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Editorial

# High Resolution Earth Imaging for Geospatial Information

The number and quality of digital images of the Earth taken from air and space has significantly increased over the last years. We can now observe our globe at a daily rate, and in principle the turn-around time of the data allows for real-time monitoring. As a result Earth images play a more and more important role in a growing number of applications. Examples comprise global change, disaster management, agriculture, forestry, insurance, security, traffic monitoring, and – of course – topographic mapping. All of these applications rely on fast and complete data exploitation with high geometric accuracy.

While digital aerial and space sensors, multiple-echo laser scanners and high resolution SAR sensors were introduced a number of years ago and are in operational use today, current trends in Earth imaging comprise an ever increasing ground resolution from space, full waveform laser scanners, unconventional platforms like unmanned aircraft systems (UAS) and geosensor networks. Developments such as those initiated by the Group of Earth Observation (GEO) and GMES (Global Monitoring of Environment and Security) will lead to even many more datasets. Automatic processing thus becomes a sheer necessity because interactive screening of the acquired images, leave alone detailed exploitation, becomes impossible due to the huge amount of bits and bytes.

These developments have formed the background for the latest edition of the ISPRS Hannover Workshop *High Resolution Earth Imaging for Geospatial Information* which was held at the Institute of Photogrammetry and GeoInformation (IPI), Leibniz Universität Hannover, between June 14 and 17, 2011 (see also the workshop report by Markus Gerke in PFG issue 5/2011). This biennial workshop, which was first held nearly two decades ago, has become a constant in the calendar of photogrammetry and remote sensing and has continually attracted around 100 participants from all around the world. It is worth mentioning that after 2005 this is already the second time that PFG dedicates a special issue to the topic of *High Resolution Earth Imaging for Geospatial Information* and to the workshop outcomes.

In parallel to the workshop, a call for papers was distributed to experts around the world. As a result, extended versions of eight workshop papers (out of 13 contributions submitted to the special issue), which have undergone a rigorous peer review process, are published in this special issue of PFG. A further paper submitted to this special issue, entitled *Assessment of reflectance calibration methods for ADS40 imagery* by Lauri Markelin et al., had to be published in the PFG issue 3/2012 due to restrictions of space.

The first paper by Daniela Poli and Pierre Soille presents a method for the refinement of digital surface models (DSM) by integrating a satellite image of higher resolution. Using a new segmentation technique, the heights inside homogeneous segments are adapted so that sharp edges at segment boundaries are obtained, which makes the method particularly well-suited for densely built-up urban areas, potentially improving the prospects of automated building detection. In the second paper, Norbert Haala and Mathias Rothermel apply the semi-global matching technique in a scenario consisting of multiple aerial images and assess the quality of the resulting DSM in terms of the accuracy and density of the underlying 3D point clouds as a function of the image configuration. Their results highlight the potential of dense matching techniques in combination with modern digital aerial cameras for producing high-quality DSMs. The third paper, written by Ali Özgün Ok et al., also deals with an aspect of image matching, but here the authors work on the reconstruction of 3D straight line segments from stereo images. Their focus is on improving the accuracy of 3D lines that are nearly aligned with the stereo base line, which is achieved by introducing fictitious 3D point entities into the estimation process.


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The fourth and the fifth paper of this special issue are dedicated to different aspects of classification. First, Txomin Hermosilla et al. describe a method for periurban change detection. They achieve their goal by comparing classification results obtained from aerial data acquired at two epochs. In classification, they combine features from image and airborne laserscanner data, additionally using local context features. Their experiments highlight the impact of using 3D information on the quality of the overall process. In the fifth paper, Andreas Braun et al. investigate the potential of a state-of-the-art classifier, support vector machines (SVM), for data fusion. They exploit the typical application of SVM for multi-class problems to integrate expert knowledge into the fusion process, using data from a particular sensor only when it can actually contribute to the separation of two classes, thus reducing the dimensionality of the feature space to a minimum. They show two applications of their framework, fusing hyperspectral with airborne laser scanner data.

The last group of papers deals with satellite SAR data. Thierry Toutin et al. investigate the accuracy of of a digital elevation model (DEM) derived from Radarsat-2 high-resolution images by means of SAR stereo. In contrast to interferometry which is restricted to small spatial baselines the stereo technique requires large viewing angle differences. The authors show that for moderate terrain the bias and the standard deviation of the DEM are similar to the pixel spacing. The potential of urban classification from fully polarimetric SAR imagery is addressed by Mariam Soheili Majd et al. They derive 20 polarimetric and textural features from the data and investigate the performance of their approach, which is based on a Fisher distribution model, in comparison to other statistical parametric models as well as to non-parametric SVM. For some important classes their method provides best results. Even though the orientation of satellite SAR images is commonly rather accurate shortcomings in the DEM used during orthoprojection may lead to considerable misalignment. In order to tackle this problem Dimitra Vassilaki propose a novel method for matching and evaluating free-form linear features for georeferencing space-borne SAR imagery.

In summary, both the workshop and the selection of papers of this special issue show a number of trends. (1) Orientation of optical satellite images, an intensively debated topic in previous workshop editions, was hardly mentioned, probably owing to the fact that most questions have been successfully solved. (2) The automatic generation of digital terrain and digital surface models seems to be well established, the latest progress in dense matching allows tackling also urban areas, which was not possible a few years ago. (3) Radar images are on their way to becoming a standard input source in our field, both in isolation and in combination with optical image data. (4) The automatic extraction of GIS objects and the update of GIS databases remain the great challenges, full automation is not in sight, and thus semi-automatic approaches are needed for practical applications.

Finally, we would like to sincerely thank everybody involved in the preparation of this special issue. We are very grateful to all IPI staff for their invaluable help in organizing the workshop, to the workshop participants who have made the meeting a success, and to the authors of this special issue for making available their excellent papers, and for keeping a tough timeline. We thank the old and the new editors-in-chief of PFG, Helmut Mayer and Wolfgang Kresse, and their teams for all the freedom we have had when assembling this special issue and for the help they extended to us in the technical preparation. In particular, we are very grateful for the possibility to have the results of the workshop published in the PFG issue prepared for the XXII ISPRS Congress in Melbourne, Australia, in order to bring them to the attention of the world-wide community of photogrammetry, remote sensing and spatial information sciences.

Christian Heipke, Karsten Jacobsen, Franz Rottensteiner, Sönke Müller, Uwe Sörgel, Hannover

This PFG-issue also includes four articles from universities in Munich, Halle, Dresden, and Potsdam providing an insight into their current fields of research in Ph & RS as well as geographic information pursued in Germany.

Wolfgang Kresse