

Possible Future Steps

After a rapid growth, the AstroWeb is currently being consolidated. It is hoped that, with the help of the astronomical community, the degree of completeness and quality of the AstroWeb database can be further improved. Certainly, database internal cross-referencing within the descriptive paragraphs is far from complete. Here the situation can presumably be remedied with an appropriate software tool.

In the future the AstroWeb database might be used as a starting base for indexing all astronomical WWW pages out on the Internet. This would involve a "robot" repeatedly fetching all relevant HTML pages, similarly to how Archie indexes all files in all registered any-

mous FTP servers. Such a project is by no means out of question. In fact, general indices spanning the whole WWW already exist, but none thus far is specific to astronomy.

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Producing Multi-Wavelength Overlays with MIDAS

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Astronomy is no longer solely a science where data obtained in different wavelength ranges are analysed separately. Astronomers are becoming more and more involved in combined multi-wavelength programmes (optical, radio, IUE, ROSAT and soon ISO . . .) for which basic coordinates transformation facilities constitute the starting point for any further data analysis. This contribution describes the method used for making the optical/X-ray/radio overlays, presented in the preceding article "Multi-wavelength study of ROSAT clusters of galaxies".

For each cluster, we have at our disposal ESO 3.6-m EFOSC R images ($\sim 4' \times 6'$; scale: $0.6''/\text{pixel}$), ROSAT survey images (~ 1 sq. degree, resolution: $\sim 2'$), MOST images ($70' \times 70'$ cosec(δ), resolution: $43'' \times 43''$ cosec(δ); we thus adopted a final layout where the X-ray and radio contours are superimposed onto the optical pixel image. The latter determines the final overlay size.

Because of the very different processes by which these images are obtained, the production of the overlays is a long and tedious procedure, all the more so since no regridding programmes are available in MIDAS, nor are there commands for converting pixel coordinates into celestial. To summarize the starting situation:

– X-ray ROSAT survey images are routinely obtained by the EXSAS package (MPE) in a J2000 system, using $25''$ pixels; the sky projection can be as-

sumed to be tangential within the overlay field.

– The radio images were initially reduced with the AIPS package, using $\sim 15''$ (not square) pixels, in a SIN projection (B1950). In order to match the X-ray data, the radio images are in turn regridded into J2000 and tangential projection using AIPS.

– The accurate sky projection of the optical images is undefined. We stress here that, for our purpose, CCD images are essential (rather than Schmidt plate scans) to provide a detailed description of the galaxy distribution of our distant clusters.

– The MIDAS (EXSAS) and AIPS image header information regarding absolute coordinates, centre of projection, etc., are incompatible.

We therefore wrote a series of MIDAS procedures to cope with the lack of coherence between the systems, knowing that without proper regridding programmes it is not possible to have exact coincidence between the three wavelengths. The method is based on the fact that after the processing, overlays (which cover a small area) will have as "world coordinates" true coordinates, i.e. RA and Dec in decimal degrees aligned with the X and Y axes respectively (owing to the radio and X-ray resolutions, a minimal $2''$ accuracy for the three wavelengths is required over a $5' \times 5'$ field). This not only a tractable way to treat the unknown distortions of the optical image, but also enables us to get object positions directly

using the command `GET/CURSOR` after the final overlay has been displayed on the screen. We now describe briefly how each image was processed to reach this stage.

– For the purpose of aligning optical images, telescope coordinates are not accurate enough, and thus reference stars are needed. As the GSC does not provide enough objects on such a small field at high galactic latitude, and most objects are too bright and saturated on the CCD image, we make use of the general COSMOS object catalogue. The figure presents a finding chart produced by the NRL/ROE package available at MPE. The brightest stars are referenced with numbers, their coordinates are listed on the right-hand side of the figure, and a corresponding ASCII list is simultaneously produced by the programme; this file is then transformed into a MIDAS table (*TA*). In a second step, the CCD image is displayed on the screen and pixel coordinates of reference stars (at least 5), well distributed over the whole field, are interactively determined using the command `CENTER/GAUSS` with a table as output option (*TB*); selected stars are given the same identifier as in the COSMOS list. Then the two tables, *TA* (celestial coordinates) and *TB* (pixel coordinates), are compared with the command `ALIGN/IMAGE` letting all parameters free (i.e. rotation angle, X and Y scale factors, X and Y translations). In this way, the image is stretched in all directions so that the residuals for the

