easy implementation of software into MIDAS. See the MIDAS Environment Document for a detailed description of the new directory structure.

3. Installation Procedure

A new extended installation procedure will be available with the 91MAY release of MIDAS. It provides an easy question and answer session during which a customized version of MIDAS, only including the application packages required, can be installed. The procedure is available for both UNIX and VMS systems.

4. Application Developments

The Table File System has been extended in order to store arrays at table items. This upgrade was required to provide compatibility with the Binary 3-D table format being proposed as a FITS extension. This format is expected to be used by a number of projects (e.g. ROSAT for event tables) due to the high efficiency of the format. Only the very basic table applications can currently manipulate such arrays. The command syntax of the previous versions is still valid but the upgraded syntax includes some additions.

An old table can be read and processed by the new Table File System. A command RETRO/TABLE is provided to convert a 3-D table to the old format.

5. MIDAS Newsletter

The Image Processing Group intend to start a MIDAS-Newsletter with two annual issues. In order to make an inventory of the MIDAS usage at ESO and the various other MIDAS sites we passed a questionnaire to the participants of the Data Analysis Workshop last year. Although not everybody reflected on the questionnaire, from the forms which have been returned it became clear that many users find the information about MIDAS published in the *Messenger* (the MIDAS Memo) insufficient. A large majority would like to obtain more detailed information, for example in the form of a separate newsletter.

In order to serve the user community better, the Image Processing Group of ESO will start a MIDAS newsletter. We hope to publish the first issue in the month of May, shortly after the release of the 91MAY version of MIDAS. At first, we will start the newsletter with a periodicity of two issues per year.

The newsletter will contain various kinds of information, e.g.:

- new commands or command modifications/improvements;
- new packages or upgrades;
- MIDAS installation and performance;
- bugs found and bug fixes;
- experiences and results obtained;
- suggestions, criticism;
- plans for the future.

It is not the intention of the ESO-IPG to be the only group that provides contributions to this newsletter. We would like to encourage all MIDAS users to make contributions as well. Obviously, such contributions should be of interest for the general MIDAS user. Clearly, the emphasis in the newsletter will be on MIDAS and on its software. However, since MIDAS is made for data analysis in astronomy, the inclusion of some astronomical results obtained by using the MIDAS software is welcome.

We would hereby like to invite you to contribute to the MIDAS newsletter. Since the first issue will probably appear in the course of May, we would be happy to receive contributions before April 1. The contributions should be submitted as a computer readable ASCII file in LaTeX format using the article style with an 11 pt font. Contributions must be submitted to the editor Rein Warmels, ESO Image Processing Group (E-mail addresses EARN: REIN@DGAESO51 or SPAN: ESO::REIN).

6. Personnel

We are happy to announce that Resy de Ruijsscher has joined the Image Processing group as technical secretary. She is responsible for documentation and distribution of MIDAS and will be your prime contact person for these matters.

7. MIDAS Hot-Line Service

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

- EARN: MIDAS@DGAESO51
- SPAN: ESO::MIDAS
- Eunet: midas@eso.uucp
- Internet:midas@eso.org
- FAX.: +49-89-3202362, attn.: MIDAS HOT-LINE
- 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 in urgent cases only. To make it easier for us to process the requests properly we ask you, when possible, to submit requests in written form either through electronic networks, telefax or telex.

Automatic Photometry at La Silla

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1. Automatic Telescopes and Photoelectric Photometry

Automatic telescopes represent a novel concept leading to a radically new way of planning and conducting observations. This is best illustrated in photoelectric photometry where the human factor is responsible for errors and for degraded accuracy. Man, with his slow reaction time and high tendency to fatigue, certainly cannot compete with a computer and with ultrafast equipment. In manually conducted photometric observations, most of the time is spent with the photometer in idle status, when the observer moves the telescope to the next star, when the observer is identifying or centring the object, or when he or she is planning the rest of the night. Above all there is the problem of manpower: for each telescope in operation a skilled observer is needed all year round, and this is a major limitation on the total number of measurements that can be made.

Especially in differential monitoring of variable stars, short integration time and short time intervals between successive measurements are essential for high-accuracy photometry. Fast speed of measurement also means that a lot of measurements can be made each night, and this means that it is much easier to incorporate many more standard and constant star measurements. This in turn leads to more consistent reductions and higher accuracy and homogeneity in the data.

