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Digital photogrammetry in the Land Consolidation Authority in Baden-Württemberg

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ABSTRACT

Besides cadastral photogrammetry and topographic evaluations, the data acquisition of digital terrain models (DTMs) plays an important part in the application of photogrammetry in the land consolidation authority in Baden-Württemberg. The DTMs are derived from aerial photographs, which have been digitized by the PhotoScan PS1, by the use of the program TopoSURF. From the DTMs we get in particular slope maps and control data for the orthoprojection on the orthoprojector Z2. The author explains the considerations, that led to the establishment of the digital photogrammetry and also the first experiences made in the application of the new technique.

1. INTRODUCTION

The application of photogrammetry in the land consolidation authority began in 1966. At that time cadastral surveys of the land consolidation areas have been the main task of photogrammetry besides topographic evaluations. Even today cadastral photogrammetry and topographic evaluations play an important part in land consolidation. But these methods have been supplemented since 1983 by the measurement and application of digital terrain models and by their derived products.
The computation of precise digital terrain models is the first area, in which digital photogrammetry is applied in land consolidation.

2. APPLICATION OF PHOTOGRAMMETRY IN THE LAND CONSOLIDATION AUTHORITY IN BADEN-WÜRTTEMBERG

The main areas of use of photogrammetry in land consolidation are:

- The interpretation of aerial photographs.
  Vertical photographs to delimit the land consolidation area, oblique photographs of the old and new situation to document the land consolidation works.
- Topographic completion of land consolidation maps.
  Up-dating the existing maps as a base for plannings. Surveying of topographical-changes after land consolidation.
- Cadastral photogrammetry.
  Measurement of the coordinates of signalized points; definition of coordinates of not signalized points.
- Digital terrain models.
  Contour line maps, slope maps, soil loss prediction maps, orthophotos.

We need two different kinds of orthophotos:

- One copy of best photographic quality, if possible in colour, which also shows very small details if interpreted by using a pocket-lense.
- A screened transparency in black-and-white, which can be combined with vector maps and copied easily by light printing.

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These orthophotos serve as project-site orientation for land consolidation engineers and are a base of further representations, for example

- at the valuation of the soil,
- at the representation of ecological important areas,
- at the planning of the new road and water system and
- at the allocation of the new lots.

3. REFLECTIONS ABOUT THE ESTABLISHMENT OF THE DIGITAL PHOTOGRAMMETRY

Until now, the mentioned photogrammetric evaluations have been done with one analogue and two analytical plotters of Zeiss. Orthophotos have been made with the analytical orthoprojector Z2. Because the more than 20 years old analogue plotter had to be replaced, there was the question: another analytical system or a digital system yet?
The answer was not easy for us. There are the following arguments for an analytical system:

- The analytical systems are well developed and they have proved well.
- At present, we are already working with several analytical systems; the expense to get accustomed to a changing system would not be very high.

Nevertheless after serious reflections we decided to establish the digital photogrammetry. Our main arguments were:

- The PhotoScan PS1 enables the change from conventional analogue aerial photographs to digital images. We believe, that the direct acquisition of digital images will not replace the conventional acquisition of analogue aerial photographs for many years. The hardware of the PhotoScan PS1 will work for a long time with sufficient accuracy and reliability.
- Now as before the development of new and better computers is very fast. We need powerful computers for analytical as well as for digital systems. At both types of systems, the computer has to be replaced after some years eventually.
- If the software is not completely developed, it can be replaced very easily by new programs. So we can participate easily in all progresses made in the development of software.

If we buy an analytical plotter, the level of technology is fixed for many years; if we establish a digital system, we can participate in the further development to a high degree:

- The hardware of the PhotoScan PS1 will work reliably for many years (just as the hardware of an analytical plotter will do).
- If the software should be developed to an essential higher level - that can be expected -, the new software can be installed very easily.
- If a higher developed software needs more powerful computers, we think that more efficient computers can be bought at stable prices in the future too.

4. APPLICATION OF THE DIGITAL SYSTEM

The main job of the digital photogrammetric system is the mass production of digital terrain models (DTMs). The preparatory works necessary for this, like the determination of the interior orientation

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and the phototriangulation, are carried out conventionally at the analytical plotter. Also the border lines of the DTMs are fixed at the analytical plotter.
The aerial photographs, which usually have the scale 1:7 500, are scanned in black-and-white with a pixel size of 15 to 30 μm. In the framework of PHODIS, the software system TopoSURF automatically generates a precise DTM with a grid width of 3 to 6 m. Because of the high density of the calculated points, we only need few skeleton lines or break lines.
The accuracy of a so determined DTM (about 0.1 ‰ of the flying altitude) is sufficient for the needs in land consolidation, that means not only for the production of orthophotos, but also for slope maps.

