

Editorial

Best of “ISPRS Hannover Workshop 2017”

Guest Editors Christian Heipke, Karsten Jacobsen, and Franz Rottensteiner, Uwe Stilla, Michael Ying Yang, Jan Skaloud, Ismael Colomina, and Michael Cramer

Sensor calibration, image orientation, object extraction and scene understanding from images and image sequences are important research topics in Photogrammetry, Remote Sensing, Computer Vision and Geoinformation Science, the areas of interest of the International Society for Photogrammetry and Remote Sensing (ISPRS). Within these areas, both geometry and semantics play an important role, and high quality results require appropriate handling of all these aspects. While individual algorithms differ according to the imaging geometry and the employed sensors and platforms, all mentioned aspects need to be integrated in a suitable workflow to solve most real-world problems.

This observation led to the organization of a common event for a number of well-established scientific meetings under the roof of the ISPRS Hannover Workshop, held in Hannover, Germany from June 6 – 9, 2017. These meetings were

- HRIGI - High-Resolution Earth Imaging for Geospatial Information, which has been held in Hannover every two years since the middle of the 1990's,
- CMRT - City Models, Roads and Traffic, a workshop dealing with automatic object extraction in urban environments with a first edition in 2005,
- ISA - Image Sequence Analysis, a relatively new workshop focussing on images sequences,
- EuroCOW - European Calibration and Orientation Workshop, looking specifically at sensors, calibration and orientation, which had previously been held in Barcelona, Spain for many years.

While HRIGI and EuroCOW are more on the geometric side, CMRT and ISA have a legacy in automatic object reconstruction and trajectory computation. The aim of the common event was to seek, exploit and deepen the synergies between geometry, semantics and sensor modelling, and to give the different scientific communities the possibility to discuss with, and to learn from, each other. The joint event was supported by 12 working groups from four of the five ISPRS Technical Commissions¹ and addressed experts from research, government, and private industry. It consisted of high quality papers, and provided an international forum for discussion of leading research and technological developments, as well as applications in the field.

Following the workshop, authors whose contributions were accepted after a full-paper double blind review were invited

¹ <https://www.isprs-ann-photogramm-remote-sens-spatial-inf-sci.net/IV-1-W1/1/2017/isprs-annals-IV-1-W1-1-2017.pdf>, doi: [10.5194/isprs-annals-IV-1-W1-1-2017](https://doi.org/10.5194/isprs-annals-IV-1-W1-1-2017), 2017 for details

to revise and extend their papers in the light of the discussions at the workshop and to submit them to a special issue of Photogrammetric Engineering & Remote Sensing. Sixteen papers were submitted and after another round of scientific reviews, eleven of them were finally accepted for publication in this special issue. This large number constitutes a major success and demonstrates both, the relevance of the addressed topics and the high quality of the manuscripts; it has also led to the fact that the special issue had to be distributed to two volumes.

The first volume contains papers related to the classification of images (three papers) and point clouds (two papers) and to change detection (one paper). The first two papers of the second volume deal with sensor design and calibration, the following two with point cloud segmentation and the last two with the modelling of specific topographic objects (buildings in this case).

The first paper, authored by Vogt et al. and entitled Unsupervised source selection for domain adaptation deals with transfer learning, i.e. the question to which extent training data from one geographic area or epoch (called source) can be employed to classify data of another area or epoch (target) even if the features in the target image follow a slightly different distribution. More specifically, the best among many available sources for a specific classification problem is determined based on similarity measurements between the marginal distributions of the features in the source and various target domains.

The second paper, Multitemporal classification under label noise based on outdated maps by Maas et al. is devoted to the problem arising from incorrect training data. While for map updating abundant training data are available in the form of the (outdated) map itself, some for the training data are incorrect and result in wrong classification results. The authors develop a new noise tolerant classification method that can also consider the outdated map as prior information and show that it helps to distinguish between real changes over time and false detections caused by misclassification.

