

High Performance Photogrammetric Production

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ABSTRACT

The paper introduces new features of the current Trimble Inpho and Trimble eCognition software solutions, which are now available as native executables for 64-bit Windows operating systems. In addition, new modules are available for the automated generation and extracting of high quality information from aerial images. With the also available airborne sensor systems, Trimble Geospatial offers end-to-end solutions for capturing, extracting, managing and analyzing geoinformation.

1. INTRODUCTION

Over the last few years the demand for geoinformation increased considerably. Better, easier to use and cheaper to operate sensors are available to collect efficiently data at high quality. On the other end of the process chain, the user community has powerful tools available to visualize, analyze and distribute geospatial information for various tasks. The use of geoinformation has penetrated various branches and industries, e.g. marketing, mapping, construction, traffic and transportation, mining and utilities, urban development, defense, forestry and agriculture, not to forget the use by individuals for private purposes such as travel and recreational activities.

In order to serve these demanding market segments, the Geospatial Division of Trimble is offering a comprehensive line of industry leading sensor solutions collecting data from platforms carried by aircraft and land based vehicles. The data collection is complemented by powerful processing modules covering the georeferencing of the data and further on the information extraction by automated feature recognition tools and interactive modules for quality control and if needed, for manual completion by human operators.

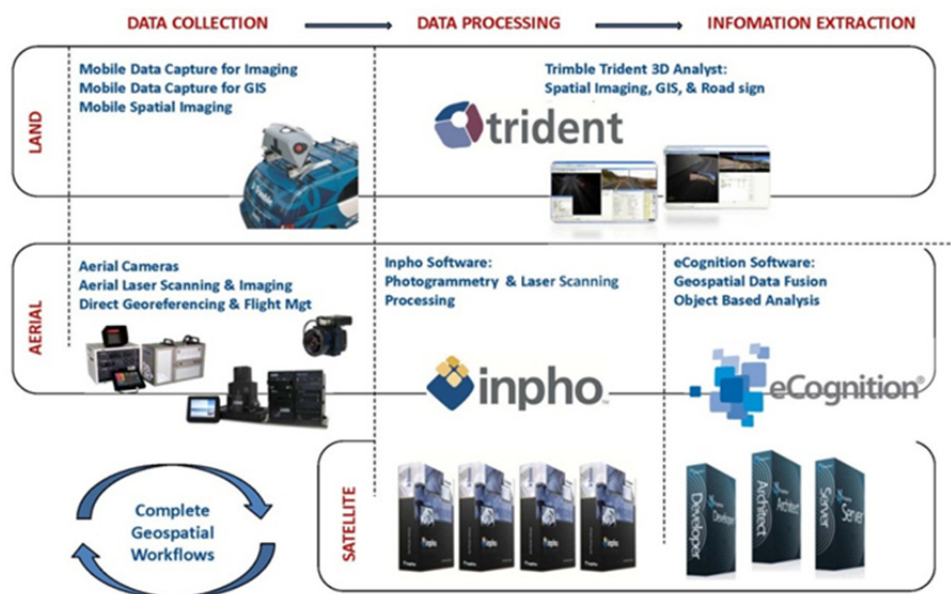


Figure 1: Trimble Geospatial products

The increase in demand of up-to-date geoinformation data requires highly automated data collection and processing systems. Trimble Geospatial is committed to serve these needs by continuously developing and extending its hardware and software solutions.

Some results of the recent developments are described in the following.

2. INPHO PHOTOGRAMMETRIC SOLUTIONS

Trimble Geospatial has released a new version of the Inpho photogrammetric processing software version 5.4. One focus is again the further improvement of the throughput for photogrammetric projects. The efficient use of multi-core CPUs of nowadays available standard workstations by applying the multi-threading technology and the benefit from using available 64-bit operating systems leads to a significant reduction of the processing time per image or ground unit.

Another focus for the current release was on

- New Generation of MATCH-T DSM for digital terrain model generation
- Optimized workflow for OrthoMaster and OrthoVista
- BuildingGenerator including related functions in DTMaster

2.1. Progress in automated DEM extraction

The automated Digital Elevation Model (DEM) extraction from aerial images is a major process step of the photogrammetric production workflow. DEM's are used for various purposes, like orthophoto generation, digital terrain modeling, slope and volume calculation.

The previous version of MATCH-T delivers already remarkable results. With the current version considerable improvement has again been achieved by applying a revised matching strategy within MATCH-T for the surface model generation. MATCH-T is now using a cost-based matching strategy in order to generate a much denser point cloud at higher quality. The density can be tuned down even to one point per pixel, generating a high quality 3D point cloud. Such a 3D point cloud greatly extends the use of aerial images for creating or updating high quality digital terrain models or for 3D city model applications.

