 DOI: 10.3217/978-3-85125-528-7-00

Kurt Niel and Peter M. Roth (eds.)

Proceedings of the

OAGM & ARW Joint Workshop 2016

Computer Vision and Robotics

May 11-13, 2016
Wels, Austria

Austrian Association of Pattern Recognition
Austrian Robotic Workshop

Editors

Kurt Niel and Peter M. Roth

Layout

Austrian Association of Pattern Recognition
https://www.aapr.at/

GMAR Austrian Robotic Workshop
http://www.roboticsworkshop.at

Cover

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ISBN (print) 978-3-85125-527-0
ISBN (e-book) 978-3-85125-528-7
DOI 10.3217/978-3-85125-528-7

Preface

The OAGM and ARW Joint Workshop on Computer Vision and Robotics 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. Even though there is a long tradition for OAGM workshops (we are celebrating the 40th workshop since 1980) and the ARW workshops (since 2011), which have their roots in the early days of the Austrian RoboCup workshops (2006), this is the first time that both communities are organizing a joint event.

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 28 full paper submissions and additional 9 papers submitted to the industrial/featured talk and poster track, where finally according to the reviews of an international programme committee 34 contributions (26 talks, 8 posters) have been selected for presentation at the workshop. The goal of the workshop is also supported by inviting five internationally established researchers, i.e., Oliver Bimber (JKU Linz), Ales Leonardis (BHAM, UK), Laurent Resquet (TIMA, FR), Andreas Müller (JKU Linz), Andreas Nüchter (JMU, DE), representing both areas.

Kurt Niel (General chair of the workshop)
Peter M. Roth (Chairman OAGM)
Markus Vincze (Chairman ARW)
Wels, May 1, 2016

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Awards 2015

The

OAGM Best Paper Award 2015 sponsored by OCG

was awarded to the paper

The Minimum Spanning Tree of Maximum Entropy

by

Samuel de Sousa and Walter Kropatsch.

The

Microsoft Visual Computing Award 2015

was awarded to

Bernd Bickel (IST Austria).

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Keynote Talks

A Holonomic Robot for Rescue Applications

Oliver Bimber

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Abstract
This talk summarizes our progress towards a fully transparent, flexible, and scaelable thin-film image sensor. In contrast to conventional image sensors, it does not capture pixels in image space on the sensor surface, but makes integral measurements in Radon space along the sensor s edges. Image reconstruction is achieved by inverse Radon transform. By stacking multiple layers, it enables a variety of information, such as color, dynamic range, spatial resolution, and defocus, to be sampled simultaneously. Multi-focal imaging allows reconstructing an entire focal stack after only one recording. The focal stack can then be applied to estimate depth from defocus. Measuring and classifying directly in Radon space yields robust and high classification rates. Dimensionality reduction results in task-optimized classification sensors that record a minimal number of samples. This enables simple devices with low power consumption and fast read-out times. Combining our sensing approach with lensless coded aperture imaging has the potential to enable entire thin-film camera systems that make the capturing of images, light fields, and depth information possible.

Hierarchical Compositional Representations of Structure for Computer Vision and Robotics

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Abstract
Modelling, learning, recognising, and categorising visual entities has been an area of intensive research in the vision and robotics communities for several decades. While successful partial solutions tailored for particular tasks and specific scenarios have appeared in recent years, more general solutions are yet to be developed. Ultimately, the goal is to design and implement proper structures and mechanisms that would enable efficient learning, inference, and, when necessary, augmentation and modifications of the acquired visual knowledge in general scenarios. Recently, it has become increasingly clear that possible solutions should be sought in the framework of hierarchical architectures. Among various design choices related to hierarchies, compositional hierarchies show a great promise in terms of scalability, real-time performance, efficient structured on-line learning, shareability, and knowledge transfer. In this talk I will first present our work on compositional hierarchies related to visual representations of 2D and 3D object shapes for recognition and grasping and then conclude with some ideas towards generalising the proposed approach to other visual entities and modalities.

Event-based Design for Mitigating Energy in Electronic Systems

Laurent Fresquet

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Abstract
Today, our digital society exchanges data flows that are incredibly large and the future promises us a data explosion due to the communications between our technological equipment, robots, etc. Indeed, we are close to widely open the door of the Internet of Things (IoT). This data orgy will waste a lot of energy and will contribute to a non-ecological approach of our digital life. Indeed, the Internet and the new technologies consume about 10 of the electrical power produced in the world. Considering that we are only at the beginning of the IoT, it is urgent to enhance the energetic performances of the electronic circuits and systems. The design paradigm based on synchronizing digital circuit communication with a clock is source of useless activity and of complicated design techniques. The digital circuit design based on local synchronizations, also called asynchronous circuits, is a way to mitigate the power consumption in electronics by only activating the circuitry when an event appears. In addition, another way to reduce energy is to rethink the sampling techniques and digital processing chains. Indeed, by using the Shannon theory, we produce more data than necessary. Indeed, useless data produce more computation, more storage, more communications and also more power consumption. If we go beyond the Shannon theory, we can discover new sampling schemes and new processing techniques able to take advantage of event-based design. Drastically reducing the useless data and activity is maybe the Grail of low-power computing.

Model-Based Control of Industrial Robots – From Theory to Practice

Andreas M ller

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Abstract
Industrial robotics has seen a major overhaul in terms of improved designs, novel kinematics, and actuation concepts. Redundancy, for instance, is becoming an important factor for increasing flexibility and robustness. As such, kinematic redundancy of serial manipulators (mimicking anthropomorphicarms) and actuation redundancy of parallel manipulators are prevailing concepts. Aiming at reducing energy consumption and increasing agility, light-weight robotics is another example of innovation in robotics. While these may not be at the core interest of a majority of robot end users, reducing production and cycle times was and still is an important issue. The solution concept applicable to all these problems is the model-based control. In contrast to classical decentralized control schemes, which are commonly used in industrial robots, model-based control schemes make use of a dynamical model. Standard control systems do not account for such models. This will be vital, however. In this presentation the basic concept of model-based control will be discussed. Particular attention will be given to efficient formulations of the dynamic model accounting for rigid as well as elastic manipulators. Strategies for the geometric calibration and the identification of dynamic parameters will be presented. It will be shown how these concepts can seamlessly integrated in industrial controller hardware.

SLAM goes Industry 4.0 – Mobile Laser Scanning for Flexible Production

Andreas N chter

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Abstract
The terrestrial acquisition of 3D point clouds by laser range finders has recently moved to mobile platforms. Mobile laser scanning puts high requirements on the accuracy of the positioning systems and the calibration of the measurement system. We present a novel algorithmic approach to the problem of calibration with the goal of improving the measurement accuracy of mobile laser scanners. We developed a general framework for calibrating mobile sensor platforms that estimates all configuration parameters for any configuration of positioning sensors including odometry. In addition, we present a novel semi-rigid SLAM algorithm that corrects the vehicle position at every point in time along its trajectory, while simultaneously improving the quality and precision of the entire acquired point cloud. Using this algorithm the temporary failure of accurate external positioning systems or the lack thereof can be compensated for. We demonstrate the capabilities of our two newly proposed algorithms on a wide variety of data sets. Applications for the developed suite of algorithms range from 3D mapping for autonomous driving to precise digitization of production lines in the automotive context. We end the talk with a description of an innovative start-up in the area of robotic SLAM.