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AUTOMATIC PROCESSING OF COMPUTER COMPATIBLE TAPES WITH DATA FROM AIRBORNE MULTISPECTRAL SCANNERS

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I. ABSTRACT

In the following pages, an overview about the Airborne Modular Multiband Scanner (SAMPOI) used by the Comisión Nacional de Investigaciones Espaciales (National Commission on Space Research) will be developed.

With this system aerial surveys, mainly for Pollution studies, are carried out.

The purpose of this paper is to comment about a Remote Sensing Data Acquisition System and its Digital processing features.

II. DESCRIPTION OF THE AIRBORNE MODULAR MULTIBAND SCANNER OF THE COMISION NACIONAL DE INVESTIGACIONES ESPACIALES

The SAMPOI (Sistema Aéreo Multiespectral para Obtención de Información-Airborne Modular Multiband Scanner) is the Spanish acronym for the multispectral scanner which the Comisión Nacional de Investigaciones Espaciales of Argentina acquired from Bendix Aerospatial Systems Division.

A. TECHNICAL DESCRIPTION

It is a scanner system which uses analog-digital conversion in order to record data in high density digital tapes. These data will be processed afterwards in a digital processing system, (STAI).

The system is installed on a turbopropelled GUARANI II aircraft, made in Argentina, mounted on a drift correction plate. The system collects analog data from the terrain as spatial energy.

The FOV incoming spectral energy is reflected by the scan mirror on a flat mirror and is directed towards the Dall-Kirkham telescope, in two different ways, one for the visible spectrometer and another for the infrared spectrometer.

The telescope focuses spectral energy on the opening providing a 2.5 milliradians IFOV.

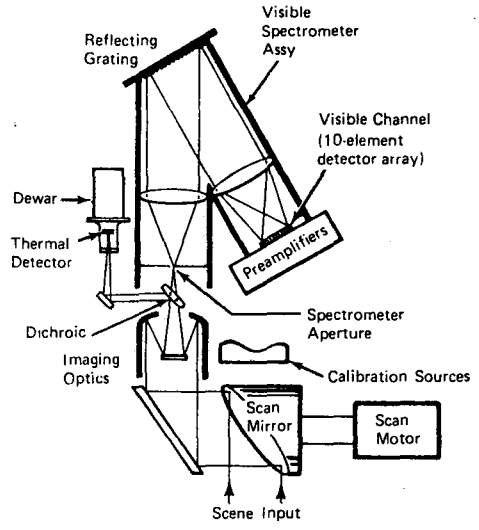


FIG. 1 - SIMPLIFIED BLOCK DIAGRAM. (SAMPOI)-OPTICS.

The data obtained from the successive scan lines are digitally converted and recorded on HDDTs on the aircraft.

The system has 9 channels of which 8 belong to the visible and near infrared regions (.38 to 1.08 microns), using silicon detectors. For channel 9 a thermal detector is used, with a spectral response from 9 to 12 microns; it is installed on an independent spectrometer and is refrigerated by liquid nitrogen.

B. SPECIFICATIONS (Summary)

Scan Unit

(1) Scan Mirror: (45 degrees) Rotating Optical

(flat 4 inches diameter).

(2) Collecting Optics: Dall-Kirkham telescope, 65 cm^2. Focal length: 40.2 cm

(3) Scan Speed: 10 to 100 lines/sec (continuously variable)

(4) Field of View (FOV): ≅ 100 degrees

(5) Instantaneous Field of View (IFOV): 2.5 mr

(6) Roll Compensation: ± 10 degrees

(7) V/H: Variable from .025 (10 sps) to .25 (100 sps)

(8) Spectral Bands

Band N°	Spectral Interval (Microns)
1	0.38 to 0.44
2	0.46 to 0.52
3	0.53 to 0.59
4	0.60 to 0.66
5	0.67 to 0.74
6	0.75 to 0.83
7	0.86 to 0.94
8	0.97 to 1.08
9	8 to 12

(9) Channel Detectors:

- visible (1 through 8), silicon
- thermal, Hg Cd Te array (9 through 12)μ

Electronics

(1) Digitizing Level: 8 bits

(2) Output modulation: Bit Phase L

(3) Bit Packing Density: ≅ 10,000 bits/inch

C. MAIN COMPONENTS (SAMPOI)

- Scan Unit, formed by scanner head, spectrometers, calibration sources (visible and infrared)
- Digital Electronics
- Video Electronics
- Tape Recorder
- Gyro

We intend to modify the original spectrometer in order to develop a 3-band multiple detector head, cooled by a liquid nitrogen deware, which should be interchangeable with the thermal detector, based upon the old closed cicle cooled 3 bands detector.

