pose the SET/PLOT command is enhanced: the user now has full control over the size of the plot symbols and can produce publication quality plots. In the ASSIGN/PLOT, SEND/PLOT and SET/PLOT an option has been built in to produce plots on a PostScript laser printer (see below).

The upgrade of ROMAFOT to the portable version of MIDAS is nearing completion. This includes several significant improvements of the package such as proper handling of undersampled images which is essential for EFOSC data and eventually also for HST images.

INVENTORY is now in the process of being migrated to the portable MIDAS and at the same time is being improved in a number of aspects.

2. Portable MIDAS

The 88NOV release of MIDAS is the first to support multiple operating systems namely, VAX/VMS and a long list of UNIX like systems. It has been implemented on machines from DEC, IBM, SUN, Apollo, Nixdorf, PCS, Stellar, Bull, Tektronix, and Masscomp. This first release contains almost all basic MIDAS commands although some of the application contexts are not yet available. This refers to a few very complex packages such as INVENTORY, ROMAFOT, CCD and Long Slit. They are expected to be ready for a minor MIDAS release 89FEB which will be sent out to sites that have the 88NOV version. This minor release will also resolve bugs and problems reported by users. The 88NOV release includes several improvements e.g. upgraded plotting routines, standard IDI routines, a terminal independent interface and a package for IRSPEC reductions.

The graphics commands use the portable version 3.2 of the Astronet Graphic Library (AGL) which supports a large variety of devices such as TEK 4010/14, VT 640, PostScript and X Window systems V 10.4 or V 11. Since we have only recently had access to version 11 of X Window, the 88NOV release only provides IDI routines for Gould IP8500 and X Window V 10.4. MIDAS will, however, support version 11 of X Window as a standard for work-stations. Institutes with other image display devices should upgrade their IDI implementation to the standard. Another component which varies significantly from system to system is the interface to magnetic tapes. This may have to be rewritten at the individual sites.

3. MIDAS Hot-Line Service

The following MIDAS support services can be used to obtain help quickly when problems arise:

- EARN: MIDAS @ DGAESO51
- SPAN: ESOMC1::MIDAS
- Tlx.: 52828222 eso d, attn.: MIDAS HOT-LINE
- Tel.: +49-89-32006-456

Users are also invited to send us any suggestions or comments. Although we do provide a telephone service we ask users to use it only in urgent cases. To make it easier for us to process the requests properly we ask you, when possible, to submit requests in written form through either electronic networks or telex.

ESO Image Processing Group

MIDAS Benchmarks of Work-Stations

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1. Introduction

The number of computer systems on which MIDAS can be used has increased substantially with the introduction of the portable version. MIDAS is now available for both VAX/VMS and UNIX systems. This opens the possibility of using a large number of work-stations which offer many interesting features for astronomical image processing such as high performance per cost unit, integrated display options and good interactive response.

To improve the situation for interactive MIDAS users within ESO, it was decided to shift parts of the image processing from the VAX/VMS systems to work-stations. For this purpose, an early version of the portable MIDAS was implemented and tested on a wide variety of work-stations. A set of typical MIDAS applications were used to benchmark the performance of the different systems used in single user mode. These performance tests were done in the spring of 1988 and used to make a final decision for the purchase of image processing work-stations for ESO.

2. Work-Stations

A typical configuration of a work-station for interactive image processing with MIDAS consists of a 32-bit CPU with a floating point processor, 8 Mbyte main memory, 300 Mbyte disk, colour display with approx. 1000*800 8-bit pixels and an Ethernet interface. The software requirements are a UNIX or VMS operating system, X Window system for the display and standard compilers for Fortran-77 and C. A number of systems with roughly these specifications were tested. The systems are listed in Table 1 including their CPU type and operating system.

In addition to standard work-stations, a few larger systems were included for comparison e.g. VAX8600, Trace 14, Targon 35 and Alliant. MIDAS was implemented and tested on all the systems; the installations on the Trace 14 and the Alliant were done remotely over a modem line. The conditions for the benchmarks of these two machines were not well controlled and for this reason the results were omitted. For the IBM PC-RT 6150 system, only the basic installation and tests were performed, the actual benchmarks could not be made due to lack of time.

The tests were carried out at the vendor sites on demonstration models which meant that some variation in the actual configuration was unavoidable. The whole installation and tests were typically done in less than two days. For that reason it was impossible to spend time on optimizing the individual systems. It is estimated that differences in configuration and optimization may introduce up to 25% variation in the benchmark results.

3. Scope of Benchmarks

The benchmarks were made to measure the typical real time performance of interactive usage of MIDAS on single user work-stations. For this reason the tests included a number of actual, frequently used MIDAS applications. The important quantity for the user is how fast the different systems respond. This depends on the performance of the system in three main areas, namely:

1. scheduling of new application programmes,
2. speed of disk I/O operations, and
3. CPU power.

