REDUCTION TECHNIQUES - ESO FACILITIES

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This paper describes the facilities available at the ESO headquarters in Munich for scanning photographic plates and for extracting information from these plates. ESO has an integrated system of three microdensitometers, a PDS 1010A, an Optronics S3000 and a Grant 800. Data analysis facilities include an HP 1000 series computer supporting an interactive data analysis system and two Vax 11/780 computers supporting general purpose computing and data analysis. Application areas currently active are: techniques for identifying objects in images and for classifying these objects, methods of analyzing extended images, and a package to reduce echelle spectra.

1. INTRODUCTION

ESO, the European Southern Observatory, has been operating a visitor oriented data analysis center since mid-1978. This was originally at CERN in Geneva and since October 1980 has been at the ESO headquarters in Munich. During 1982, there were 122 visitors coming to Munich specifically to use the ESO microdensitometers and data analysis facilities. Typical stays were of the order of 3 days, so that there was on average always a visitor using the facilities.

In Geneva, ESO supported an Optronics S3000 scanning microdensitometer, a Grant 800 single screw measuring engine, and a Hewlett-Packard HP 1000 system for data analysis. Just before the move to Munich, a PDS was acquired and this went into full operation soon after ESO's arrival in Munich. Also, at the time of the move to Munich, ESO acquired a Vax 11/780. Roughly one year later, a second VAX 11/780 was installed.

In the following sections, details of the physical installations and their capabilities are presented. Finally, some of the on-going research and development programs, both scientific and technical, are discussed.

M. Capaccioli (ed.), Astronomy with Schmidt-Type Telescopes, 99–106.

2. MEASURING MACHINES

ESO has put some effort into building an integrated hardware and software system for the measuring machines (see Figure 1). Thus each measuring machine has its own control computer which handles the direct interaction with the particular measuring machine. The user then talks through a terminal to an HP 1000 system which in turn communicates with the control computer. This arrangement has many advantages. It allows all the capabilities of a real computer with disc files and so on. Thus, star catalogues, user catalogues of coordinates to be scanned, wavelength tables, etc. can be centrally stored, accessed, manipulated, and used to drive the various measuring machines. Figure 1 shows a schematic diagram of the overall layout of the system. Table 1 compares various aspects of the machine and also indicates the anticipated performance of "FIRST", the Optronics upgrade currently taking place.

