, 160
Roth, Peter M., 158
Rüther, Matthias, 68

Sablatnig, Robert, 109, 111, 146
Sanz, Pedro, 2
Schardt, Mathias, 128
Schitter, Georg, 74
Schreiberhuber, Simon, 167
Schönfelder, Andreas, 128
Seitner, Florian, 160
Soukup, Daniel, 146
Steinbauer, Gerald, 9, 32, 39, 61
Steinegger, Michael, 74
Stern, Darko, 140
Štolc, Svorad, 152
Stuebl, Gernot, 107, 115
Stöger, Christoph, 16
Sulz, Clemens, 22

Tan, Xiaoying, 113
Tanzer, Robert, 122
Trenker, Markus, 22

Ulz, Thomas, 61
Uray, Martina, 120
Urschler, Martin, 140

Varhegyi, Thomas, 74
Vincze, Markus, 87, 167
Völkl, Matthias, 26

Wallner, Marco, 61
Walzel, Bernhard, 68
Weiss, Astrid, 45
Welk, Martin, 134
Wieser, Volkmar, 113
Windoffer, Reinhard, 99
Wohlhart, Paul, 97

Yahyanejad, Saeed, 80

Zambanini, Sebastian, 109
Zarnhofer, Manfred, 26
Zeilinger, Marcel, 51
Zeiner, Herwig, 26
Zillich, Michael, 87

Keynote Talks

Recent Achievements in Underwater Intervention Systems the Role of Perception & Robotic Manipulation

Pedro J. Sanz

IRS-Lab, Universitat Jaume I, Spain

Abstract

From the UJI foundation (1991), one of the research elds more active has been robotics. So, a lot of di erent activities concerning this exciting eld have been developed during these years. In addition, many projects, some of them funded by European and Spanish institutions have been successfully carried out. There are other robotic labs at UJI, but only one working in the underwater domain: IRS-Lab. Thus, after more than twenty years of research in some speci c technologies (e.g. multisensory based manipulation, telerobotics, or human-robot interaction HRI), always applied to real life scenarios, a few years ago we face the underwater intervention context. In this new scenario the dream is named the underwater autonomous vehicle for intervention (I-AUV). However, a long path is still necessary to pave the way to underwater intervention applications performed in a complete autonomous way. This presentation reviews the di cults to overcome, the solutions explored and the evolution timeline in the way towards I-AUVs, putting the enphasis on the main contributions reached through those projects coordinated by the IRS-Lab, and always considering the role played by perception and manipulation there.

Dense & Direct Methods for 3D Reconstruction & Visual SLAM

Daniel Cremers

Computer Vision Group, Department of Computer Science,
Technical University of Munich, Germany

Abstract

The reconstruction of the 3D world from images is among the central challenges in computer vision. *Starting in the 2000s, researchers have pioneered algorithms which can reconstruct camera motion and sparse feature-points in real-time. In my talk, I will introduce spatially dense methods for camera tracking and 3D reconstruction which do not require feature point estimation, which exploit all available input data and which recover dense or semi-dense geometry rather than sparse point clouds. Applications include 3D photography, 3D television, and autonomous vehicles.*