

Strategy for Up-Dating the Authoritative Topographic-Cartographic Information System - ATKIS by Image Processing

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Besides the well-known analogue topographic maps in the oncoming information society there is a strong need for digital data on the earth's surface. To meet these needs and the fulfill their own tasks the surveying and mapping agencies in Germany developed a concept to realize ATKIS as soon as possible. the basis of ATKIS is the Digital Land Model (DLM) consisting of the Digital Situation Model (DSM) and the Digital Terrain Model (DTM). Deriving from the DLM there will be Digital Cartographic Models (DKM's) for outputs especially in the form of maps.

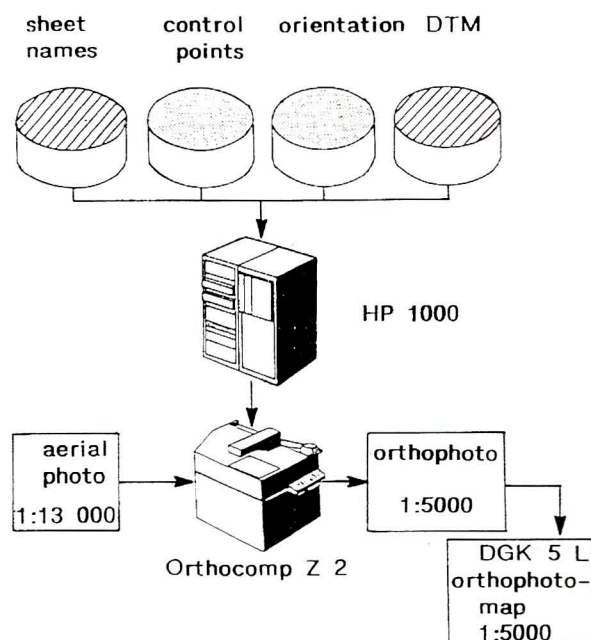
In 1988 the Surveying and Mapping Agency of Northrhine-Westfalia (NRW) started with capturing all topographic data out of the German Basic (Line) Map 1: 5 000 and of the orthophoto map 1:5 000. Other objects of lower accuracy are derived from the topographic map 1:25 000. Until now the data acquisition is done for 173 of the whole area of NRW. But at this time it is necessary to create a concept for updating and to start with these activities early in 1992 to make ATKIS an actual information system up-dated continuously.

For the Surveying and Mapping Agency of Northrhine-Westfalia ATKIS is only the beginning of the digital world. More digital results will follow or are available already, for example the raster data for our topographic maps 1:50 000, 1:100 000 and 1:250 000. We are just beginning with a concept to scan the analog German Basic Map 1:5 000. Doing this, our orthophoto map 1:5 000 becomes a very important part in our scope of products and consequently, the production line has to be changed from an analog form into a digital one. Especially in Northrhine-Westfalia we have more than 20 years of experience in the production of analog orthophoto maps 1:5 000 including the addition of cartographic supplements. The technical process (Fig. 1) is based on aerophotos 1:13 000 and on the orthoprojector Z 2 of the ZEISS company. We are renewing the sheets of the orthophoto map 1:5 000 every 6 years (Fig. 2) which can be seen by

the production rate: 1500 maps/year (2x2 km). This 6-year-term is based on close cooperation among all surveying and mapping administrations of Northrhine-Westfalia. Remarkable about this updating-program is the high number of revision sections.

Analogue producing of orthophoto maps

German Basic Map series 1:5000



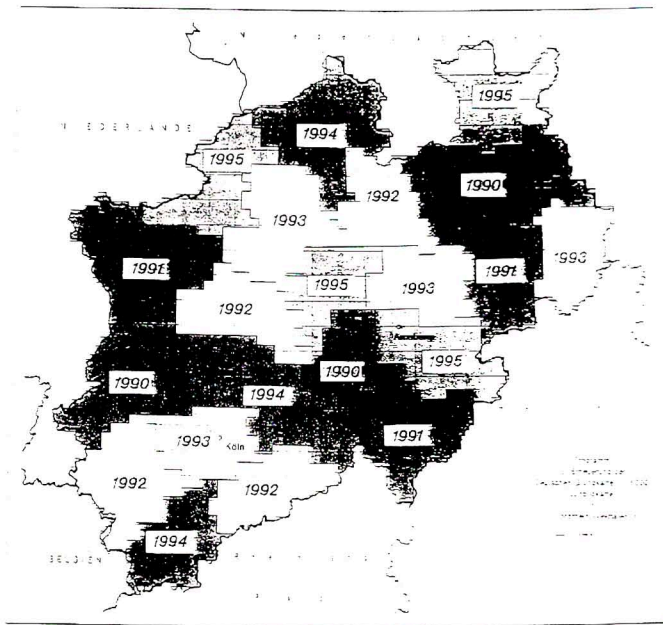
Photogrammetric tasks

- data input
- data control
- interior and exterior orientation
- rectification and exposure
- printing sheet corners and text