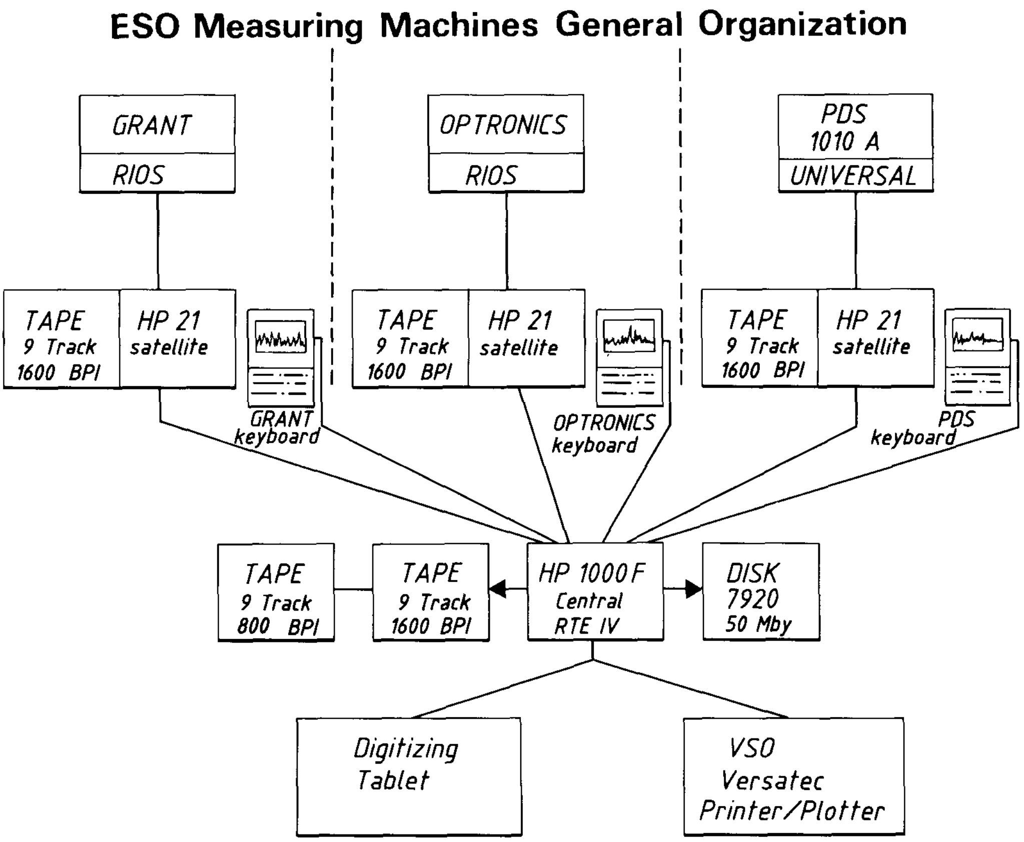

Figure 1: General organization of the measuring machine installation

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Table 1: Summary of Measuring Machine Parameters

Machine	Scanning Area (cm)	Positional Accuracy (microns)	Typical Scanning Speed (mm/sec)	Density Range	Pixel Size (microns)
Optronics	35 × 35	0.5	10	2.5	10
PDS	25 × 25	1.5	10	4.0	10
Grant	40 × 10	1.0*	1	2.5	0-45
FIRST	35 × 35	0.5	10 256 pixels	2.5	10

* Relative accuracy but absolute accuracy determined by the lead screw temperature

An HP Digitizing Tablet is connected to the central HP 1000 computer. This can be used to determine the approximate position of objects to be measured or scanned.

The overall use of this installation is quite high. The PDS is used the most and has averaged about 150 hrs/month in 1983. The Optronics is next and is used an average of 100 hrs/month, while the Grant is used somewhat less than 50 hrs/month.

2.1. Optronics S3000

The Optronics S3000 is a granite based two dimensional scanning microdensitometer mounted on air bearings. The mechanical quality of this device is excellent and it has a repeatability of the order of 0.5 microns. It can accept plates up to 36cm by 36cm and scan areas up to 33cm by 33cm. Thus, it is ideally suited to doing astrometry on Schmidt plates. In the near future, an upgraded optical system will allow an increase in speed of about 250 using a reticon, and a micro-processor to preprocess the data will be installed. This project is called FIRST.

2.2. PDS 1010A

The PDS is the standard one used by almost all astronomical institutes. ESO, like most other institutes, has modified certain aspects of the electronics. In addition, we use a Hewlett-Packard computer to control the system. The PDS is the work horse of the measuring machine installation because it is better known, and easier to use than the Optronics.

A new high speed amplifier will be installed soon, and this should increase the scanning speed at densities up to 4 by a factor of two.

2.3. Grant Machine

The Grant 800 is a standard device which has been integrated into the measuring machine complex. It can be used for manual measurements or for one-dimensional scans. A Heidenhahn encoder is being installed on the Grant to improve the positional accuracy.

3. DATA ANALYSIS SYSTEMS

ESO supports two data analysis systems with different capabilities. The IHAP (Image Handling And Processing) system is based on Hewlett-Packard machines and has been in use for more than six years. A newer system, MIDAS, (Munich Image Data Analysis System) based on VAX computers has been available for about 1 year.

3.1. IHAP

The hardware resources of IHAP are shown in Figure 2. This configuration has been quite stable for a number of years. The IHAP represents the first attempt at ESO to build an interactive data analysis system. Major design aspects are: a special file system to enhance performance, command driven operation, a single very large program and a command macro facility. The IHAP system has proved very successful especially in supporting analysis of one-dimensional spectra.

The major application area of IHAP has been in spectral analysis. The Image Dissector Scanner data from La Silla is routinely analysed on IHAP. IUE spectra, and Image Photon Counting System data are also handled. In addition, many image analysis functions are available.