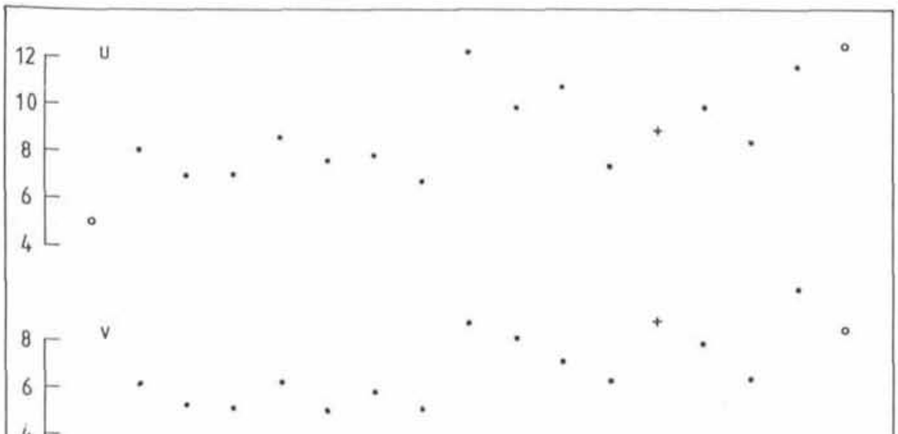

Figure 1: *Systematic difference (ordinate = milli-magnitudes) between mean standard deviation of one differential measurement for the same telescope and photometer operated manually (DAN50), or automatically (SAT). Open circles denote measurements obtained by the same observer, and the + sign is a reference point obtained at the ESO 50-cm telescope.*

Automatic telescopes are perfectly suited for observations which do not require decisions that only a human operator can take. This does not mean that complex decisions cannot be taken: computers can be programmed to execute evaluations well beyond the capacity of a human observer in terms of complexity and speed. This includes decision-taking according to the accomplished part of the programmed task, and interaction with data coming from on-line reduction.

Automatic telescopes are of course suited for observations beyond photometry, but photometry has been a test ground for the first telescope of this kind because classical photometric observations are easy to perform, and the field of application – even on bright stars – is gigantic and – in the classical approach – needs a large amount of manpower. In addition, complete automatization eliminates travel and lodging costs of the observers (a very important factor, even for large telescopes where observing runs are shorter and where there is a faster turnaround of observers), and is a more economy-efficient solution than remote control observing.

Automatic telescopes, specifically built for observing without human assistance, will always have an edge over conventional telescopes, even over those which are computer controlled, since they can move more quickly from star to star. Dedicated telescopes such as the commercially available APT's (Automatic Photometric Telescopes) are optimal in this respect since they take only a few seconds for pointing and centring. Automatized telescopes on the other hand suffer from their large inertial momentum and need tens of seconds to find and centre a star. Roughly speaking, a quarter to half of the possible observing time is lost, and the interval between successive star pointings is roughly twice as long as it could be, so that larger changes in the atmospheric conditions will intervene.

2. Our Experience with an Automatized Manual Telescope

The SAT (Strömgren Automatic Telescope, Florentin Nielsen et al., 1987) is the name given to the ESO Danish 50-cm telescope after it was refurbished and provided with full computer control. The SAT has now been used for several years with considerable success. It is essentially a mission instrument where as a rule each observer gets a few weeks observing time per run. A rather flexible programming language was developed, and it is the responsibility of the user to code his observing sequences for each night, and hence each observer programmes the telescope in his own way. The result is that the SAT is functioning essentially in the same way as before automation, but that it is faster and has a larger output. However, when compared to dedicated APT's its typical setting time of 30 seconds is pretty long.

A big advantage of the SAT (over any existing APT) is its four-channel photometer which allows the measurement in the four Strömgren bands at the same time. Moreover, Hβ photometry can be performed by simply commanding the turning of a lever to enter the Hβ mode which yields simultaneous measurements in the two β bands. Hence the slowness of the telescope motion is largely compensated by the simultaneity of the measurements in the different colours, and by full-time availability of the Hβ mode.

Programming the SAT in an efficient way requires a thorough knowledge of the language, and an evaluation of all possible situations that can be expected during the night. Any programme will contain several loops and conditional evaluations. Since observing runs are of relatively short duration, few astronomers make the effort to thoroughly study the programming language. They either construct short programmed sequences and monitor the telescope all night, or they hastily write a poor programme, and leave the telescope unattended for many hours. This frequently leads to inferior results because standard stars are sometimes observed at too high airmasses, or because a critical phase of an eclipsing binary has been missed. Our experience shows that, for a similar observing programme, the average airmass over a full night is larger in automatic mode by systematically 0.05 to 0.15. Since the SAT telescope is a small instrument, with many stars having more than 5 mmag photon noise, the policy is to increase the number of integrations for the fainter stars. This is a rule which is easily forgotten when programming the sequences in automatic mode, especially if the telescope is used by people with limited observing experience in photometry.

In the framework of the Long Term Photometry of Variables programme at ESO (Sterken, 1983), a lot of observing time has been attributed on the SAT. Several observers have carried out the observations with varying degrees of success. Each observer had about one month of observing time, and would design the programme on the spot (eventually along the lines of a programme made by a predecessor).