The paper by Drees and Roscher, Archetypal analysis for sparse representation-based hyperspectral sub-pixel quantification,

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suggests a new classification method for hyper-spectral image data. Typically these data have a rather coarse geometrical resolution resulting in mixed pixels (pixels containing more than one spectral class). The authors develop a new constrained sparse representation of the data, where each pixel with unknown surface characteristics is expressed by a weighted linear combination of elementary spectra with known land cover class. They then determine the elementary spectra from image reference data using archetypal analysis combined with a Reversible Jump Markov Chain Monte Carlo method.

The next group of two papers on 3D point classification starts with Classification of aerial photogrammetric 3D point clouds by Becker et al. The authors present a new method to classify 3D point clouds derived from aerial imagery which exploits both geometric and colour information. They show that incorporating colour yields a significant increase in accuracy; the approach can also be used to derive high accuracy digital terrain models from digital surface models.

The contribution by Hackel et al. entitled Large-scale supervised learning for 3D point cloud labelling: SEMANTIC3D.NET suggests a new benchmark data set for the classification of 3D point clouds. Inspired by the recent success of deep learning and Convolutional Neural Networks (CNNs), attributed to the large number of employed training data, the authors hope to boost 3D point classification in a similar way by providing a total of four billion manually labelled points for investigation by the scientific community. They also describe some initial work that underpins the expectations that CNNs might also lead to very competitive results in this area.

The authors of the last paper of the first volume, Yang et al., work on the problem of building change detection. In 4D Change detection based on persistent scatterer interferometry - A case study of monitoring building changes they suggest to track persistent scatters over time and to use them as indicators for new and demolished buildings, respectively, in an automatic statistics-based scheme. The new approach is successfully evaluated based on simulations and on TerraSAR-X images.

The second volume starts with two papers on sensors. In the first contribution, On a novel 360° panoramic stereo mobile mapping system, Blaser et al. present a new mobile mapping system equipped with different panoramic cameras which achieves a full 360° multi-stereo coverage. The authors report on system calibration and operational tests which yielded an accuracy in the cm to dm range for both, relative and absolute measurements.

The next paper, authored by Voges et al., deals with a particularly important and often overlooked aspect for sensor system calibration, namely time synchronisation. Using an example from robotics the authors show how time offsets between different parts of the sensor system can be retrieved for SLAM (simultaneous localisation and mapping) observations.

The next two papers are concerned with the non-semantic segmentation of point clouds from different sources. The contribution A voxel- and graph-based strategy for segmenting 3D buildings scenes using perceptual grouping laws: comparison and evaluation by Xu et al. presents two different segmentation methods using voxel and supervoxel data structures, respec-

tively, by help of perceptual grouping. In experiments using both laser scanning and photogrammetric point clouds the authors could demonstrate high quality results also for complex scenes and nonplanar object surfaces.

In their paper Range-image: Incorporating sensor topology for lidar point clouds processing, Biasutti et al. take a different view on LiDAR point cloud processing. Rather than working in 3D they project the 3D points into 2D space, arguing that in this way the large amount of successful work on disocclusion from images can be made use of. Based on these images a semi-automatic segmentation procedure based on depth histograms is presented, and detected occluded areas are reconstructed using a variational image inpainting technique.

The last two papers of this special issue tackle the problem of object modelling. First, in Geometric reasoning with uncertain polygonal faces, Meidow and Förstner discuss different strategies which can help to strike a balance between too unspecific and too restrictive models. They then suggest to model and to instantiate buildings as arbitrarily shaped polyhedra and to recognize man-made structures in a subsequent stage by geometric reasoning; examples are given to illustrate their method.

We hope that the reader will enjoy this variety of papers ranging from sensor design to semantic image and point cloud processing, and from novel scientific techniques to the investigation of data acquisition and processing systems. We would like to sincerely thank everybody involved in the preparation of this special issue. First of all and foremost, we are very grateful to Alper Yilmaz, Editor-in-Chief of PE&RS, to have offered to us the possibility to publish refined versions of the workshop manuscripts in his journal, and for all the freedom we could enjoy when preparing the special issue. We are very grateful to the authors of this special issue for making available their excellent papers, and for keeping a tough timeline. We also wish to wholeheartedly thank the reviewers of both, the workshop and the journal papers, who have tremendously contributed to improve the submitted manuscripts. We wish you, the readers, an informative and enjoyable reading and hope that we could reach the level of scientific excellence you expect from this journal.

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