Theme issue on airborne laser scanning editorial

Author(s):
Baltsavias, Emmanuel P.

Publication Date:
1999

Permanent Link:
https://doi.org/10.3929/ethz-a-004658677 →

PHOTOGRAMMETRY & REMOTE SENSING

ISPRS Journal of Photogrammetry & Remote Sensing 54 (1999) 61–63

Editorial

Theme Issue on Airborne Laser Scanning

Einstein is considered by many the father of laser. Although he did not invent the laser, his work laid the foundation with the postulation of the photons and stimulated emission in 1917. In 1954, the American physicist C.H. Townes developed the first microwave laser (MASER). In 1958 he and A.L. Schawlow published a paper on the possibility of laser action in the visible and infrared spectrum. The first successful optical laser, using a ruby crystal, was developed in 1960 by the American physicist T.H. Maiman. A short while after this development many labs around the world tried out different substrates that were successfully lased. As the manufacturing techniques improved, these lasers rapidly made the transition from the lab bench to commercial applications.

Airborne laser ranging, first tried out in the 1960s, started to be developed from the early and middle 1970s, especially in North America, with experimental systems particularly for bathymetric and hydrographic applications. It was first in the late 1980s that the use of GPS made accurate range measurements with airborne laser profilers on a larger scale possible. Investigations, particularly at the University of Stuttgart, led to a higher maturity of this technology and the development of processing algorithms and methods. In the early 1990s, profilers were gradually replaced by scanners, while GPS was combined with INS. At the 1996 ISPRS Congress in Vienna a laser scanner manufacturer participated in the exhibition and reports about investigations and tests with airborne laser scanners were presented. Several ISPRS Working Groups started dealing with laser scanning related topics and in 1998 OEEPE, a regional member of ISPRS, established a special WG on this topic.

In spring 1997 these facts led us to the idea of a theme issue of the ISPRS Journal on Airborne Laser Scanning (ALS). How correct this decision was, has been proven by the developments since then. Many new manufacturers and even more service providers entered the field. Researchers increasingly deal with (a) algorithms and methods for postprocessing of laser data, especially for filtering and separation of objects, and extraction and classification of objects, primarily buildings, (b) combination of laser range measurements with other sensor and GIS data, and (c) visualisation. New applications are emerging in different fields. Several accuracy and feasibility tests have been performed in different countries, leading to convincing results and current operational use of ALS in five continents. New, 'second generation' systems are manufactured, integrating the latest developments in GPS/INS, computer and electronics technologies, while a combination with other sensors on the same platform is also a clear trend. ALS is competing with, complementing or even replacing current technologies for geoinformation acquisition.

However, the developments are still progressing rapidly and reaching a critical phase, requiring proper decisions and actions for advancements in the correct direction. To consolidate and further strengthen the performance and profitability of ALS, and support its penetration in new, broad application areas, novel advanced algorithms and methods are needed, as well as standards on data acquisition, sensor calibration, and postprocessing methods. Hiding problems and promising too much, not paying proper attention to critical components, like calibration, flight planning and execution, lack of intelligent software to convert huge amounts of raw data into useful information for the application-at-hand, little cooperation

PII: S0924-2716(99)00013-1

between firms and researchers for methodological developments, lack of openness from the service providers and unfair competition among them, are pitfalls that can throw back this exciting and promising technology, as it partly occurred with the introduction of digital photogrammetry some 10 years ago.

Thus, this theme issue comes at the right moment and covers a gap. It is high time to have a comprehensive overview and summary of the state-of-the-art in ALS. This can help form a solid basis for further advancements in the correct directions. The issue also contributes in making the ALS technology more widely known to people within and outside ISPRS, and furthermore presents new processing algorithms and results.

Our intention was to cover different topics, from tutorials, overviews and surveys to applications in different fields, as well as processing methods and algorithms. We wanted this issue to be interesting also for practitioners and persons knowing little on this topic, and not just researchers in the academia. Attention was also paid to (a) the geographic distribution (included papers come from Europe, N. America and Japan), and (b) the presentation of various ALS systems. In the following, a short summary of the papers will be given.