Cartographic and reproduction tasks

Fig. 1

Program for renewing the Orthophotomap 1:5000
in Northrhine-Westfalia



Footnote: The first renewing program applies
to the years 1978 - 1983
1984 - 1989
1990 - 1995

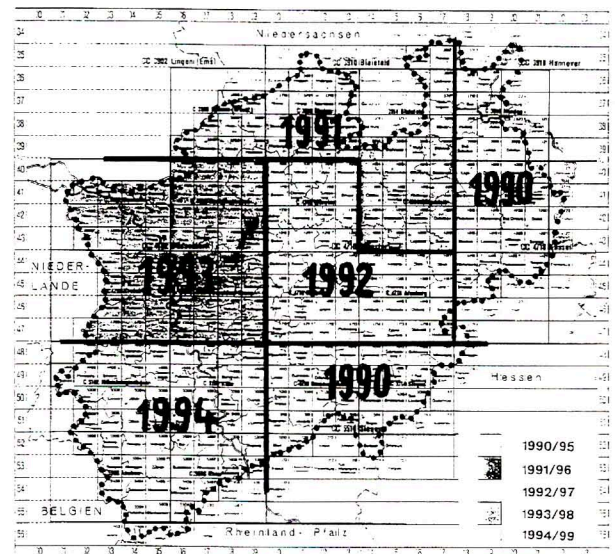
Fig. 2

In the future we have to change from a 6-year to a 5-year-program, because we want to be on the same level as our updating program for the topographic map 1:25 000 (Fig. 3) (ATKIS provides the content of the map 1:25 000 based on the geometry of the Basic Scale Map 1:5 000.) This guarantees better organizational and technical prerequisites for the use of the digital orthophoto map for the ATKIS-project.

Which were our considerations to change the analog production method of the orthophotos 1:5 000 into a digital one (Fig. 4)? Our main goal is to evaluate the original aerophoto more economically by using digital means. This is not only useful for ourselves, but also for our users. In Northrhine-Westfalia we realized a growing demand for digital topographic information. Especially the aerophoto is a very important and effective means to get a lot of information of large areas in a short time.

In 1990 we bought an image processing system named "SIGNUM IS 200" which enables very fast data transfer between the interactive work-station and the real-time-disk. Just some weeks ago we got the second modul of our system: a CCD-scanner for evaluating orthophotos including a DAT-Archive-system. So we only need a last, third modul of the system: the recorder (Fig. 5) to get an output of the data in analog form. Some users, e.g. the 54 cadastral offices, will need an analog output for reproduction purposes besides the digital one.

Revision program for the
Topographic Map Series 1:25 000



Projected program for renewing the Digital Orthophotomap 1:5000 in harmony
with the revision program of the Topographic Map Series 1:25 000

Fig. 3

Reasons for the conversion of the orthophotomap
production from analogue to digital processing

Technical possibilities

- rather quick and simple quality improvement of digital image data with respect to standardization demands throughout the country (e.g. radiometric quality)
- essentially more economical methods of image manipulation with respect to the exchange of image sections (e.g. neutralization of military areas) and addition of semantic information (e.g. lettering)
- automated extraction of topographical information from aerial photographs (e.g. by pattern recognition)
- progressive installation and periodical renewing of topographical data bases
- derivation of analogue orthophoto-mapsheets 1:5000 and in different scales
- direct manipulation of other original image data (e.g. remote sensing data)

Use of image data

- delivery of topographical information in a digital form to the user
- background-information on display units
- digital spatial reference system for special functional data bases

