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Editorial

HIGH-RESOLUTION EARTH IMAGING FOR GEOSPATIAL INFORMATION, PART I

THIS ISSUE OF *The Photogrammetric Record* is the first of two special issues 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 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 Virtual Earth 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 these special issues 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.

This first special issue comprises five papers dealing with geometric and radiometric sensor modelling, calibration and orientation of satellite images as well as with the derivation of products such as digital terrain models and orthophotos. The second, the December 2008 issue, will contain papers reporting on digital aerial cameras and image analysis approaches for automatically extracting land cover, buildings, roads and traffic information. The papers are primarily based on presentations made at the ISPRS Hannover Workshop with the same topic as the special issues, held from 29th May to 1st June 2007 at the Institute for Photogrammetry and GeoInformation (IPI), Leibniz Universität Hannover in Germany; see also Holland and

Mills (2007). The workshop, held biennially in Hanover for more than two decades, was organised on this occasion by ISPRS Working Groups I/5, ''Geometric modelling of optical spaceborne sensors and DEM generation'' and IV/3, ''Automated geo-spatial data acquisition and mapping'', and supported by Working Groups I/4, ''Airborne digital photogrammetric sensor systems'' and IV/9, ''Mapping from high resolution data'', and was attended by 109 participants from 26 different countries. In parallel, a call for papers for this special issue was published in *The Photogrammetric Record* and was distributed to experts around the world. Based on the usual rigorous peer review procedures employed by *The Photogrammetric Record*, 10 papers from among all the submissions were initially accepted for publication, with a small number of other papers possibly qualifying for acceptance in due course.

Weser et al., the authors of the first paper contained within the pages of this special issue, present a new generic pushbroom sensor model for high-resolution satellite images. Information available from image providers is mapped into the generic model and then used for further processing. Based on independent test sites, and images from various high-resolution satellites, accuracies on the ground in the range of 1 pixel and below have been reached. A similar line of thought is followed by *Shaker* et al., who investigate imagery produced by a small satellite. Despite their reduced ground resolution, small satellites are attractive for many applications thanks to the lower cost of building and launching the sensor platform. Consequently, images are often also available at reduced cost. The authors use the example of the Compact High Resolution Imaging Spectrometer (CHRIS), which is part of ESA's Project for On-Board Autonomy (Proba). Based on a test site in Hong Kong, different approaches using the 3D affine transformation for sensor orientation are investigated.

The paper by *Srivastava* et al. describes the Indian remote sensing satellite Cartosat-1, which features along-track stereo capabilities at a ground resolution of 2·5 m. Cartosat-1 was built for the operational derivation of digital terrain models and orthophotos. India is well known as one of the major players in this field, and the paper written by the scientists from the Space Applications Centre of the Indian Space Research Organisation (ISRO) in Ahmedabad clearly underlines this observation. The contribution from *Baltsavias* et al. also deals with Cartosat-1 data. Based on material distributed within the framework of the international Cartosat-1 evaluation programme initiated by ISRO in cooperation with ISPRS, the authors use data from two test sites to investigate image quality, sensor modelling and the generation of digital terrain models. Without any manual editing, accuracies in the range of the ground resolution were obtained by comparison to reference data, a very good result.

In the final paper of this first special issue, *Kocaman and Gruen* discuss the adaptation of a self-calibration sensor orientation approach developed by the authors to images of the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM), a three-line stereoscopic scanner on board the Japanese Advanced Land Observing Satellite (ALOS). The sensor model is refined for PRISM to take into account the multiple camera heads. The approach was investigated using a number of different test sites, and the results so obtained are reported and analysed.

In summary, it can be said that in recent years multiple methods for the orientation of satellite images have been developed and are in practical use today. Some of the models are based on sensor-oriented rational polynomial coefficients (RPCs) and are more generic, whilst others reconstruct the actual geometric situation during image acquisition and are thus adapted specifically to particular sensors. In both cases geometric accuracies in the range of 1 pixel can be reached at independent check points. Thus, based on results available today, it seems that both approaches are equally applicable for topographic mapping. Another observation is that in recent years the number of countries which have launched their own imaging satellites has

significantly increased, especially when small satellites are included in the total. We expect this trend to continue over the course of the next few years.

This is the first time that *The Photogrammetric Record* has published a special issue with papers derived from workshop proceedings, although readers of long standing will of course recall regular issues of *The Photogrammetric Record* covering the biennial "Thompson Symposia" of the Photogrammetric Society. While the rules of *The Photogrammetric Record* clearly state that papers previously published in "grey" literature such as conference proceedings should be significantly extended before publication in the journal, some similarities between the proceedings and the articles of these two special issues inevitably exist. This is especially true for the workshop's two Invited Papers, those of Srivastava et al. and Baltsavias et al., which were subsequently submitted in response to the call for papers for the special issue. In these cases, the authors had already prepared extended versions of their papers for the ISPRS Hannover Workshop proceedings (ISPRS, 2007), and thus the need for further extensions was felt to be less pressing. Nevertheless, these submissions were subjected to the same rigorous peer review procedures as all other technical papers submitted to *The Photogrammetric Record*, and are significantly improved over the proceedings papers as a result. All papers include a heading explicitly pointing to the prior publication. We hope that readers will consider this approach to be an appropriate way of handling this somewhat sensitive issue.

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 issues. We would like to thank Paul Newby, Editor of *The Photogrammetric Record*, and his team for allowing us to conduct this experiment and for all the freedom and help they extended to us in the preparation of the special issues. Last but not least, we express our gratitude to Wiley-Blackwell for their role from the final copy editing of the manuscripts to the production of the finished journal.

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