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PATTERN RECOGNITION AND IMAGE PROCESSING REPORT OF WORKING
GROUP III-5

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ABSTRACT

An account of the activities, plans and problems of ISP(RS)-WG III/5 is presented, along with a scenario for the role that pattern recognition and image processing can play in future photogrammetric work.

1. WG III-5 ACTIVITIES

1.1 Formation of the WG

The WG III-5 was formed at the Congress of ISP in Hamburg on the basis of a resolution of Commission III to stimulate work in the area of "mathematical aspects of pattern recognition and image processing". The author of this article was appointed as the chairman of the working group.

The first problem was a definition of the areas of work for which this WG was to be active. The difficulty here was and is the fact that in a "gold-rush" type of interest in digital image processing there are numerous groups in various commissions of ISP that deal with similar topics. The time has not yet passed to give clearer perspectives at the various specialties that are developing around digital techniques of processing images. A direct and immediately felt problem was to avoid excessive overlaps with WG III-4 on geometric aspects of image processing.

Lengthy exchanges of proposals have, however, led to a somewhat meaningful dividing line between WG III-4 and 5. The terms of reference for WG III-5 have been defined.

The main and most obvious problem of the WG is the fact that the fields of pattern recognition and image processing per se, thus excluding geometric aspects, still are strange birds to photogrammetrists. On the other hand, the fields of pattern recognition and image processing are establishing themselves as separate academic disciplines within computer science; very little interests exist in these groups for photogrammetrists, except when geometric aspects are addressed.

Although it is the firm belief of this author that pattern recognition and image processing are of enormous significance to photogrammetry there is little to show for it in the work of the WG III-5.

1.2 Terms of References at Working Group III-5

There is a broad spectrum of pattern recognition topics of relevance to photogrammetry and remote sensing. However, it would be futile to establish a complete list of pattern recognition tasks of interest, since there is no set limit. The following is therefore only meant to be a list of samples of representative items:

- Image enhancements
 - Spatial transforms, logical array operators, density requantisation etc;
- Image data compression and coding
 - Coding techniques for single images (run length, bit levels etc), principal components and other transforms of multiple images, color coding;
- Classification and clustering
 - Unlabeled clustering, area and volume counts, supervised classification, use of spectral and other object parameters;
- Spatial feature recognition
 - Line following, mask-matching, map guidance;
- Change quantisation
 - Multi-temporal image analysis;
- Analysis of binary images
 - Raster-to-line conversion, vectorization;
- Use of image analysis techniques with non-image data
 - Digital height data processed with image processing methods;
- Digital processing of synthetic aperture radar signal histories;
- Image based digital information systems
 - Combined analysis of images and vector data;
- Computer science aspects of image processing mathematics
 - Classes of systems, data structures, parallel processing;
- Generation of synthetic images
 - This may appropriately be computer graphics, but has relations to pattern recognition and image analysis problems.

1.3 Activities

An initial attempt was made to generate interest in the WG III-5 by mailing out than 120 invitations to participate in some form. Both photogrammetrists and experts of pattern recognition/image processing were addressed. The result was disappointing; this is reflected in the number of papers submitted on the topics of the terms of reference at this symposium.

The failure to generate more interest has led to a lack of short-term, informal WG-work-shops during the reporting period 1980-1982.

2. WG III-5 PLANS

The WG should draw from interest in two fields, namely pattern recognition and photogrammetry. This presents peculiar difficulties because of a clearly interdisciplinary character of the WG.

To overcome that problem a work-shop is planned to be held in Graz, Austria, from 10 to 12 October 1983, on the topic of "Potentials of Digital Pattern Recognition in Photogrammetry". This will be organized around a few selected topics such that both pattern recognition and photogrammetric experts can be motivated to participate.

Potential topics of emphasis could be

- (a) Knowledge-based image analysis
(image-map correspondence; image-based information systems, interpretation assistants etc.!)
- (b) Reconstruction of object shape
(stereo correlation, similarity detection, shape from shading, data structures etc.)
- (c) Raster-to-vector conversion
(line following, segmentation, vectorisation, natural and non-natural images etc.).
- (d) Image simulation.

The detailed selection of topics is planned to be done during this Commission III-symposium and a WG-meeting at the occasion of the 6th Congress of the International Association for Pattern Recognition (IAPR) in Munich, 22-26 October 1982.