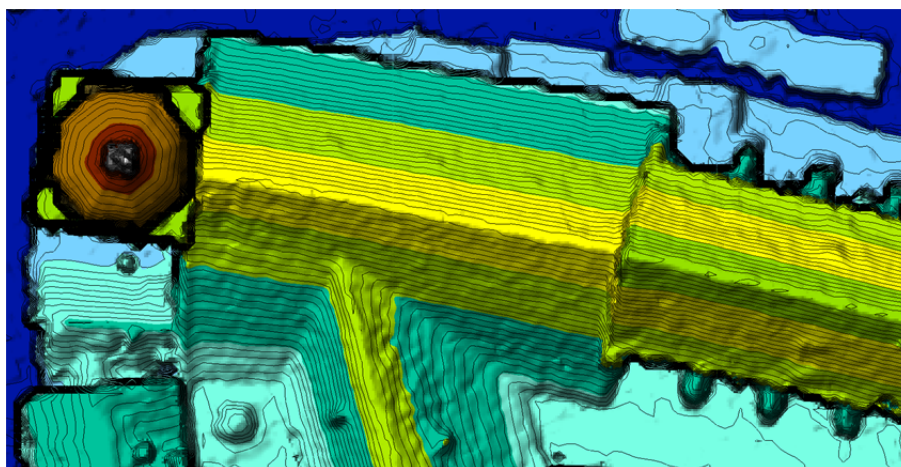


Figure 2: MATCH-T DSM 5.4 result

More details are described in “Towards a next level of quality DSM/DTM extraction with MATCH-T” by Tobias Heuchel et al. in this volume of Photogrammetric Week ’11.

2.2. Orthophoto Production

Similar to the DEM generation orthophoto production is another major processing step in the photogrammetric workflow. The overall process is subdivided into several tasks, like ortho rectification, color balancing, image corrections, seam finding, mosaicking, tiling etc. The heavy batch processing has been increased in performance by optimizing tasks and by leveraging the multi-core technology of modern computer hardware. With the current version 5.4 of OrthoMaster around 4.500 high resolution large format aerial images can be processed per day using just one license. If higher throughput is still needed, a scalable solution of additional licenses managed by a distributed processing environment is available.

All processes are running on standard computer workstations. With the flexible floating licensing management, which is used for all Inpho modules, the software runs on any hardware available in the network working with Windows operating system. There is no need for specific graphic card hardware.

For good reasons OrthoMaster and OrthoVista are independent of each other but they can be interlinked by commonly generated project files. This enables automated generation of the final ortho mosaic out of aerial images with almost no user interaction. The new version also emphasizes the reduction of manual interactive work by further increasing the quality of the automated seam finding and seam blending processes.

OrthoMaster and OrthoVista as an optimized solution for orthophoto production are providing an unbeaten price/performance ratio, especially if superior quality of the final product is required.

3. AUTOMATED INFORMATION EXTRACTION

3.1. BuildingGenerator

BuildingGenerator is an automated tool for the extraction of 3D building models for city model applications. The building models are extracted automatically out of 3D points clouds generated either by MATCH-T DSM as described before or measured by airborne lidar systems like the Trimble Harrier. Further input data are the digital terrain model and the footprints.

The BuildingGenerator creates buildings by means of partitioning and segmenting the 3D points of the footprint area and then selecting the appropriate roof type model and best fitting it to shape the 3D building model. This process takes less than a second per building.

In order to provide optimal support the generation of state-wide building models, the BuildingGenerator is embedded in a workflow and process control system called novaFACTORY. novaFACTORY offers a

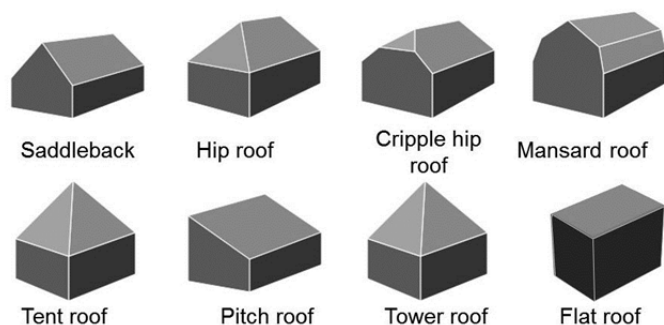


Figure 3: BuildingGenerator roof types

web-based browser interface to setup and supervise the production processes.

DTMaster, Inpho's interactive digital terrain editing tool, has been enhanced to handle the 3D building data, which are stored in the spatial data base Oracle. DTMaster Building Add-On offers quality control functions of buildings created by BuildingGenerator and in addition also sophisticated tools to measure efficiently buildings interactively by the operators.