The graph shown in Figure 1 gives the rms value of the differential results obtained for pairs of constant stars having more than 10 measurements. This is probably the best estimate of the overall accuracy of each run. All observations occurred according to the same instructions, except for the first and last run, which are the only runs carried out by the same observer (C.S., but with a very different observing programme). The run indicated with a cross is an observing run carried out at the ESO 50-cm telescope, and is given for reference only. "Automatic" operation started in December 1987. It is clear that rather large variations occur between the DAN50 and SAT block of runs (in spite of completely comparable observing missions).

Though we cannot rule out a hardware effect, such as an incorrect centring procedure (which in the case of a spectrophotometer of this type would introduce larger scatter), we think that a large factor affecting the overall accuracy of the result may probably be found in the programmation of the SAT. The worst cases were obtained by inexperienced astronomers who wanted to write long programmes and leave the telescope alone during a major part of the night. It is absolutely necessary to do such programming very carefully and test the code exhaustively in order to avoid unpleasant errors. This shows the importance of the software in developing APT systems. A lot of planning has to be done before efficient observations are carried out. We conclude that automatic telescopes are an improvement only when they are being programmed by observers who have extensive experience in manually conducted observations.

3. Conclusion

The SAT telescope unveils the promises of automatic telescopes. It is a substantial improvement compared to the old Danish 50-cm configuration in almost every aspect. The experience we got on the SAT is certainly positive, but we believe that most of the problems we encountered would not appear in the APT environment.

Three major lessons have been learned.

(i) Automatic telescopes are only as good as the software that runs them. The programming language has to be highly sophisticated to allow very flexible operation during the observations. This is a clear example of a situation where expert-systems or "artificial intelligence" is needed. The similarity with satellite operation is striking.

(ii) A good programming language is not enough. Not only the instructions given by the astronomer must make sense, also the command files written by the user or the controller should be complete and well-tested.

(iii) Refurbishing an old telescope for automatic operation is not the only solution. The costs of retrofitting may even be comparable to the cost of building or buying a very compact specifically-designed photometric telescope.

Implantation and operation costs of automatic telescopes of the one-metre class are very small compared to the scientific return. Such photometric telescopes are fundamental as support for large ground-based telescopes and – as more and more astronomers have found out during the last years – also for observations from space. In addition, they can perform tasks that are too tedious to be undertaken by astronomers, such as monitoring of objects during several months. Moreover, such telescopes can be linked in a local or global network. A cluster of small automatic telescopes at ESO may become a crucial node in such a global network, and eventually provide a unique opportunity for European astronomers for collecting photometric data.

References

Florentin Nielsen, R., Nørregaard, P., Olsen, E.H.: 1987 *The Messenger*, **50**, 45.
Sterken, C.: 1983, *The Messenger*, **33**, 10.

New Literature in the La Silla Library

Excerpt from TORUS by James Follett (Mandarin Paperbacks, London 1990), p. 205 to 217)

"... There were more celebrations at the end of 1989 when the excavation of the line of four thirty-metre-square pits was completed. Each of the huge pits was twenty metres deep. The model of the finished telescope in the planning office showed the four telescopes that made up the system aiming their lattice frameworks at the heavens like the projectors of a science fiction battle cruiser in a big budget space movie.

... It was the first telescope and not due to start observation work until 1999. The entire system of the four linked telescopes with their giant ten-metre diameter mirrors was not scheduled to be fully operational until 2002. Diem could only wonder at the determination of a people who, in their ceaseless quest for knowledge, were prepared to spend such vast amounts of money and resources. And it wasn't only the Soviets; giant telescopes were being built all over the Pacific by different nations, such as the mighty Geck telescope on Hawaii, although none rivalled the Kuro Multiple Mirror instrument that Diem's employers were building.

... Hundreds of computer-controlled actuators hooked to the back of the giant floppy mirror to maintain its parabolic curve – providing continuous compensation for distortions caused by wind, temperature changes and gravity. It was the design breakthrough that had made the ten-metre supertelescopes possible."

Like the person in this science fiction paperback playing in the late 1990's, did you never wonder at the *real* reason why we are prepared to sink so much money into supertelescopes? Here the stunning answer is revealed, together with design details that were till now not available in the open literature. Read all about CCDs, active optics, site selection techniques, mirror making and much more at a level *you* understand. The first two hundred pages are a bit dreary and consist of the usual staff thrillers are made of: determined men, beautiful women, violence and sex. After having plodded through this part, you'll be rewarded by insights into VLT budget fiddles and personalities of some key personnel.

Insiders will easily see through the obvious trick to replace ESO by a certain country and will have fun matching the book's characters (communists, crooks and mad scientists, sometimes all at once!) with their ESO counterparts. The ending of the novel is not to be revealed here. Let it suffice to say that it ends like all mad scientist projects.

H. DEKKER, ESO