Robotics and Autonomous Systems 91 (2017) 208–209

Contents lists available at ScienceDirect

Robotics and Autonomous Systems

journal homepage: www.elsevier.com/locate/robot

Editorial

Special Issue on Autonomous Driving and Driver Assistance Systems

Research on Autonomous Driving and Driver Assistance Systems has increased and became an active research field during the last decades. This increase in research is motivated by the need to reduce road accidents, which represent the 6th cause of dead in high-income countries according to the World Health Organization, and 11th worldwide. Vehicles are becoming more and more intelligent, promising fully autonomous vehicles for the near future. Such a big challenge opens a wide range of research topics that need to be tackled and efficiently solved by the community.

This Special Issue on Autonomous Driving and Advanced Driver Assistance Systems (ADDAS) published by the Robotics and Autonomous Systems Journal contains extended versions of a set of selected papers from a special session on the same topic, which took place in the framework of the Second Iberian Robotics Conference, November 19th–21st 2015, in Lisbon, Portugal. The papers included in this special issue address several subjects of relevance to the ADDAS community, from scene representations using multi-modal data to infrared imaging or multiple sensor calibration algorithms.

From the papers accepted for publication, two or three main interest lines were observed, which could be interpreted as current dominant trends for this community. They cover mainly 3D perception, multimodal sensors and sensor fusion. The importance of 3D perception is now undeniable in the ADDAS context, be it using lidar or stereo based sensors. As such, several papers in this special issue address the problem in several fronts, ranging from the automatic calibration in lidar and cameras multisensorial setups (Pereira et al.), up to efficient modelling and detection of features for navigation, namely on the ground, as shown both in 3D lidar approaches (Asvadi et al.) and stereo approaches (de la Escalera et al.). The ultimate challenge in processing 3D data is naturally environment and scene reconstruction, and the works by (Oliveira et al.) include relevant contributions in that field as well. Multimodality also appears as a relevant issue, and it is no longer uncommon to see on the same setups crossed combinations of lidar, vision, infrared and even radar; this richness of exteroceptive modality naturally implies the need for sensorial calibration and the subsequent data fusion procedures.

The selected papers include contributions on the following topics:

Evaluations on the usage of images resulting from the fusion of cross-spectral inputs, applied to the monocular visual odometry estimation, have been reported (Sappa et al.); such a fused image based approach has shown advantages when compared with the state of the art.

The classical traffic signs detection and classification have been tackled with a highly optimized and accurate convolutional neural network architecture in Aghdam et al.; the stability of proposed approach has been evaluated on noisy images.

In de la Escalera et al. a stereo odometry algorithm that detects and tracks features on the surface of the ground is proposed. In order to ensure a uniform distribution of feature keypoints, an inverse perspective image is used. Results show that this visual odometry is accurately estimated.

In order to overcome the fact that particle filters are computationally demanding, a hardware implementation on FPGA (field programmable gate arrays) has been proposed and validated to estimate the localization and mapping (SLAM) of a robot (Sileshi et al.).

In Ćesić et al., a multisensor setup consisting of a radar and a stereo camera mounted on top of a vehicle is used. Authors model the sensors uncertainty on the product of two special Euclidean groups, and show that the model is more accurate than classical approaches.

Autonomous vehicles and ADAS systems often resort to multimodal setups in order to improve the efficiency of the systems. This, however, raise the problem of geometric registration between the sensors. The work described in Pereira et al. presents a solution for the automatic calibration of multiple sensors of different natures, e.g. LIDARs and cameras, using a simple spherical calibration object.

In Asvadi et al. a framework for the detection of static and moving obstacles is proposed. The algorithm is based on a piecewise planar surface fitting and a 3D voxel representation. Results have been tested on diversified driving environments.

The online reconstruction of scenarios observed by autonomous vehicles is not trivial. The work presented in Oliveira et al. (a) proposes an algorithm designed to create a geometric representation of such a scenario. Furthermore, this work proposes a way to update these representations online. Results show that the approach is capable of producing accurate descriptions of the scene.

Finally, the work presented in Oliveira et al. (b) focuses on the photometric reconstruction of the geometric scenario reconstructions produced in Oliveira et al. (a). The algorithm uses a constrained Delaunay triangulation to produce a mesh that is updated using a specially devised sequence of operations that ensure the quality of the final texture. Results show that the approach is capable of producing fine quality textures.

We hope that these works may contribute to the development of novel and more efficient ADDAS algorithms and systems.

http://dx.doi.org/10.1016/j.robot.2017.01.011
0921-8890/

Acknowledgments

This Special Issue has been partially supported by the Spanish Government under Project TIN2014-56919-C3-2-R; and by the "Fundação para a Ciência e Tecnologia" (Portuguese Foundation for Science and Technology) under grant agreement SFRH/BPD/109651/2015 and National Funds within project UID/EEA/50014/2013. This work was also financed by the ERDF - European Regional Development Fund through the Operational Programme for Competitiveness and Internationalisation - COMPETE 2020 Programme within project "POCI-01-0145-FEDER-006961".

Vitor Santos
IEETA - Institute of Electronics and Informatics Engineering of Aveiro, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

Angel D. Sappa*
Computer Vision Center, Universitat Autònoma de Barcelona, 08193-Bellaterra, Barcelona, Spain
Escuela Superior Politécnica del Litoral, ESPOL, Facultad de Ingeniería en Electricidad y Computación, CIDIS, Campus Gustavo Galindo Km 30.5, Vía Perimetral, P.O. Box 09-01-5863, Guayaquil, Ecuador
E-mail address: sappa@ieee.org.

Miguel Oliveira
INESC TEC - INESC Technology and Science, R. Dr. Roberto Frias s/n, 4200-465 Porto, Portugal
IEETA - Institute of Electronics and Informatics Engineering of Aveiro, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

* Corresponding editor.