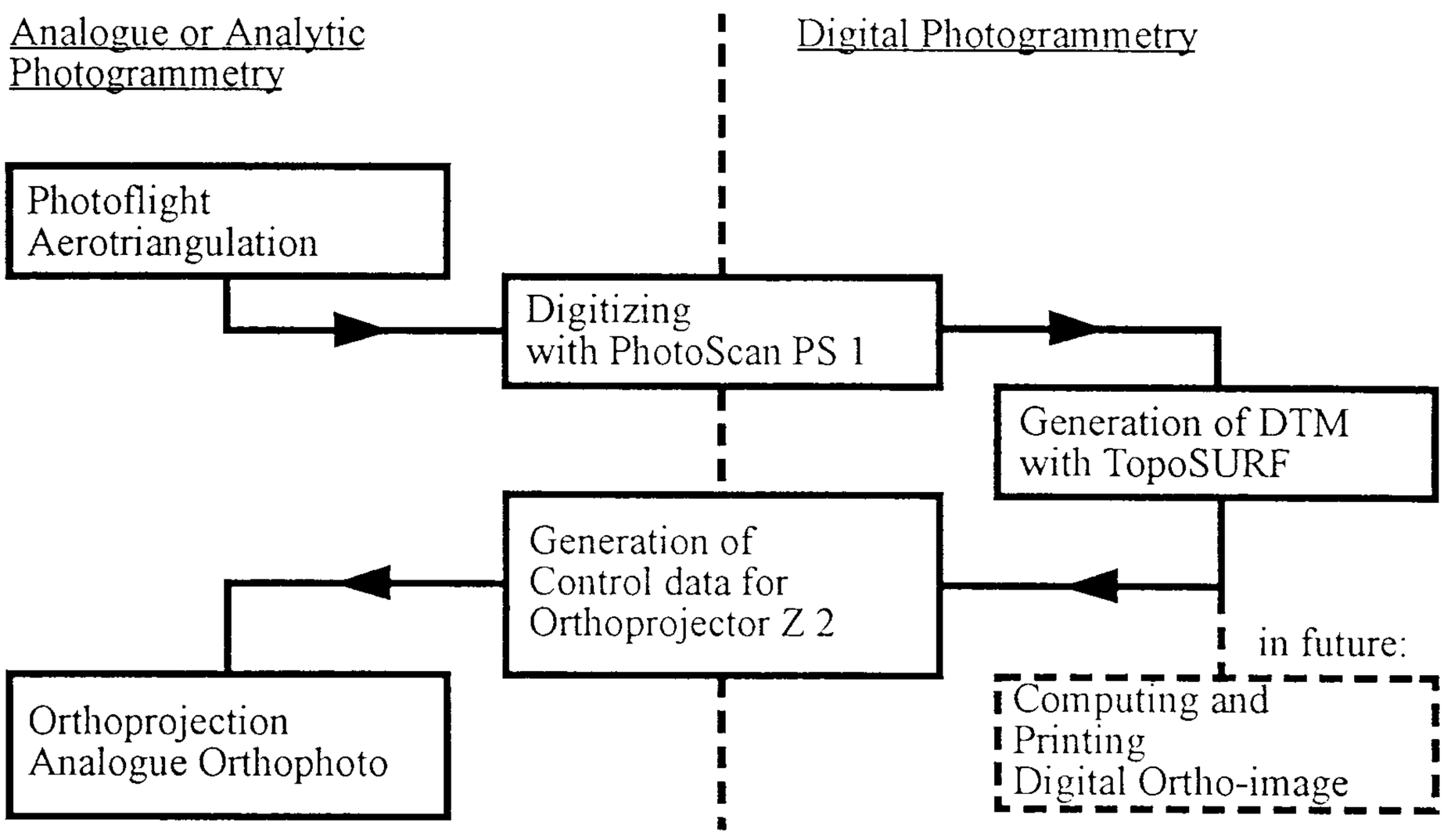

Figure 1: From the photoflight to the orthophoto.

From this compact DTM and if necessary also from the additionally measured break lines we derive a wider DTM, which corresponds to the DTM that we made with the help of the analytical plotter till now. All following products, which also have been used yet - especially control data for the orthoprojector and slope maps - can be derived from this sparse, definitive DTM with a grid width of 5 to 10 m.
So orthophotos are made, till now and in the future, from the analogue aerial photograph at the analytical orthoprojector Z2. The user of the orthophotos does not perceive anything of the digital part of the way from the aerial photograph to the orthophoto (Fig.1).
The new digital technology does not influence the production of colour orthophotos: the colour aerial photographs are scanned in black-and-white, the DTM is produced automatically from the intensities of the scanned image and delivers the control data for the orthoprojector. By the help of these control data the orthoprojector reprojects the colour aerial images to colour orthophotos.

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Since we have films of higher resolution power for aerial photographs, colour orthophotos play an important part in the land consolidation authority in Baden-Württemberg. They offer better possibilities of interpretation.

5. FURTHER DEVELOPMENT

There is the question, why we leave the digital line just before reaching the digital ortho-image and why we produce the orthophotos conventionally in an analogue way. The main reason is, that our orthoprojector Z2 is working to our complete satisfaction and we hope, that it will do for many years. The quality of the analogue photographic orthophotos is so high, that also digitally computed and printed ortho-images cannot be much better.
But we are convinced, that we are not in a deadlock here. In some years, if our Z2 will have to be replaced, we will extend the digital line in direction to the production of digital ortho-images and their printing by a raster plotter. The investment of today in the PhotoScan PS1 will prove to be efficient so long as analogue aerial photographs have to be scanned, so long as digital images cannot be taken from the aeroplane.

6. CONCLUSIONS

Until now, we do not think at the general digital line beginning with the digital (aerial) image and ending with the final products. But we think at the possibility to use digitized aerial photographs for the digital transfer of points from one image to another and for the digital image triangulation. Also an automatic digital cadastral photogrammetry seems to be possible or an automatic interpretation for example of agricultural cultivations for the programs of the European Community. As a basic requirement for all these ideas, the digitized aerial photograph remains important. We have opened the way to this development by installing the PS1 and the software system PHODIS. So photogrammetry will play an important part in the land consolidation authority in Baden-Württemberg also in future.