Fig. 4

Digital producing of orthophoto maps

Hardware configuration

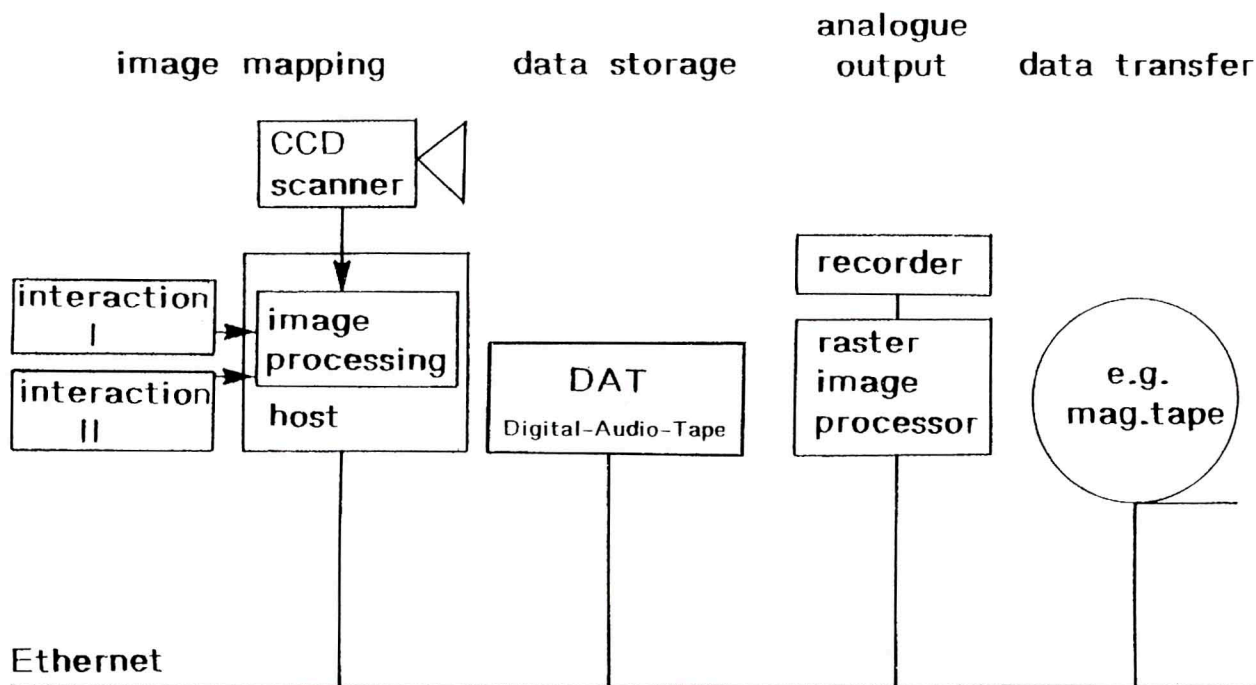


Fig. 5

The above mentioned fast data transfer between the workstation and the real-time-disk is necessary to produce around 1800 maps/year which is the rate of our production program. During this process the original orthophoto data will be transferred radiometrically to one standard and in case of certain defense objects parts of the orthophotos are neutralized.

First the digital production line will only deal with the imagery, later on semantic data and the geodetic grid will be added (Fig. 6). The goal is to achieve optimal dataflow by clearly defined interfaces. As soon as we will have all three moduls (processor, scanner recorder) available, we hopefully will be able to start the production of digital orthophotos in 1992.

The data of digital orthophotos are the major source for our updating activities of ATKIS. This will be an important step for the development of a fully automatical process, because all data will be available in a standardized format throughout the whole country. (Fig. 7). As already mentioned we will cover 1/5 of our country by the yearly production of digital photo-maps. Besides we have to look for other information sources to achieve a continu-

ous dataflow into our digital situation model. In order to discuss all arising problems we defined a working-group in the agency to work out solutions for the present and the near future.

Production process of the Digital Orthophotomap 1:5000
(German Basic Map series 1:5000)

1. step

- scanning of aerial photographs, resolution 0,25µ
- preparation of control points, orientation parameters, DTM

2. step

- digital image processing
 - . interaction (radiometric adjustment and neutralizing of military areas)
 - . batch-processing, (geometric rectification)
- mosaicking within the area of overlapping margins of aerial photographs
- Cutting-out of storage units according to UTM-grid lines

3. step

- Storing of image data with DAT-archive-system and delivery in case of need

4. step

- fair drawing of map sheets by recorder; inner and marginal lettering is added by analogue cartographic methods
- It is projected, that later on the lettering and the map frame will be added automatically by digital methods.