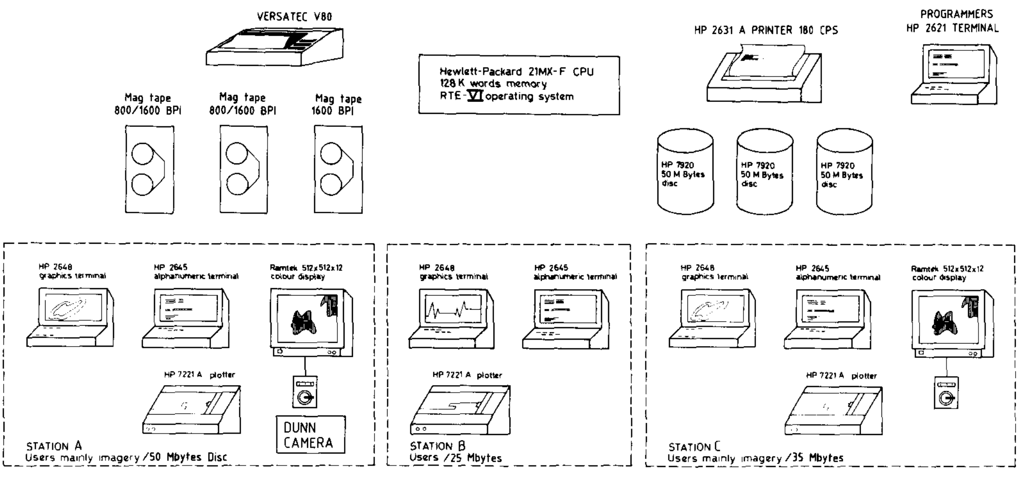

Figure 2: IHAP System Hardware components and user stations

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3.2. MIDAS

The VAX based data analysis system was conceived to expand the resources and capabilities of the IHAP system. Three areas were to be enhanced. First, the total number of work stations on the VAX systems is six plus there are several terminals spread through the building. Second, the execution speed should be increased, and third, the ease of programming should induce astronomers to contribute application programs. In order to achieve these results, the hardware shown in Figure 3 was purchased.

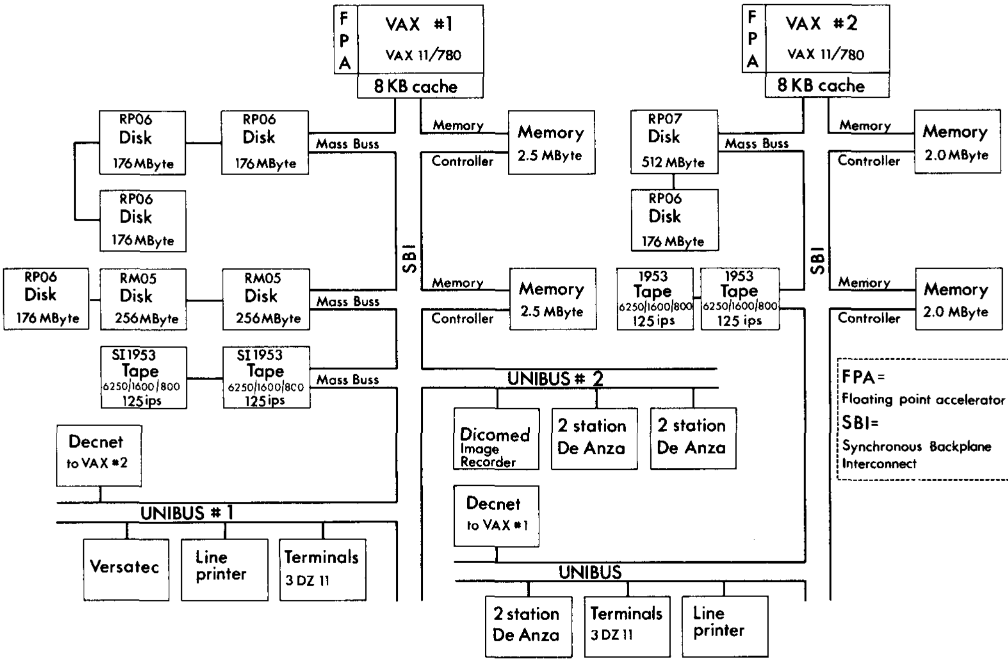

Figure 3: VAX computer installations for MIDAS

The MIDAS software developments were conceived to expand on the successes of IHAP and to allow easy integration of user programs. Thus MIDAS is command driven and makes use of extensive on-line help facilities. MIDAS includes a very extensive command macro facility, can be interfaced to a variety of graphics and display peripherals, and has been designed with very clean interfaces to the MIDAS data structures.

In addition to the usual image data structures, MIDAS supports named global variables for passing data between programs, table structures for storing and manipulating data in tabular form, and catalogue structures to aid in data management.

The concept of using well defined and simple interfaces to the MIDAS data structures has been quite successful. Figure 4 shows the logical structure of a MIDAS application program.

