REPORT OF ISPRS WORKING GROUP II/3
INSTRUMENTS FOR ANALYSIS OF REMOTELY SENSED DATA

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COMMISSION II

INTRODUCTION

In 1981 the former WG II/4 was reconstituted into two groups, II/3 - Instruments for Processing and Analysis of Remotely Sensed Data, and II/4 - Instruments for Processing, Storage, and Dissemination of Remotely Sensed Data. Concurrently, the areas of interest were divided. WG II/3 will be concerned with the systems, components, devices, and configurations of hardware and software for analysis. Primary consideration will be on digital analysis because of the importance of this analysis method, although optical or other processing will be included as appropriate.

Accordingly, the topics of interest are listed below. The breakdown is slightly different than that reported in the 1982 Commission II Symposium. A major emphasis will be on remotely sensed images, representing the growing importance and technological requirements of that data source.

TOPICS OF INTEREST TO WG II/3

1. <u>Systems</u>

A. Large, Multi-user Systems

These are characterized by being "facility" systems, serving many users, containing multiple peripherals, multiple terminals and networking capabilities. Included are image analysis systems which are intended to be served by host computers, and the various computer architecture approaches.

i. System Architecture
ii. Parallel and Array Processors; Processor Architectures
iii. System Software - Modular Techniques, Interfaces to Users

B. Single User Systems and Workstations

These are characterized by the use of microprocessors, and includes those systems primarily intended for stand-alone use. They may be relatively low cost comapred to mainframe systems, with correspondingly lower capabilities. Storage media typically are floppy disks and "Winchester" style hard disks. The low cost of the microprosessors make special multiprocessor configurations practical, although few multiprocessor systems are yet available.

i. System Architecture - Single and Multiple Processors
ii. Capabilities and Limitation of the Micros
ii. Workstations for Stand-alone Processing

C. Networking and Distributed Systems

Networking as a technology is maturing. The large size of images and the need for interactive display during processing has hindered the networking of image analysis. Of interest are networking between major locations and networking in the local area.

i. Desired Characteristics for Networked Systems
ii. Network Protocols and Image Processing
iii. Local Area Networks for Image Processing
iv. Relation of Networks to Multi-processor Systems

D. Optical and Hybrid Systems

Optical processing will play an important part to many users, ranging from visual analysis in color additive viewers to coherent optical processing and optical-electronic hybrids.

i. Viewers and Optical Visual Aids
ii. Coherent and Incoherent Optical Processing
ii. Hybrid Processing and Optical Devices used with Digital Systems

2. Special Devices

Current developments in two areas - microprocessors and very-large-scale integrated circuits (VLSI) - will make the use of special purpose devices more commonplace in image processing. VLSI will make the construction of special devices possible. Microcomputers and read-only memory will make the connection of these to conventional computers practical. Standardization of some of the algorithms may make such a connection acceptable.

i. Considerations for Special Purpose Peripherals and Co-processors
ii. Conversion of Mathematical Techniques to Hardware Form
iii. VLSI Design Techniques

3. Media Conversion Devices

Remotely sensed data will not be analyzed in vacuuo. Other data types are required in conjunction with the remotely sensed data, and digital processing of film images is required. Conversion of data between the various media is required.

A. Input Devices

Images will be required to be digitized, registration control points must be located, and (particularly for geographic data analysis) maps must be converted to computer-compatible form and registration control points located.

i. Image Scanning and Digital Conversion
ii. Map Conversions - Line Following, Raster Scanning
iii. Geographic Coordinate Reference Point Locations

B. Output Devices

Output hard copy will take several forms, each with its own uses, advantages, and disadvanteges. Interest will be in the capability, functions, and potential uses of the various types of devices.

i. Film Recorders
ii. Paper Hard Copy Printers and Plotters

4. Displays and Computer Graphics

A large amount of analysis of remotely sensed data is interactive image analysis using image monitor displays, with or without overlays of digitsl data planes.

A. Display Techniques

The large size of the desired display images (1024 x 1024 or larger) and the concurrent need for several simultaneous image and data planes place a large burden on memory and interface data rate requirements. A particular requirement for interactive analysis is that there be no interruption during updates.

i. Display Media (CRT, etc.)
ii. Refresh Techniques and Memory Management.
iii. Data Plane Overlay Techniques

B. Interactive Techniques

Interactive analysis typically requires the identification of particular image points, lines, and areas, and often the overlay of various data planes such as masks, maps, and annotation.

i. Light Pen Techniques
ii. Cursor Techniques

C. Human Factors and Man-Machine Interface

Continued attention must be paid to the efficiency of the analyst when interfacing with the computer. Additional factors beyond those normally considered for alphameric or computer graphics display may be important when dealing with image analysis and display.

i. Types of Program Control - Menus, Commands, etc.
ii. Types and Sizes of Displays
iii. Division of Labor between Man and Machine

5. Interfaces

The transfer of data and algorithms may be facilitated by standardization, which is only beginning. Early consideration of standard approaches may avoid much duplicated and non-interchangeable work.

