THE LOW COST REMOTE SENSING SYSTEM "LARSS" FOR ENVIRONMENTAL MONITORING AND PHOTOGRAMMETRIC APPLICATIONS

H. Rüdenauer
University of Essen
Germany

Commission I, Working Group I / 2

KEY WORDS: Scanner, Video, Environmental Monitoring, Low Cost Remote Sensing System

ABSTRACT:

Airborne Remote Sensing Platforms are highly developed and expensive systems to meet all the different requirements of the users as for spectral bands, resolution and geometric accuracy.
With those systems data and images of large areas can be obtained in a short time. For smaller projects - for example in the field of environmental monitoring or large scale mapping for construction purposes, where actual information is needed - a inconcruity between the cost of the airborne mission and the volume of the project can arise.
The platform is for use on unmodified light fixed wing aircrafts (Cessna 172) which means a considerable cost reduction. Different sensors (photographic and digital) ca be used simultaniously. The main attention directs to the test of multiband videosystems and to the data analysis of a prototype color line scanner.
The development of the new platform took place in the background of the availability of PC based digital processing systems (softcopy photogrammetry) and photogrammetric image scanners at a moderate price.
The aim of the complete system is to make airborne photography, photogrammetry and remote sensing available to smaller projects which could not afford these technics before.

1. INTRODUCTION

Photogrammetry and remote sensing have penetrated into a lot of disciplines in the near past. this may be because of the availability of images which fit the interests of these disciplines (e. g. satellite images) or because of the improved flexibility and affordability of the processing tools (analytical plotters, digital image processing systems).

With the future "reduction" of photogrammetry to a "program package" in conjunction with standard computer equipment (digital photogrammetry) the spreading of photogrammetric and remote sensing methods will continue ("democratization of photogrammetry" (Leberl, 1992)).

In this trend of "photogrammetry for everybody" fits very well a simplified low cost sensor platform for individual applications by new user groups.

To avoid special modified aircrafts, the camera format has to be reduced, which means the application of 70 mm cameras. Other sensors (video, multispectral, thermal cameras, scanners) are also possible.

The use of 70 mm cameras is not new of course. A lot of articles from the 60 th and 70 th can be found (mostly U.S: Ulliman,1970, Marlar,1967, Woodcock, 1976), some actual activities in Germany (Martin, 1990). Most of the actual contributions deal with video systems (Everitt, 1990, Hutchinson, 1990).

What is new is the availability of a complete system of simplified photogrammetry as mentioned before together with an increasing demand for image information from new user groups.

2. REQUIREMENTS TO THE SYSTEM

2.1 Platform Requirements

The requirements to the platform design can be divided into two groups: the first group stands for the cost effectiveness, the second group for the performance:

a. - independence of a special aircraft
   - optimized and adapted for an aircraft type because of a stable mounting without influenceing the aerodynamic conditions.

b. - platform correction and control for vertical images
   - navigation system (video and GPS controlled)
   - camera control (pin point) and registration of projection centres
   - simultanious data collection with different sensors

2.2 Sensor Systems

2.2.1 Photographic Camera System: The mainly used sensors are 70 mm photographic cameras. Some of them are modified by the manufacturer as metric cameras with calibrated lenses, reseau correction or vacuum equipment. Aerial film types are available in black and white, color and infrared.

The image size (56 x 56 mm), compared with the standard aerial camera format (9 x 9 inch) restricts the range of application to "local" projects because of the number of images.

2.2.2 Video System: The simultaniously used CCD video camera has three tasks: 1.: visual navigation and drift correction, 2.: control of the 70 mm image and its overlap, 3.: recording of video images as an independent product.

The recording format as well as the choice between analogue or digital recording is a question of cost and has to be decided individually according to the requested image quality of the video frames.

Up to four video cameras can be mounted on the platform for multispectral videography. The actual video system is a two camera system with a RGB three chip camera and a monochrome camera for near infrared connected with an industrial PC.

2.2.3 Color Line Scanner: The examined color line scanner is a prototype developed by the Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven and the Technical College, Bremen (Bochert, 1994).