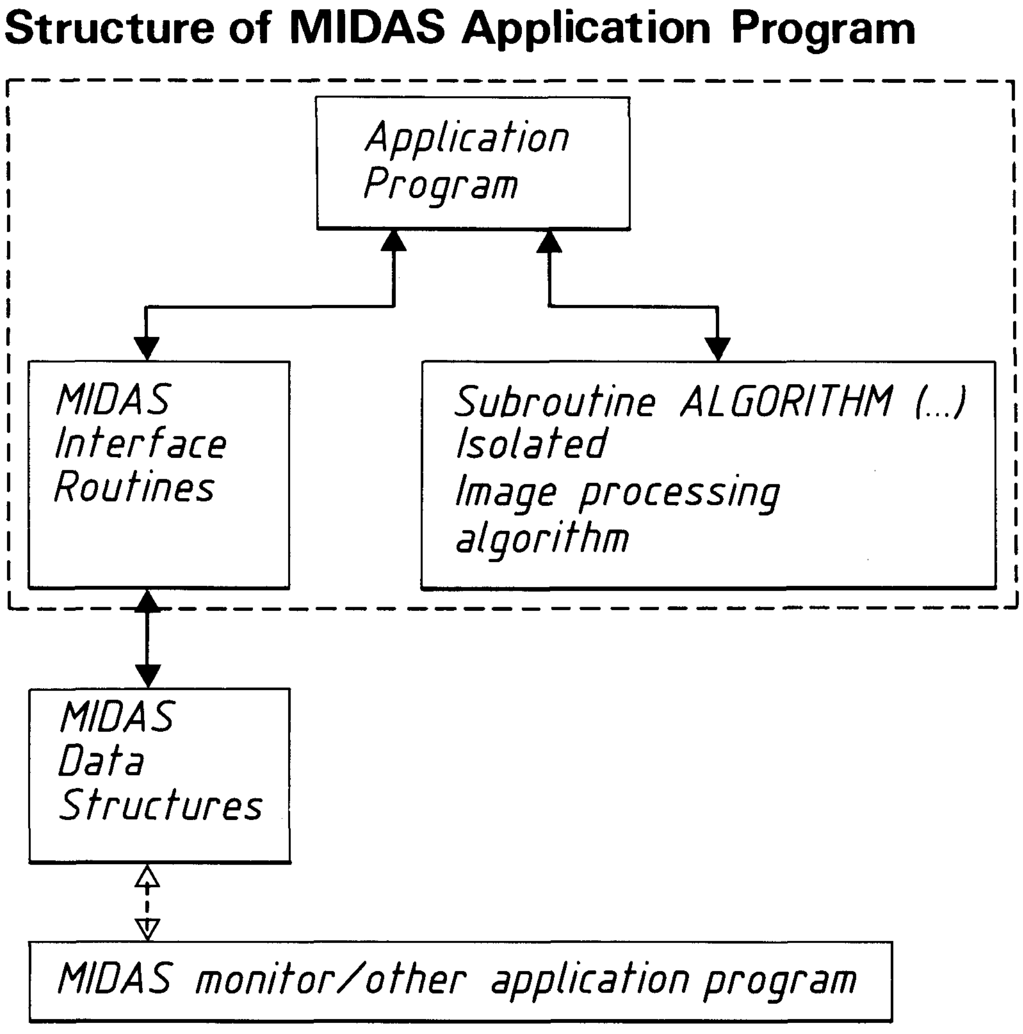

Figure 4: Structure of MIDAS Application Programs

Major MIDAS application areas at present include correction of CCD images, extraction of echelle spectra, full two-dimensional analysis of IPCS spectra, and image classification schemes.

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4. SAMPLE APPLICATIONS

In addition to the day to day use, two major programs are being pursued at ESO using the facilities described above. First, the approximately 17,000 galaxies in the ESO/ Uppsala catalogue are being scanned and analysed for their major photometric properties. Figure 5 shows a typical galaxy from this sample and also shows the high quality of the Dicomed image recorder. The other project involves identifying and classifying faint objects. Figure 6a shows a CCD frame and Figure 6b shows the identified objects. The software developments from both of these projects are to be integrated into the general MIDAS system.