A. Data Interchange

Several activities concerned with the standardization of data interchange formats are underway. The Landsat project is using an interchange format which has been designed to also be more generally applicable. More work and more implementation definitions are needed as new data types are incorporated.

i. Assess the Suitability of the Various Existing Formats
ii. Define Areas Needing Further Work
iii. Consider the Particular Requirements of Geographic Information Systems

B. User-System Interface

Both main frame and terminal systems designers are designing and building systems, with less than possible thought to standardization of the interfaces and to the protocol as seen by the users. These could be coordinated without usurping manufacturers' perogatives.

i. Interactive Terminal Protocols and User Procedures
ii. Terminal-to-system Connections and Software Protocols

C. System-Algorithm Interface

Most modern analysis systems are modular, with the system supervisor calling executable modules for execution. However, the various systems have different methods of calling the modules, passing parameters, and logical and data interfaces. This unnecessarily prevents the easy interchange of modules, and will interfere with sharing of software, networking and distributed systems.

i. Module Calling Methods
ii. Parameter Passing
iii. Logical and Data Interfaces
iv. Interface with Different High Level Languages

SCHEDULE OF ACTIVITIES

The WG has supported two major meetings, the 1982 Commision II Symposium in Ottawa [ISPRS 1982], and a joint meeting with WG II/4 and II/5 at the Nihon University, Tokyo, Japan. Our special thanks go to Professor Tsuchiya of the Chiba University and the organizing committee and to the Remote Sensing Society of Japan for their efforts in holding the Tokyo meeting.

REPORTS OF RELATED ACTIVITIES

It is recognized that most of the active work in the areas of ISPRS WG II/3 interest is done independently of ISPRS. In addition to direct activities such as listed in the above schedule, personnel of the WG are involved in and/or follow the developments of outside activities. Several items of direct interest are listed below.

1. Multispectral Imaging Science Working Groups

The NASA Office of Space Science and Applications has sponsored a series of workshops at which the future remote sensing needs were discussed. The following condensed report from the Information Science Panel [MISWG 1982] was included in more detail in the Commission II 1982 Congress Proceedings.

Systems Design

Flight segment parameters (notably spatial and spectral resolution, revisit interval, and viewing conditions) will be influenced by the analysis desires of the user community. However, this community has little basis on which to decide parameter tradeoffs. What is needed is the development of comprehensive remote sensing research with parameter extents which exceed all likely parameter limits for the near future, with adequate ancillary data.

Technology for Data Handling

Digital geographic information systems are being designed to include remotely sensed data in conjunction with the more conventional geographic data. These systems are each different, designed to serve the developer, with little commonality. The multiplicity of data formats has hindered the use of disparate data in the solution of geographical problems, although the Landsat format family of formats has helped somewhat.

Data co-registration continues to be a central problem, particularly for disparate data, in which the data sets represent different phenomena, and so do not easily correlate. The geometric warping required still represents a major computer commitment.

VLSI techniques are being developed which will greatly speed the design and implementation of (time consuming, using normal software approaches) algorithms in VLSI form. This will allow VLSI to be used in smaller production runs than commercial applications, and thus make these available to the relatively small community of remote sensing users.

Technology for Information Extraction

With the use of many data planes in a given analysis, and the availability of more spectral bands, the data quantities are increasing rapidly for a given analysis. Development of quantitative methods of extracting information are required, as are methods for storage, labeling, addressing, and retrieval of specific data packets upon request by an analyst.

Methods of atmospheric sensing and correction of effects of the atmosphere on other data are required.

With the push for increased resolution of image data, better estimates of the utility of this resolution are needed. This is part of a complete system design tradeoff which is needed for optimum use of the available data photons.

An overriding problem is the mechanics of overlaying and registration of the multiple data sets, including digital versions of cartographic maps. Suitable systems are within the state of the art, but have not been developed because of the lack of the cross-discipline funding required.

2. ACSM National Committee on Digital Cartographic Data Standards

The American Congress on Surveying and Mapping has established a committee to investigate and recommend standards for the interchange of digital cartographic data [ACSM 1984]. Under investigation are about ten existing data formats. The clientele for the standards will be the entire digital cartographic and geographic information systems community, including users of remotely sensed data.

Three major issues have been identified: terminology, modeling and data interchange. The focus of the modeling issue will be interchange modeling; such a model being the framework of the interchange process. The data interchange issue is attested to by the numerous efforts by individual organizations to standardize this process for their own use, and the resultant lack of standardization across the entire community.

Digital cartographic data may be used in at least two ways: 1) analysis in the digital domain; and 2) conversion to conventional map form for display. For the first, the topological information must be specifically included; for the second, the cartographic attributes such as line width, color, symbology, and labels must be included. Unless the use of the digital data is known, both sets of information are required.

A two step process is being considered for the development of a standard interchange format:

1) Define a suitable superstructure surrounding the data which can identify the data source, format, and other ancillary information as required for the translation. This superstructure would be an "envelope" around the data sets as currently being distributed. Recognizing that there are numerous data archives, data bases and data interchange formats in existence, this would not require them to translate the data into some new format. This would not require new software at either the archive or user facilities if data interchange software already exists.

2) Define a new, expandable format family, to work within the superstructure. This would include standard ways of specifying the various data types. Such a solution would closely follow the more popular current formats. With this, define standard ways, such as ANSI X3.61-1978 for Geographic Point Locations, for coding the various elements.

The work of this committee is continuing. Efforts will be made to include international interests as appropriate.

3. Technical Meetings on Computer Architecture for Image Analysis

Although it is not possible to report on all of the technical meetings of importance to the WG, two listed below are of particular interest.

1) II Conference on Image Analysis and Processing, Selva di Fasano, Italy, November, 1982. This conference included a number of papers on the topic areas of interest to the WG, including discussions of computer architecture for image processing. A report on the conference is published as a book "Digital Analysis and Processing", edited by S. Levialdi, by Pitman Books, Ltd.

2) Computer Architecture for Pattern Analysis and Image Database Management, Pasadena, California, USA, October 1983, sponsored by the IEEE Computer Society. Proceedings are available as IEEE Catalog No 83CH1929-9.

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