ROSAT Identification

Survey UKST IIIaJ

Field No. 381

Plate Epoch: 1976.4100

ROSAT Position: 12 36 41.9 -33 54 46

ROSAT / MPE / RSDC 27-OCT-94 09:20:28

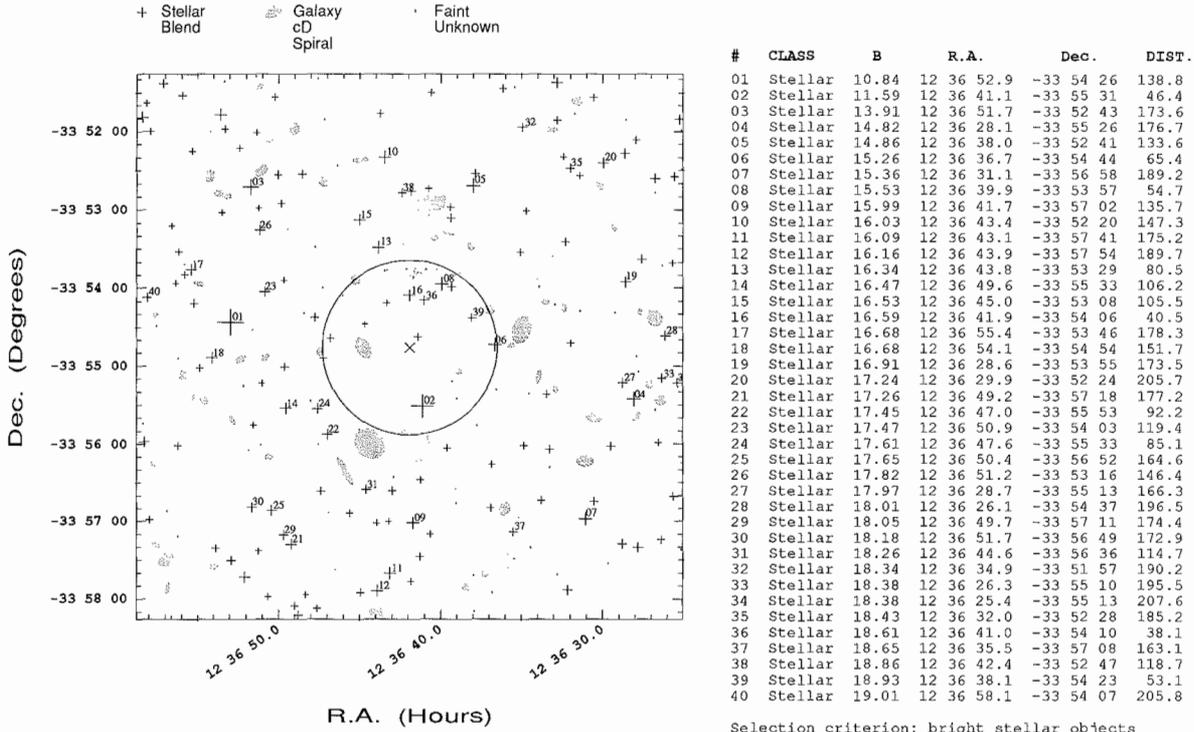
ROE/NRL Finding Chart

in : PRG7.MOS;1

out: prg7.ps

ROSAT Source Name: 000001RX J1236.7-335

Error radii: 1 sig = 40.8, 1.645 sig = 67.2, 2 sig = 81.7, 3 sig = 122.5 arcsec



Selection criterion: bright stellar objects

Example of a ROE/NRL/MPE finding chart (Abell 700) used in the alignment of the optical CCD images. Galaxies are plotted as grey ellipses and stars with crosses. The ROSAT centroid (X) and the 90% error circle are also indicated.

