Foreword
Special Issue: High-Resolution Earth Imaging for Geospatial Information

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This edition of *Photogrammetric Engineering & Remote Sensing* is a special issue on "High Resolution Earth Imaging for Geospatial Information".. Images of the Earth from above have always fascinated the human race, both because of their inherent beauty and because of the possibility of using them in a multitude of disciplines, a principal example being the acquisition and updating of geospatial information. In recent years, new techniques such as digital imaging from the air, laser scanning (lidar), and the advent of synthetic aperture radar (SAR) imagery have served to increase this fascination and have opened up new possibilities and challenges for science, technological development and real-world applications. Today we see many different countries launching Earth observation satellites; we learn about requirements for real-time processing, for example in disaster management, which are being met successfully; and, we see different virtual globes such as Google Earth and Microsoft Bing Maps available to us and extending the use of Earth imagery to a degree nobody could have anticipated even a few short years ago. Thus, the theme of this special issue seems both timely and appropriate.

The science of acquiring, interpreting and automatically processing satellite imagery was originally termed *remote sensing,* in contrast to *photogrammetry* which at the time was considered exclusively to address aerial and terrestrial images, and dealt mostly with geometrical questions. In the era of digital imaging from air and space at ever higher resolution — for instance, the first commercial satellite delivering spaceborne imagery with a ground sample distance of 0.5 m was successfully launched in 2007 — the geometry and the interpretation components of these previously separate disciplines have long since merged. Thus, we simply note that, in order to derive accurate and reliable information and products in object space, sensor modelling, sensor calibration and image orientation have to be dealt with appropriately, regardless of the imaging platform. Similarly, the automatic interpretation of images is carried out using image processing and analysis procedures, many of which are sensitive to the ground resolution, but again no distinction is made with respect to the platform as such. This integration of photogrammetry and remote sensing is also reflected in the ISPRS strapline of *Information from Imagery* where no distinction is made as to how the primary image data was originally acquired.

The papers are based on presentations given at the ISPRS Hannover Workshop with the same topic held from 2[nd] to 5[th] June 2009 at the Institute for Photogrammetry and GeoInformation (IPI), Leibniz Universität Hannover in Germany (see ISPRS 2009 for the papers presented at the workshop and. Butenuth and Jutzi 2009 for a report on the workshop). The workshop, held biennially in Hannover for more than two decades, was organised on this occasion by ISPRS Working Groups I/2, "LIDAR, SAR and Optical Sensors for Airborne and Spaceborne Platforms", I/4 "Geometric and Radiometric Modelling of Optical Spaceborne Sensors", IV/2 "Automatic Geospatial Data Acquisition and Image-Based Databases", IV/3, "Mapping from High Resolution Data", and VII/2 "SAR Interferometry". This time the workshop was organized in conjunction with the 12th AGILE International Conference on Geographic Information Science. Altogether, the ISPRS Workshop was attended by 118 participants from 24 different countries.

In parallel, a call for papers for this special issue was distributed to experts around the world. Based on the usual rigorous double-blind peer review procedures employed by *Photogrammetric Engineering & Remote Sensing*, eight papers from among all the submissions were finally accepted for publication. Four of those deal with optical imagery, one with airborne laserscanning, and the remaining three with SAR.

Aerial photography is globally the most important data source for topographic mapping of various kinds. *Redweik et al.* report about efforts to recover Portugal's aerial image repository, which dates back to the late thirties of the 20th century. This archive offers valuable data required for time series analysis and change detection. In the paper the repository is described and the steps necessary to make the images available to the modern scientific community and to the general public are discussed, including the set up of a photo-geographic database. Examples illustrate the usefulness of the approach.

Turning from historical analogue images to the present, the next paper of *Cramer and Haala* evaluates the performance of modern digital aerial camera systems. The authors summarize findings of a large project conducted under the auspices of the German Society of Photogrammetry and Remote Sensing (DGPF). Twelve different camera systems have been investigated. Results from 34 test participants including university institutes, camera manufacturers, mapping agencies, and the private mapping industry are reported. The investigations of this remarkable test focus on the geometric accuracy, the geometric and radiometric calibration procedures, the geometric accuracy for point determination and DSM generation as well as issues of manual stereo plotting and automatic land cover classification.

Radhadevi et al. investigate the potential of the Indian Cartosat satellite family for large scale mapping. Information content and geometric fidelity of the two satellites Carotsat-1 and Cartosat-2 are discussed. The different data acquisition modes are explained and the mapping potential is assessed with the help of different examples. The authors show that if rigorous photogrammetric procedures are employed, the Cartosat satellite images can be used for mapping at a scale of 1:10,000 and larger.

Alobeid et al. compare several image matching algorithms for DSM generation in urban areas from high-resolution optical satellite imagery. Besides the standard least squares matching approach, dynamic programming, and semi-global matching are investigated with the help of four different Ikonos stereo pairs. It turns out that for urban areas semi-global matching yields qualitatively and quantitatively the best results.

A complementary and well established technique to determine 3D structure is airborne laserscanning (ALS). State-of-the-art sensors digitize the temporal waveform from which the width and the so-called intensity of each echo can be estimated. *Jutzi and Gross* investigate different surface reflection models to normalize this intensity such that undesired influences depending on range, incidence angle, and atmospheric attenuation, are mitigated. The results based on 17 different types of urban land cover revealed that the standard Lambertian reflection model is sufficient for such purpose.

Crosetto et al. present a review of potentials and limitations of satellite-based persistent scatterer interferometry (PSI) to monitor surface deformation phenomena. They also compare traditional C-Band (ERS, ENVISAT) data and high-resolution X-Band (TerraSAR-X) for such purpose. Using C-band data, PS densities of up to 800-1000 PS/km2 were achieved compared to about 39000 PS/km2 for TerraSAR-X. In the latter case also the residual topographic error of the estimated 3D position of the PS is improved. The authors demonstrate this effect impressively by mapping a large number of PS which were caused by facade elements of skyscrapers on 3D models of these buildings.

Wegner et al. deal also with SAR data, but their focus is on object recognition from amplitude images, i.e., such analysis is feasible even if only a single SAR image is available. Often linear object primitives like edges or lines are the fundament for further reasoning aiming at more complex objects, be it building recognition or road extraction. The authors provide insight about the spatial accuracy we can expect from segmented linear features in SAR data, which limits the overall accuracy by error propagation. They model the geometrical accuracy of extracted lines using real TerraSAR-X data of an urban scene and simulations.

Modern SAR sensors are capable of acquiring simultaneously several SAR images of different polarization. Reflection at surfaces may alter the signal's polarization plane depending, for example, on the object geometry and the number of reflections. *Ronny Hänsch* applies multi-layer perceptrons for land cover classification from high-resolution, fully-polarimetric SAR data of an airborne sensor. The author proposes a complex version of a neural network for such purpose because SAR data are complex valued, too. The approach is applied successfully using airborne SAR data.

Obviously, this special issue would not have been possible without the authors who have submitted their papers, and who at various stages of the publishing process have had to keep to the rather strict deadlines of the iterative review process. We are also grateful to the reviewers, who have invested substantial amounts of time in reading and commenting on the submitted drafts and have thus significantly improved the final material published in the special issue. We would like to thank Russ Congalton, Editor-in-Chief of *Photogrammetric Engineering & Remote Sensing*, and his team from the American Society for Photogrammetry and Remote Sensing for all the advice, support and the freedom they extended to us in the preparation and realization of the special issue.

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