The final distribution will have band 1 through 8, already mentioned, plus:

Band N°	Spectral Interval (Microns)
9	1.60 to 1.80
10	2.10 to 2.30
11	8 to 12

The latter bands are very close to the thematic mapper bands N° 5, N° 7 and N° 6, respectively.

III - APPROXIMATE SCALE OF SAMPOI IMAGES DISPLAYED ON THE MOVING WINDOW DISPLAY (MWD) OF THE STAI

The SAMPOI Field of View (FOV) is of 100 degrees. In accordance with Figure 2 the following is obtained:

$$\text{tg } 50° = \frac{\frac{x}{2}}{h}$$

$$x = 2 \text{ tg } 50° \cdot h$$

$$\text{tg } 50° = 1{,}19175$$

$$x = 2 \cdot 1{,}19175 \cdot h$$

$$\boxed{x = 2{,}3835 \cdot h}$$

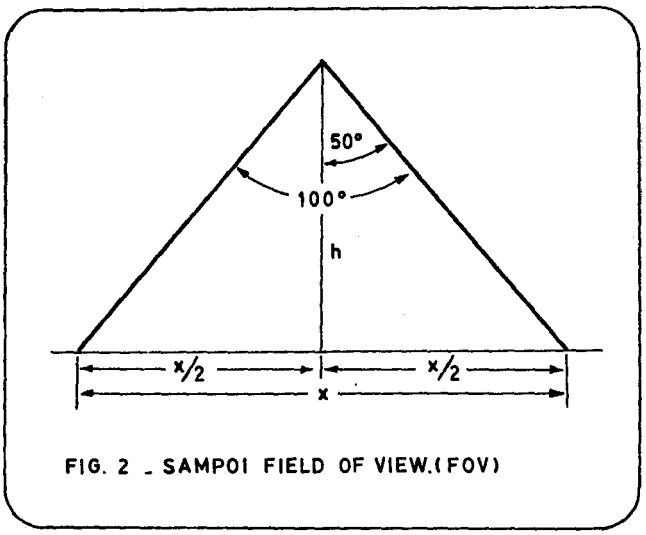


FIG. 2 - SAMPOI FIELD OF VIEW.(FOV)

Where,

Aircraft x = ground line width
h = aircraft altitude from ground

The ground element distance sample (b) will be:

$$b = \frac{x}{803} = \frac{2{,}3835}{803} \cdot h = 0{,}0029682 \cdot h$$

Or,

$$\boxed{b(\text{meters}) = 2{,}9682 \cdot h(\text{kilometers})}$$

The input scan lines contain more "pixels" than can be displayed and it would be possible to display only 472 elements (of the 803 total elements) taken from the beginning or the end of the scan line.

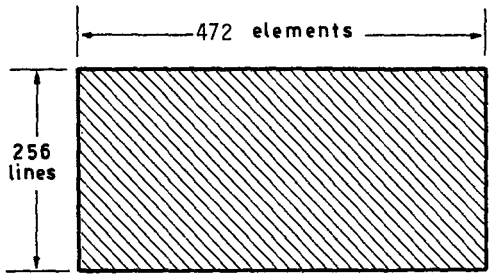


FIG. 3 - DISPLAY DISTRIBUTION IN LINES PER ELEMENTS.

The approximate ground size coverage per scree is:

Horizontal: $H = 472 \cdot 2{,}9682 \cdot h_{(km)} = 1400h_{(km)}$

Vertical : $V = 256 \cdot 2{,}3825 \cdot h = 610h$

i.e., for, $h = 1$ km

The displayed image size is: 1400 m by 610 m

The aspect relation is: 2,297

$$\frac{H}{V} = 2{,}297$$

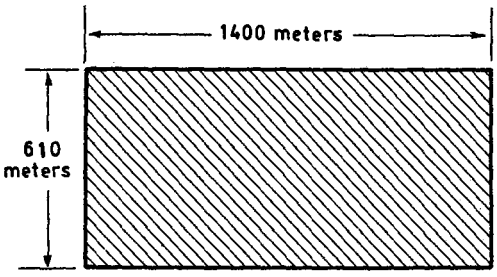


FIG. 4 - APROXIMATE GROUND SIZE COVERAGE PER SCREEN, FOR NON CORRECTED CCT. (h = 1 km)

And, for a 28 cm . 12.2 cm screen image size the approximate display scale will be:

1:5,000 . h (km)

Of course, a photographic copy of the same size will have the same approximate scale.