These quantities were measured with different MIDAS applications. Since MIDAS makes most calculations in single precision floating point, the CPU performance measured refers mainly to the operations with real values. The execution time of the benchmark procedures was measured in elapsed time since this indicated the interactive response of the system in single user mode.

It was not within the scope of these tests to derive absolute values for performance. The lack of optimization of the individual applications and general time constraints meant that the benchmarks could be used only as a relative measure of performance for the tested pre-release version of MIDAS. Better results can be achieved by tuning both the application programmes and systems parameters. The changes in the hardware configuration may also change the results in a non-linear manner. At the time of the tests, graphics and image display applications were not yet implemented. They were therefore not included in the benchmarks. The benchmark procedures will be further developed and improved to provide a standard performance test of MIDAS on computer systems. This implies that some tests may be modified in the future. Reference to the values presented here should therefore include the version number, i.e. MIDAS Benchmarks Version 0.9. The results cannot be used to estimate the performance of the systems with other packages than MIDAS due to differences in the usage of resources.

4. Benchmarks

Four of the 18 different benchmark procedures used are discussed here. They represent the general results of the benchmarks and indicate the performance of the systems with respect to CPU, I/O and scheduling. The four tests were:

1. Schedule. This procedure scheduled a simple MIDAS application which opened an image file and read a descriptor. This was repeated a total of 100 times. The execution of this test depends on the time it takes to schedule a new programme and access simple information in a file. This type of operation is done very frequently in MIDAS procedures and is therefore important to estimate how fast a system can perform long sequences of MIDAS applications. Since the actual task only accesses a single piece of information in the file, the elapsed time indicates the system overhead in executing applications and opening files.

2. Scaling. The scaling operation of an image involves access to the data, a multiplication and additions with constants, and finally the creation of a new file. A frame with 512*512 real pixels was used in this benchmark. This operation is used whenever an image is displayed. The speed of a simple arithmetic operation is in most systems so high that the performance is limited by the I/O rate of the disk. This test indicates the I/O bandwidth of a system which in turn shows how many data can be passed through in a given time.

3. Median. The median benchmark applies a median filter on a real image with 512*512 pixels. In contrast to scaling this task requires a significant number of operations per pixel and is thus limited by the CPU performance of the floating point unit. Although tasks of this type are executed less frequently in interactive sessions, it shows the basic speed with which any CPU demanding process can be executed.

4. Table. The benchmark performs a number of mathematical operations on a table with 13 columns and 10,000 rows. The calculations include arithmetic operations and trigonometric functions. Tables are often used during reduction of data in MIDAS. The efficiency of these functions is essential for the total through-put. Further, tables are used in the final analysis of data where the speed of interaction is crucial. Due to the size of the table used in the benchmark and the operation done, the time is set largely by the floating point CPU performance and only to a lesser extent by the I/O bandwidth.

The scaling and median tests were done also with larger images. For systems with main memory large enough to avoid swapping or paging, the elapsed times showed a linear increase. When this was not the case, a dramatic decrease in performance could be observed.

The benchmarks were, in most cases, executed several times and showed little variation. The results are given in Table 2 where the mean elapsed time in seconds is listed. Some values could not be obtained due to minor errors, time limitation and lack of disk space. Especially the I/O limited tasks (e.g. scaling) are sensitive to the fragmentation of the file system on which the data are located. This may introduce a systematic bias. Due to wrong compiler options in two tests (i.e. HP 350 and SUN 3/60) software floating point computations were used although hardware units existed. The Masscomp MC 5450 system can allocate contiguous files on disk which improves the I/O performance significantly. This option was not used since it is a real-time extension

TABLE 1: *Systems on which MIDAS has been implemented.*

Vendor-Model	CPU-type	Operating System
HP 9000-835	RISC HP-PA	HP-UX
HP 9000-350	MC 68020	HP-UX 6.0
Apollo DN 4000	MC 68020	Aegis
Apollo DN 590	MC 68020	Aegis
SUN 4/110	SPARC	SunOS 4/4.0
SUN 4/260	SPARC	SunOS 4/3.2
SUN 3/60	MC 68020	SunOS 3.5
Bull SPS 9/830	RISC-4	SPIX9 31.5
Tektronix TEK 4301	MC 68020	UTeK 2.4
Matra MS 1326	MC 68020	SunOS 3.4
Matra MS 1306	MC 68020	SunOS 3.4
Masscomp MC-5450	MC 68020	RTU
IBM PC-RT 6150-125	ROMP	AIX 2.1
Prime PXCL 5500	MIPS R2000	UNIX SysV 3.1
DEC μVAX II	VAX	Ultrix 2.0
DEC VAX 8600	VAX	VMS 4.7
DEC VAX 3500	VAX KA650	Ultrix 2.2
PCS Cadmus 9900	MC 68020	MUNIX 5.2
PCS Cadmus 9933/RC	MIPS R2000	MUNIX 5.2
Nixdorf Targon 35	RISC	UNIX SysV
Alliant FX/1	Alliant	Concentrix
Multiflow TRACE 14	WLIW	UNIX 4.3 BSD

to UNIX. The values for the VAX 8600 are given for comparison and were also obtained with a single user on the system.