This scanner system consists of three linear array sensors (2048 pixels) in the visible area with a maximum scanning rate of 100 lines / sec. The image information is converted to digital data in the camera with an output to a SCSI Dat - streamer.

As all parts of the scanner are standard products from the shelf, the system can be manufactured at very low cost.

The first test of the line scanner was performed by the AWI in 1995 during an Arctic campaign for investigation of the relationship between sea ice and climate.

A test data set is at the moment under examination to evaluate the quality of the images in regard to use the scanner on the described platform for environmental monitoring projects and related fields.

2.2.4 Additional Sensors (Thermal Sensors): For the spectral bands of thermal infrared (3 - 5um and 8 - 14 um), compact cameras with high resolution focal plane arrays (256 x 256) and digital and analogue data exit are available. So thermal aquisition of terrain or water surfaces (e.g. waste deposits) will be possible at good value.

2.3 Data Processing

2.3.1 Softcopy Photogrammetry: The standard evaluation system for aerial photography with any camera and orientation parameters is the analytical plotter. These instruments have reached a relatively big amount of popularity in the past 15 years.

Digital systems however, based on Personal Computers can reduce the system costs in a considerable way because only the software is still a special photogrammetric tool as already mentioned.

First experiments were made with a PC based digital stereo system where the photogrammetric evaluation software is completely embedded in a CAD environment.

The second application on the same system is orthophotography. Combined with automatically generated DEM´s, in many cases this technic can reduce the threedimensional extraction of vectors by an operator to a twodimensional task. This will be welcome by a lot of new users.

2.3.2 Precision Image Scanning: The first step into digital photogrammetry with analogue images is the digitizing process. This is at the moment the bottle neck in introducing low cost digital photogrammetric systems because there are no really satisfying scanners with high resolution (pixel size < 15 um) and high geometric stability for a suitable price. The minimum cost for PC based precision scanners is at present about US$ 40.000. This can mean a cost doubling of the complete system. An interim solution could be to use professional scanning services.

3. FINAL REMARKS

With the background of new fields of applications and especially the demand of photogrammetric and remote sensing technics for local projects, a low cost system for data aquisition and data processing using digital components lets present itself in a new light. The author hopes with this contribution that photogrammetry and remote sensing will be a more common technic in the future.

4. REFERENCES

A. Bochert, C. Wamser, " New Airborne Line Scanner Systems for High Resolution Sea Ice Observation", The Global Athmosphere and Ocean System, Vol. 2, pp 247 - 251, 1994.

J. H. Everitt, K. Lulla, D. E. Escobar, A. J. Richardson, "Aerospace Video Imaging Systems for Rangeland Management", Photogrammetric Engineering and Remote Sensing,Vol. 56, No. 3, pp. 343- 349, March 1990.

C. F. Hutchinson, R. A. Schowengerdt, "A Two - Channel Multiplex Video Remote Sensing System", Photogrammetric Engineering and Remote Sensing, Vol. 56, No. 8, pp. 1125 - 1128, August 1990.

F. W. Leberl, "Towards a new Photogrammetry?", ZPF - Zeitschrift für Photogrammetrie und Fernerkundung, Heft 1, pp. 9 - 12, 1992.

T. L. Marlar, J. N. Rinker, "A Small Four - Camera System for Multi - Emulsion Studies", Photogrammetric Engineering, p. 1252, 1967.

K. Martin, W. Robl, "Die Verwendung mittelformatiger Senkrechtluftbilder in Forst- und Umweltplanung", ZPF - Zeitschrift für Photogrammetrie und Fernerkundung, Heft 5, pp. 149 - 153, 1990.

J. J. Ulliman, R. P. Latham, M. P. Meyer, "70 mm Quadricamera System", Photogrammetric Engineering, pp. 49 - 54, 1970.

W. E. Woodcock, "Aerial Reconnaisance and Photogrammetry with Small Cameras", Photogrammetric Engineering and Remote Sensing, Vol. 42, No. 4, pp. 503 - 511, April 1976.