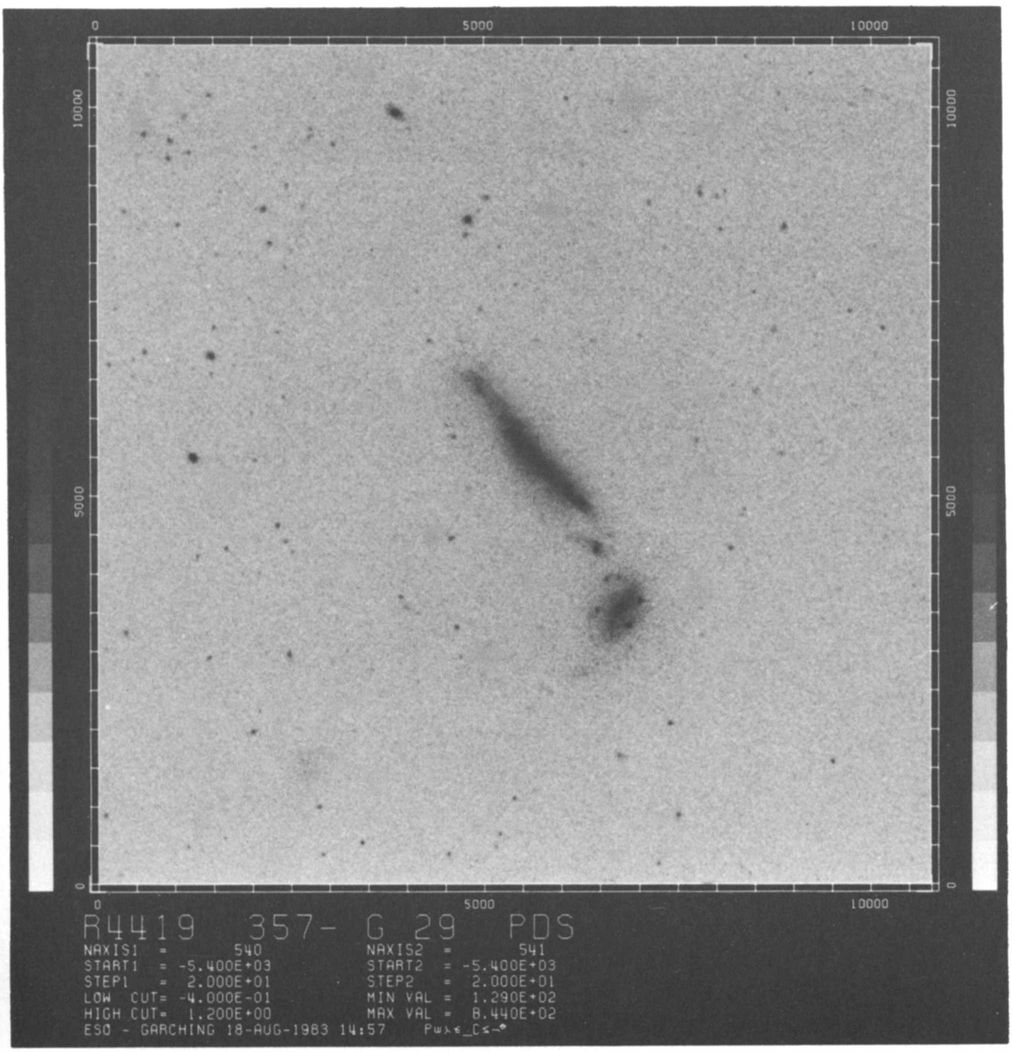

Figure 5: Discomed copy of a galaxy from the ESO/Uppsala survey being scanned and reduced at ESO.

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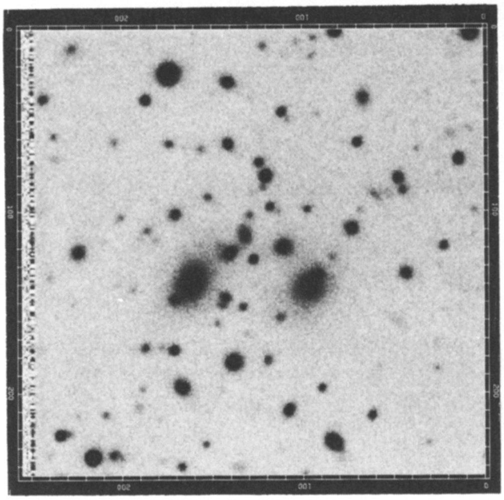

Figure 6a: CCD frame showing faint objects.

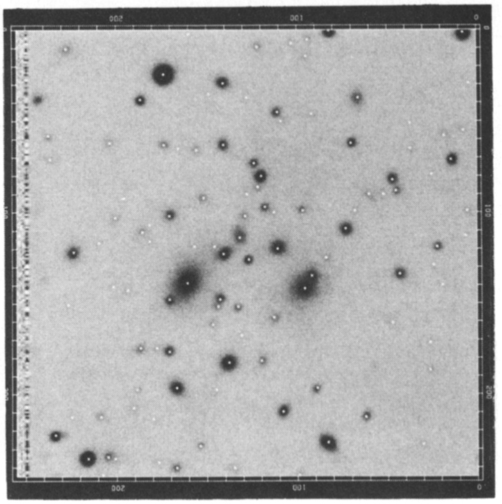

Figure 6b: Same as 6a but each automatically identified object has a dot in the middle.

5. CONCLUSIONS

ESO supports a major centre for the analysis of astronomical data. This is a growing centre which hopes to provide first class facilities for the ESO member states, and for the astronomical community at large.

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