5. Discussion

The results in Table 2 reflect the behaviour of the systems in three different aspects: Process scheduling in the first column, I/O bandwidth as scaling operation in the second column and floating point performance in the third column. The table operations included in the fourth column give an indication of both I/O bandwidth and floating point performances.

The times for process scheduling show a surprising spread with almost a factor of 10 between the fastest and slowest system. There is little correlation between the speed of starting a new task and general CPU performance. The Aegis and VMS operating systems have a significant lower performance than typical UNIX systems. This is especially odd in the case of VMS, since MIDAS executes application tasks differently for VMS and UNIX machines: In UNIX machines a child process is started and the task executed in the context of that subprocess. In VMS a subprocess is created only once, then, the applications are executed in the context of that subprocess. Therefore, the measured time for VMS is just the time for running an executable task in an existing subprocess, not for creating a child process as well.

The I/O bandwidth indicated by the scaling task depends on three major factors namely: physical speed of disk drive and interface, block size of the file system and implementation of hashing techniques. Due to the two latter factors, most BSD UNIX systems have at present a higher disk I/O performance than those based on SYS V. One of the exceptions is the Bull SPS9 system based on SYS V but using a very efficient disk controller. The SUN 3-4/260, VAX 8600, PCS and SPS9 used SMD type controllers with 8 inch disks which give higher performance than the SCSI or ESDI interfaces available on most other systems.

TABLE 2: *Benchmark results in seconds elapsed time.*

Vendor-Model	Schedule	Scaling	Median	Table	Remarks
HP 9000-835	33	13	33	34	
HP 9000-350	–	39	118	–	Software FP
Apollo DN 4000	167	14	–	47	
Apollo DN 590	142	13	–	50	
SUN 4/110	25	7	61	30	
SUN 4/260	30	8	41	22	
SUN 3/60	46	27	124	90	Software FP
Bull SPS 9/830	24	7	–	17	
Tektronix TEK 4301	97	15	–	46	
Matra MS 1326	40	11	–	32	SUN 3/260
Matra MS 1306	39	16	–	63	SUN 3/60
Masscomp MC-5450	73	20	–	79	Standard file system
Prime PXCL 5500	31	17	58	–	
DEC μ VAX II	115	30	157	89	
DEC VAX 8600	167	10	30	37	
DEC VAX 3500	38	11	51	44	
PCS Cadmus 9900	130	34	109	–	
PCS Cadmus 9933/RC	17	13	27	37	
Nixdorf Targon 35	39	10	45	15	

The single precision floating point performance is given by the median filter. It is interesting to see how the performance of relatively cheap work-stations slowly approaches that of machines like the VAX 8600. One may even argue that some work-stations have too high CPU performance compared to their I/O bandwidth when used for interactive image processing. The RISC machines usually have a much higher rate of executing instructions than CISC processors. This is not reflected in the benchmarks because they mainly measure the performance of the floating point co-processor.

For the evaluation of the total performance of the systems for interactive image processing the four quantities shown in Table 2 were used. The normalized performance for each test was defined as the median divided by the elapsed time given. The final rating was based on the mean of the normalized performances. This added more weight to the I/O performance than to CPU speed which is reasonable for interactive systems.

MIDAS Models Interstellar/Intergalactic Absorption Lines

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1. Introduction

Most of the current tools available in MIDAS, as well as in other image processing systems for Astronomy, are dedicated to the first step of data reduction which is to eliminate the instrumental signatures from the observations. This is clearly the main priority for such a system and continuous development is going on to support all the instruments available at La Silla. Very little effort has been dedicated to the complementary problem, the development of analysis tools to bring physical interpretation closer to the observed data. This article describes a new MIDAS context – CLOUD – that allows such an analysis, namely, to model the absorption of interstellar or intergalactic clouds as observed in spectroscopic data.

The programme models absorption features superimposed on a continuum which may also contain emission lines. The resulting output spectrum is computed at a given instrumental resolution and can therefore be used for a direct comparison with observations (provided the lines are resolved). This is particulary suitable for high resolution spectra, as observed by ESO instruments such as Caspec.

The main characteristic of the pack-