reference stars are minimized. The obtained transformation parameters finally enable us to rebin the image into RA, Dec via the command `REBIN/ROTATE`. A last check, using COSMOS reference stars not involved in the determination of the transformation, shows that a 1'' accuracy is reached – which is actually the nominal precision of the COSMOS positions. We must stress that we have encountered a difficulty due to the output format of the command `CENTER/GAUSS`: only 6 digits are available. This means that for the final check, as image coordinates are now equatorial, it is not possible to reach arcsec accuracy (e.g. we get in output: RA = 156.342). We overcame this difficulty (which is just an output problem, the computed START and STEP descriptor values being in double precision) by temporarily subtracting the integer part of the START value in the descriptor (e.g. this time `CENTER/GAUSS` will give 0.3423). We recommend that, in future, this command (as well as `GET/CURSOR`) works in double precision, which seems to be logical, considering that the START and STEP descriptors of the image header are double precision numbers.

– The X-ray image has world coordinates in unit of 0.5'' (coordinates 0,0 at the field centre) but possesses in its descriptor the coordinates of centre of the projection (`POINT_LONG, POINT_LAT`). This is used by the EXSAS command `TRANSFORM/COORDINATES` to convert pixel coordinates into celestial coordinates; the X and Y axes are aligned along the RA and Dec directions. With the aim of introducing celestial coordinates as world coordinates to match the optical image, we determine the equatorial coordinates of two reference pixels (usually the centre C and a 2nd point A about 2' off the centre). This provides unique pixel transformation equations, $(i, j) \rightarrow (RA, Dec)$, assuming that all over the field: (1) projection effects are negligible and (2) $STEP(x) = STEP(y) \cdot \cos(Dec(C))$. Descriptor START and STEP values are consequently modified to yield world coordinates in decimal degrees. In this new coordinate system, RA and Dec are exact for point C and all points located on the circle (C,A). At a distance of 10' from the centre we have computed a 2'' discrepancy with the new coordinates, and the true ones are provided by the command `TRANSFORM/COORDINATES`,

which is fully within the above accuracy requirements.

– The AIPS descriptors of the radio image provide in principle accurate information as to the celestial coordinates of any pixel; however, there is no way to handle them easily with the current MIDAS commands. Therefore, we adopted the following steps. The RA, Dec of the projection centre (C) of the image can be determined by simple linear equations: $RA = START(x) + NPIX(x)/2 \cdot STEP(x)$, $Dec = START(y) + NPIX(y)/2 \cdot STEP(y)$, but this is not true for any other pixel. Thus, to have a scale compatible with the optical image and assuming again that projection effects are negligible, we set: $STEP(x) = STEP(x)_{old} \cdot \cos(Dec(C))$ and $STEP(y) = STEP(y)_{old}$. This finally enables us to reset the START values adequately. Checking with AIPS point source positions over a large field gives satisfactory accuracy (comparable to that reached in the X-ray band).

The procedure described above provides the desired positional accuracy for the proposed scientific goals. However, one can easily imagine cases for which comparable accuracy will be required on much larger fields, or, alterna-

tively, with significantly higher accuracy, on smaller fields (e.g. VLA, VLBI positions, etc.). This procedure, unless it is further adapted, is unlikely to provide the expected precision. Therefore, we would recommend that the MIDAS environment

provide the opportunity of processing images obtained with different projections, mapped in different equinoxes as well as related header information fully compatible with those obtained with other standard packages.

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The 94NOV Release of ESO-MIDAS

SCIENCE DATA ANALYSIS GROUP

Introduction

The new 94NOV release of ESO-MIDAS will contain several improvements and new features in the core system as well as in the application areas. In this article you will find a summary of the most interesting new ones. More detailed descriptions can be found in the recent *ESO-MIDAS Courier* (October 1994).