Fig. 4 displays the result of the building generation processes, which can be used for:

- Visualization purposes
- City planning
- Solar exposure analysis
- Noise propagation



Figure 4: 3D building models

3.2. eCognition image analysis software

eCognition is the most advanced object based image analysis software available for geospatial applications and now available as native 64-bit application. This represents an important technical milestone for processing of very large areas more effectively, fully benefiting from state of the art computer hardware. In 32-bit operating systems, applications which have to handle massive amounts of data are quickly confronted with limitations caused by restricted memory availability. By moving to a 64-bit environment this barrier is removed and both the workflow and the image analysis routines are more easily structured.

eCognition 8.64 enables users to analyze much larger data sets without the need of complex tiling. Users can now segment very large and high resolution data sets at a fine scale generating billions of image objects, not only out of various image types but also out of additional data sources, like 3D point clouds or other GIS vector data sets.

By using automated object based image analysis software complex projects can be executed even with limited budgets, as most cost-intensive human operator work is no longer needed or reduced to the minimum, as demonstrated by following example.

The Department of Surveying and Geo Information of the State Government of Lower Austria (GEOinfo) is currently developing a land-use and land-cover model for more than 20,000 km² of territory, encompassing bodies of water, forests, urban and rural areas. Utilizing eCognition, the State Government developed a software application to detect and quantify changes in forests, buildings, field and water areas from airborne Light Detection and Ranging (LiDAR) data and orthophotos. The software application was designed for urban planning initiatives and as part of a European Union higher-traffic network project to develop sound-wave propagation models of

traffic noise. The application correctly classified built-up areas for 94.3% of the region and forested areas for 96.1% of the region. This initiative represents the inaugural project of a planned five-yearly periodic land-use analysis.



Figure 5: Source aerial image



Figure 6: Results of automated classification

Further examples of eCognition application are:

- Mapping trees and shrubs near power lines
- Land cover mapping for various object classes
- Urban tree canopy assessment
- Impervious surface for private and commercial properties
- Solar suitability mapping
- Change detection
- Agriculture

The eCognition Software Suite is formed out of three packages:

- eCognition Developer
The development environment for object-based image analysis
- eCognition Architect
The easy to use front end for non-technical professionals
- eCognition Server
The processing environment for the batch execution of image analysis jobs.

eCognition Server is based on a service oriented architecture and therefore highly scalable for any server environment and customer needs. Depending on the investment in hardware infrastructure and software licenses, state- or even country-wide jobs with high resolution input data of any source can be processed in the desired time frame.

4. TRIMBLE AERIAL SENSORS PORTFOLIO

In addition to the software portfolio for processing data of almost any aerial sensor systems, the Trimble Geospatial division is also offering a comprehensive range of aerial sensors, such as the Trimble Aerial Camera (TAC), the Trimble DSS camera system and Trimble Harrier, a laser scanning and imaging solution. These systems have been introduced to the geospatial market place a while ago.

The Trimble Aerial Camera is a camera system which can be used either as a stand-alone imaging system or integrated with other sensors e.g. a laser system.

Recently the TAC has been enhanced with forward motion compensation (FMC) to improve greatly the image quality and expand the operation time in the air under poor lightning conditions. The left image of Fig. 7 shows a shot of a spinning wheel with FMC switched off, where for the right image FMC was switched on.

The TAC is available with a wide range of interchangeable lenses (35 mm – 100 mm) as well as different sensor models. Therefore it can be easily adapted to fulfill the requirements of various jobs such as corridor mapping or area mapping.

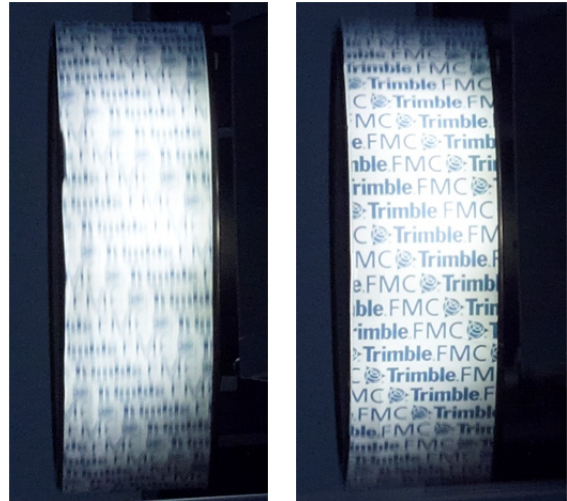


Figure 7: TAC Forward Motion Compensation

For further information, see also:

<http://www.trimble.com/geospatial/>

<http://www.inpho.de>

<http://www.ecognition.com>