Further plans of WG-activities will depend on the result of the 1983-work-shop. But it should be considered that pattern recognition is an emerging field with potentially enormous effects on photogrammetry. Therefore the role of WG III-5 should be seen in a larger perspective

than other WG's that are oriented towards more short lived topics of momentary interest.

3. PATTERN RECOGNITION AND IMAGE PROCESSING IN PHOTOGRAMMETRY

3.1 Pattern Recognition

One must observe that authors, conferences and journals in pattern recognition and image processing are developing there own "photogrammetry" with digital images. The extraction of information from digital images is considered there to be a topic of pattern recognition, along with the extraction of information from other data.

Pattern recognition is defined, e.g. by Niemann *) as the discipline of processing and interpreting simple and complex patterns. A simple pattern is for example a letter, a complex pattern is a word composed of letters. Images are just one source of data to which this is applied. Others include handwriting, speech etc.

Within the area of pattern recognition in images several specialisations are developing that are of great concern to photogrammetry, such as image sequence analysis; shape determination; knowledge-based image classification and analysis. Generally this is entirely in the realm of computer science with little or no reference to photogrammetry which is seen to be entirely in the area of topographic mapping.

3.2 A View at Future Photogrameters

(a) Hardware

It is only since the end of the '70s that the computer has successfully penetrated into work with pictorial and graphical data. Vector-type displays and processors have become accessible to the common applications; raster data displays and processing is also progressing towards wide distribution; yearly growth rates in the hard- and software fields are unparalleled. Storage media are increasing their capacities at great strides: there are expectations that current video disc technology will ultimately not only be available for reading but also for on-site writing. This will allow to read/write and to store many digital photographs on one disc.

Also computer output devices are rapidly progressing to a state where they are well-suited to present results of photogrammetric and remote sensing work, including

*) Niemann H. (1981) Pattern Recognition. Arbeitsberichte der Inst. fuer math. Maschinen und Datenverarbeitung, Univ. Erlangen, Vol. 14, Nr. 1

filmwriters, color matrix printers, color electrostatic plotters (to be available soon). Interactive work stations increasingly enable one to operate on digital vector and raster type graphical and image data.

In the area of data acquisition one already has today digital cameras for close-range and industrial applications. Developments are ongoing to create the digital airborne and spaceborne camera.

In this context one may well expect that the analog frame camera will not necessarily be replaced by the digital frame camera, but by a hybrid frame-strip device, such as that proposed by Derenyi (1970) *), discussed for the MAPSAT-proposal and in the digital camera development of Messerschmitt-Boelkow-Blohm (MBB) in Munich: three image lines are generated at one time corresponding to the left and right edge of a frame camera and of a parallel line through the principal point.

This system, together with new techniques of sensor stabilisation, may well be the digital successor to the analog film camera.

(b) Photogrammetric Methods

These hardware prospects lend themselves to a consideration of developments in the domain of image analysis. Given the expectation that maps will be complemented or replaced by digital geo-information data bases, an interest in computer-supported image analysis and in pictorial information systems is an obvious consequence.

Possible consequences may be in the all-digital orthophoto; image-map correspondence comparing a digital map or the contents of a geo-information system with a digital image; image-image correspondence for stereo correlation, image merging, geometric rectification etc. The potential exists of a total change of the photogrammetric tool-kit and the products of photogrammetric work.

This potential for the future is complemented by more current thematic mapping tasks in remote sensing. Multi-sensor, -spatial, -position and -temporal image sets are increasingly the object of intense study for thematic mapping efforts. There is a wide variety of mathematical problems that need to be mastered: image registration, classification, rectification, image - DHM correspondence etc. A semi-operational use of these techniques is currently merely in the framework of scientific studies;

*) Derenyi E. (1970) An Exploratory Investigation into Relative Orientation of Continuous Strip Imagery. Ph.D. Thesis, Report No. 8, Univ. of New Brunswick, Fredericton, Canada.

this reflects the overall situation of remote sensing.

4. CONCLUSION

Among photogrammetrists the current interest in the area of pattern recognition is limited. This situation is unchanged since previous photogrammetric meetings in the framework of ISP. The topic may thus seem peripheral at this time when compared to classical problems such as aerial triangulation and adjustment theory.

However, the digital techniques with sensors, storage devices, soft copy displays and hard copy printer/plotters combine with the theories and algorithms of pattern recognition to a promise for an enhanced future of photogrammetry if its role is maintained in a development where computer science penetrates all engineering fields.