IV - DISPLAY, PROCESSING AND CCT CONVERSION OF HIGH DENSITY DIGITAL TAPES (HDDT) RECORDED WITH THE SAMPOI

A detailed description can be found in the paper printed in the Proceedings of the Machine Processing of Remotely Sensed Data (June3-1980), Purdue University), presented by Eng. Norberto SCQUIZZATO.

A. DESCRIPTION

STAI is the Spanish acronym for the digital analysis system for information processing from multispectral sensors of LANDSAT satellites, or, from the Multispectral Multiband Scanner System (SAMPOI) which the Comisión Nacional de Investigaciones Espaciales has installed at the Vicente Ló- Remote Sensing Center.

The STAI can be included among the digital processing systems called as interactive, having a great input and output diversification, but also having preprocessing capacity since it can convert HDDTs, High Density Digital Tapes, from the SAMPOI Scanner, into CCTs, Computer Compatible Tapes.

The main operating system has special programs for the SAMPOI scanner. They are as follows:

- L1: 4 - SAMPOI CC tape display
- L1: 6 - SAMPOI aircraft, video tape display
- L1: 7 - SAMPOI aircraft, video tape conversion
- L1:16 - SAMPOI categorical processor

By means of the L1:6 file the STAI allows to display, directly from the HDDT at $7\frac{1}{2}$ ips, and to record simultaneously a black and white strip for one channel with "S" correction.

The primary function of this mode is to input SAMPOI HDDT data to computer memory and exhibit this data on the display.

The operator may carry out color assignments which are sampled at the input and may change them at any time. The display may be chosen as color slice of one channel or false color, by operator's selection of 3 channels.

The operator may hold the command during run, causing the display to become stationary, thus being able to photograph the displayed imagery.

The L1:7 file is used to convert HDDT tapes into CCTs. All channels on the HDDT are transferred to the CCT.

V - DISPLAY AND PROCESSING OF SAMPOI CCTS OBTAINED WITH L1:4 PROGRAM

A SAMPOI scan line is formed by 803 elements or "pixels". This format is approximately the same than a quarter of LANDSAT image strip line, of the former NASA format; its only difference is the quantity of available channels.

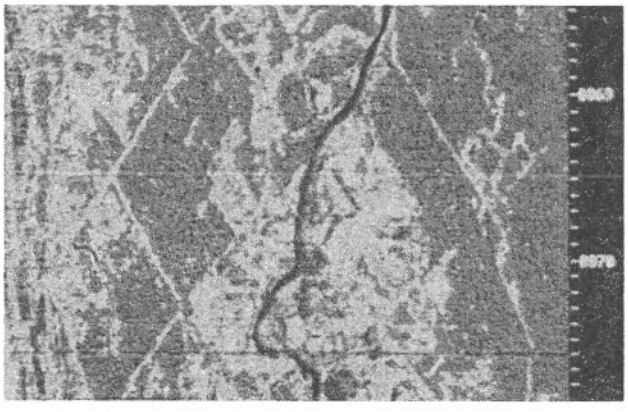
SAMPOI CCTs may be displayed in the same way as a LANDSAT strip; i.e., over a STAI video terminal having a refresh memory size of 512 elements (of which 472 are available for video data) per 256 lines.

It is possible to introduce training sets for supervised classification, once the former step is achieved, and by means of a rectangular cursor.

VI - CONCLUSIONS

Some surveys of the Río Paraná Area and of the Valle Inferior del Río Chubut (Province of Chubut, Argentina) have been carried out with the SAMPOI System.

The obtained HDDT tapes were processed through the STAI System and an image is enclosed in this paper as example. This image belongs to the processed bands obtained directly with the TV Monitor.



Norberto Scquizzato was born in Buenos Aires, Argentina. He received the degree in telecommunication engineering from the National University of La Plata in 1971. He worked for 5 years in the Remote Sensing Group of the State Secretariat of Agriculture and Livestock (Secretaría de Estado de Agricultura y Ganadería) of Argentina. In 1974, he attended several courses held in different Educational Centers of U.S.A. At present, he is a staff member of the Comisión Nacional de Investigaciones Espaciales and a member of the Faculty of the National Technological University of Buenos Aires.

Sigfredo F. Pagel was born in Buenos Aires, Argentina. He received the degree in Telecommunication Engineering from the National University of La Plata. He worked in the Teledetection area of the State Secretariat of Agriculture and Livestock (Secretaría de Estado de Agricultura y Ganadería). He attended several courses in different Technical Institution in U.S.A. At present, he is Head of the Research and Applications Department of Remote Sensing of the Comisión Nacional de Investigaciones Espaciales. Also, he is a professor at the National Technological University of Buenos Aires.