Fig. 6

**The position of the Digital Orthophotomap 1:5000
with regard to up-dating the ATKIS**

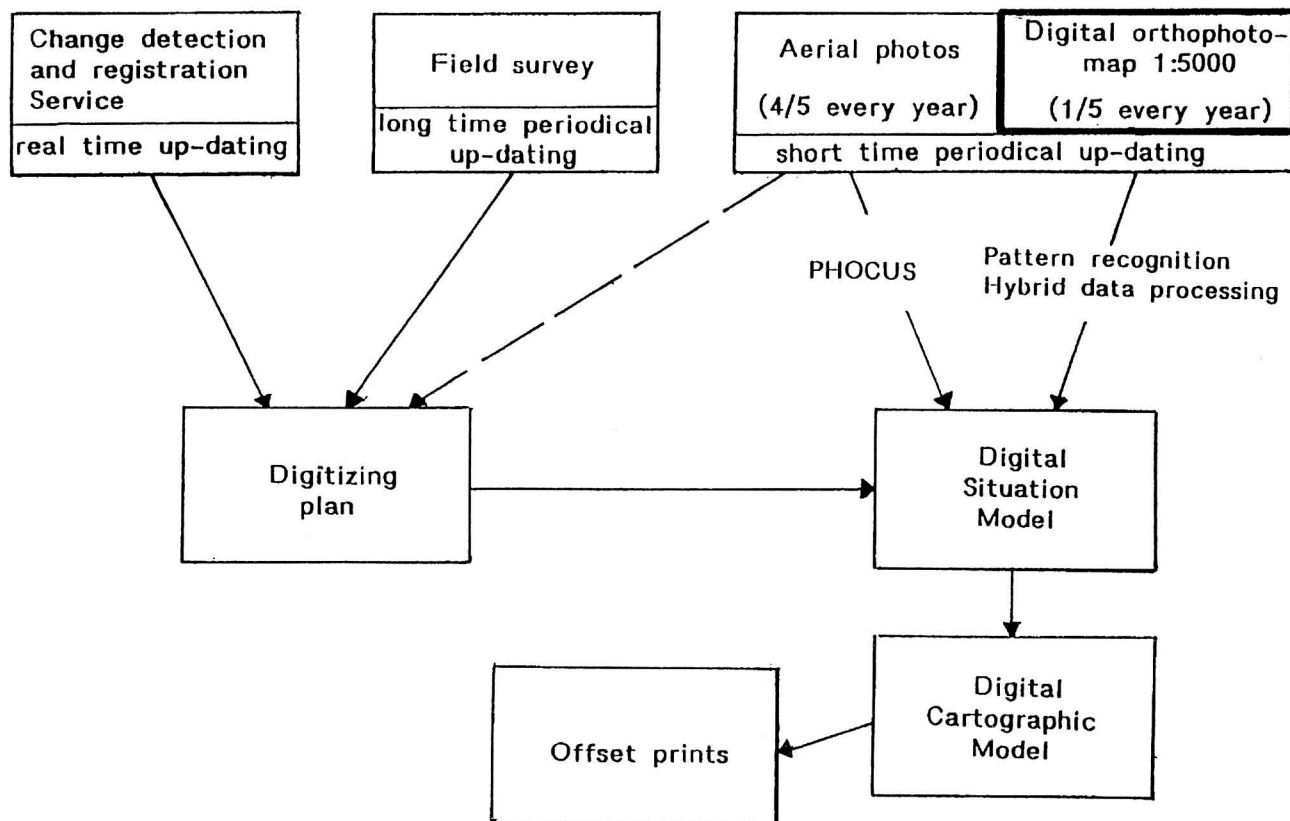


Fig. 7

In the beginning the further use of orthophoto data will mostly be done by manual methods. We plan to merge ATKIS-vector-data with orthophoto-raster-data directly on the screen. Our goal is to analyse the changings, to define the new objects and to take these objects into the data base by interactive methods. At present it may be more effective to analyse the changings by comparing analog aerophotos with plots from the data base, because it is uneconomic to look for these changings by means of a rather expensive system. On the other hand we hope to have a more skillfull software some day, which improves the projected method mentioned above. This proceedings seems to be the most efficient and economical way to introduce the new method.

The Surveying and Mapping Agency of Northrhine-Westfalia will focus their activities on cooperation with other institutions in the next years. We hope to get useful ideas and succeed in finding more and more fully automatical working procedures. Only in this way it is possible to change from a manual production line to an automatical one.

We are sure, for example, that the statistical methods for doing land classification now is not good enough to get exact and reliable topographical information to take over

into our data base. We need a better reliability by observing more exactly and by a high-accuracy data aquisition. High priority must be guaranteed for the dataflow between the satellite and the ground segment. There are some very promising solutions, including earth observations by cameras, especially by stereo-cameras. Only this can provide a 3-D-model necessary for many applications to solve 3rd-world problems. To use cameras is the only way to minimize the necessary, very expensive field works.

Last but not least; I want to mention the problems in comparing old new digital data. We are looking for assistance in using pattern recognition. We need help to install artificial intelligence in our daily work, which is a must to guarantee continuous up-dating. Our data to be obsolete is one of the most frequent reproaches of our clients.

The surveying and mapping agencies would be grateful to get support of research and development. Only the cooperation between the scientist, industry and responsible agencies can realize a useful actual information system for all ground-related data and this not only for parts of Germany but for the whole of Europe.