Wehr and Lohr give an introduction and overview presenting the basic principles of laser, the two main laser classes (pulse and continuous-wave), aspects relating to range, resolution and precision, the main laser components and the role of the laser wavelength, different scanning mechanisms, position and orientation determination with GPS/INS, the data processing chain for producing digital terrain and surface models, and a short overview of applications. As a continuation of this paper, Baltsavias presents a summary of relations and formulas related to laser scanning and especially parameters that are important for flight planning, while in another article he presents an overview of existing systems, firms and other resources. This survey is by far the most complete and up-to-date information available today on commercial ALS. Additional data on contact information, links for manufacturers, service providers and owners of ALS is given.

Prof. Ackermann, the 'pope' and initiator of ALS in our community, shares with the readers his thoughts on the current status and future expectations of ALS. Baltsavias presents a comparison of photogrammetry, using manual or automated processing methods, to ALS, pointing out advantages and disadvantages of each technology.

A number of papers deal with the use of ALS for specific applications. Petzold, Reiss and Stössel present the experiences with ALS (ALTM 1020 of TopScan) at several State Surveying and Mapping Offices in Germany. Since German Federal States were among the first to use ALS operationally for DTM generation over their whole area, these experiences are of particular value for other countries with similar problems and requirements. Pereira and Wicherson from Rijkswaterstaat, The Netherlands, report on the suitability of high-density data from the FLI-MAP-I system for the management of fluvial zones. Rijkswaterstaat has performed several tests using various ALS systems for various applications since the early 1990s. Blair, Rabine and Hofton from NASA/GSFC present LVIS, a laser scanner for mapping vegetation (including its vertical profile) and topography. NASA has been involved in development of laser systems for nearly 25 years, and the authors have been involved in the development and realisation of many other NASA laser systems. Irish and Lillycrop present the SHOALS bathymetric laser. SHOALS can be used for mapping of coastal zones and sea-bottom topography, an application where laser scanning is the only reasonable or possible airborne technology. It has been used extensively in the USA and other countries, while recently it can also be used commercially. Finally, Murakami, Nakagawa, Hasegawa, Shibata and Iwanami report on the use of a Japanese ALS system from Nakanihon in order to detect changes, especially vertical ones, of buildings. Their application was the detection of damaged buildings after earthquakes and in this case after the big earthquake in Kobe.

Haala and Brenner use ALS (TopoSys) in urban environments and present two methods for data collection. The first one combines multispectral imagery and laser scanner data in an integrated classification for the extraction of buildings, trees and grass-covered areas. The second method uses laser data and existing 2-D cadastral ground plan information for a 3-D building reconstruction. Axelsson uses data of the Saab TopEye and presents some methods and algorithms for data filtering to determine the ground surface, DEM generation, classification of buildings for generation of 3-D city models, and detection of electrical power lines. Thereby, the use of reflectance data and multiple echoes from the laser scanner is examined and found to be useful in many applications. Maas and Vosselmann report on two new techniques for the determination of building models from laser altimetry data. Both techniques work on the original laser scanner data points and may optionally use available ground plan information. The use of the techniques with a FLI-MAP laser scanner dataset and an accuracy analysis of the results are presented.

We hope that this issue can serve as an important reference for the next period. The ISPRS Journal will continue to follow this topic. Apart from two important papers published in recent issues (Kraus and Pfeifer, Vol. 53, No. 4, and Huising and Gomes Pereira, Vol. 53, No. 5), interesting and novel articles on ALS will continue to be published.

We express our gratitude to all authors for their contributions, the referees for their reviews, numerous persons from companies and organisations who provided information, and the publisher who showed a great deal of understanding for the delayed submission of the manuscripts and gave the possibility to persons not subscribing to the journal to order this issue comfortably and at a very good price.

Aloysius Wehr, Uwe Lohr
Guest-Editors
Emmanuel Baltsavias
Editor-in-Chief