The new release has been tested on a variety of platforms: SUN/SunOS 4.1.n and SUN/Solaris 2.3, HP/HP-UX, SG/IRIX, IBM/AIX, VAX/VMS, DEC/OSF1, DEC/Ultrix, VAX/Open-VMS and VAX/VMS, and PC/Linux. At the time this *Messenger* is distributed, the official 94NOV version will be released and all registered sites informed about its availability in the "midas" ftp account.

In order to optimize the distribution of this new release we request that MIDAS sites with Internet connectivity retrieve it from the "midas" ftp account. Sites with no connectivity can obtain the new release on magnetic media after having sent a completed ESO-MIDAS Request Form to the MIDAS Group (midas@eso.org).

System

New Line Editor for the 94NOV Release

One of the most prominent changes that (Unix) users will immediately experience is the implementation of a new line editor. In previous releases of ESO-MIDAS the monitor used the "TermWindows" library for its line-editing capabilities. "TermWindows" was implemented on VMS and UNIX systems and contained line-editing features inspired by those working on VAX/VMS. The 94NOV release of MIDAS includes and uses a new line-editor for the monitor based on the GNU "readline" library (also used in the GNU "bash" shell). This library, widely supported on UNIX platforms, enhances the line-editor capabilities of MIDAS with features like a history stack of commands, emacs or vi editing func-

tions, command and filename completion functions and a communication channel to the MIDAS GUI "help" for on-line help. This line-editor will be the default one for UNIX systems. For VMS systems the 94NOV release of MIDAS still provides the same line-editor as before.

FITS data decompression on the fly

The 94NOV release will contain an automatic "decompression on-the-fly" procedure from which commands like `INTAPE/FITS` can benefit. The biggest improvement is that previous processing sequences like e.g. separate decompression of files, removal of the compressed files to save disk space, and finally reading the decompressed files by `INTAPE/FITS` are now greatly simplified: `INTAPE/FITS` now takes care of the decompression without the need for extra disk space for the decompressed data.

Applications

Upgrade of the CCD package

In order to monitor the quality of the CCDs used on La Silla, ESO has started a programme of standard CCD tests. To support this programme from the software side, a number of new commands are incorporated in the CCD context. These commands operate on catalogues of images like bias, dark and low-count flat frames and will for example give the hot and cold pixel locations, the linearity and transfer curves, the shutter pattern, and the charge transfer efficiency.

A new astrometry context

A new context `ASTROMET` contains the astrometry package previously known as the programme `POS1` originally written by Richard West and implemented in MIDAS by Olivier Hainaut. For the MIDAS implementation the algorithm was not changed as it proved to be extremely accurate. While the original `POS1` was doing everything in one pro-

gramme, the MIDAS version has been split into 3 steps.

Firstly, read the measurements and standard stars, and compute the transformation parameters (this step is performed by command `ASTROMETRY/TRANSFORM`). Secondly, edit the standard star table to remove/restore some stars. This step is performed by the command `ASTROMETRY/EDIT`. Finally, compute the converted coordinates by the command `ASTROMETRY/COMPUTE`.

Graphical user interfaces

Two new graphical user interfaces (GUIs) will be included in the 94NOV release: a GUI for the Data Organizer (DO) and one for the infrared spectroscopy package `IRSPEC`.

Because the DO is particularly intended to be used in an on-line environment, it is essential that observers can interact efficiently with the tools offered to them. Therefore, a versatile graphical user interface has been fitted to the DO. The main interface window contains the Observation Summary Table on which all subsequent operations can be performed. With a number of special widgets the user can e.g. edit the classification rules, classify the biases, etc. A customized on-line version of the DO is now running at the NTT.

A second new GUI was created for the `IRSPEC` context by Cristian Levin at La Silla. Its main purpose is to provide an easy way to reduce infrared data on-line at the NTT, but it can also be very useful for off-line data reduction. The main features are:

- It has interfaces to all the commands of the existing context to reduce infrared data.
- A file management feature that allows to keep sets of input frame names in ASCII files.
- Some commands were grouped in the interface, and default values are provided for most of the parameters, so the user can reduce the data very quickly.

From the main menu of the `IRSPEC` graphical interface the user can create