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Starlink Project
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TSP — A Time Series/Polarimetry Package
Version 2.3
Users' Manual

Contents

1 Introduction

TSP is an astronomical data reduction package which handles time series data and polarimetric data. These facilities are missing from most existing data reduction packages which are usually oriented towards either spectroscopy or image processing or both. Where facilities for polarimetry or time series data have been provided they have usually not been sufficiently general to handle data from a variety of different instruments.

TSP is currently used to process data from the following instruments:

- Spectropolarimetry data obtained with the AAO spectropolarimeters using wave-plate or Pockels cell modulators in conjunction with either IPCS or CCD detectors.
- Infrared spectropolarimetry obtained with the IRPOL polarimeter module in conjunction with the CGS2 grating spectrometer and the UKT6 and UKT9 CVF systems at UKIRT.
- Infrared imaging polarimetry obtained with the IRIS instrument at the AAT and with similar instruments
- Time series imaging and polarimetry obtained with the AAO Faint Object Polarimeter.
- Time series polarimetry obtained with the Hatfield Polarimeter at either UKIRT or AAT.
- Time series polarimetry obtained with the University of Turku UBVRI polarimeter.
- Five channel time series photometry obtained with the Hatfield polarimeter at the AAT in its high speed photometry mode.
- Time series infrared photometry obtained with the AAO Infrared Photometer Spectrometer (IRPS).
- Time series optical photometry obtained using the HSP3 high speed photometry package at the AAT.

TSP is an ADAM application package and can be run from the UNIX shell or from the ICL command language. It uses the HDS data system for data storage and the NCAR/SGS/GKS packages for graphics.

TSP does not attempt to duplicate features that are available in other Starlink packages, and it is assumed that it will typically be used in conjunction with packages such as KAPPA, FIGARO and CCDPACK. These packages might be used to perform any standard image processing operations required for CCD or IR array reduction with TSP then being used to perform the polarimetric reduction.

2 Running TSP

2.1 Starting TSP

Make sure you have sourced the /star/etc/login and /star/etc/cshrc files (probably by including them in your own .login and .cshrc files) and that you have a subdirectory of name adam in your home directory.

Type the following command at your shell prompt.

```
csh> tsp

  TSP commands are now available -- (Version 2.3-0)

csh>
```

Any TSP command may now be entered. Note that on UNIX commands are case sensitive and must be entered in lower case.

The following example shows the use of the PPLOT command to plot a polarization spectrum. The SN1987A data file is included with the software, so you can use this command to check that TSP is working.

```
csh> pplot
INPUT - Stokes Data to Plot> /star/bin/tsp/sn1987a
BINERR - Error per bin (per cent) /0.5000000E-01/> 0.1
AUTO - Autoscale Plot /TRUE/>
LABEL - Label for plot> SN1987A  1987 Sep 2
DEVICE - Plot Device> xwindows
```

2.2 TSP Commands

TSP programs will prompt for all the parameters they need. Parameters may also be specified on the command line.

The individual TSP commands are listed in appendix A and described in appendix B. Some information on using TSP to reduce various types of data is given in subsequent sections.

3 TSP Data Format

The essence of the system is a common data format in which time series polarimetry data can be represented. This format is based on the Starlink standard data format described in SGP/38. In particular the polarimetry example given in that document is the basis for the TSP data format. The hierarchical structure of a typical TSP dataset is shown below.

Component	Type	Description
DATA_ARRAY(N,M)	_REAL	Stokes I array
VARIANCE(N,M)	_REAL	Variance on I array
LABEL	_CHAR	Label for data
UNITS	_CHAR	Units for data
AXIS(2)	Structure Array	Axis information
AXIS(1)	AXIS	Wavelength Axis
.DATA_ARRAY(N)	_REAL	Wavelength Axis Data
.LABEL	_CHAR	Wavelength Axis Label
.UNITS	_CHAR	Wavelength Axis Units
AXIS(2)	AXIS	Time Axis
.DATA_ARRAY(M)	_DOUBLE	Time Axis Data
.LABEL	_CHAR	Time Axis Label
.UNITS	_CHAR	Time Axis Units
MORE	EXT	Extension structure
.POLARIMETRY	EXT	Polarimetry Extension
.STOKES_Q	NDF	Q Stokes parameter structure
.DATA_ARRAY(N,M)	_REAL	Stokes Q array
.VARIANCE(N,M)	_REAL	Variance on Q array
.STOKES_U	NDF	U Stokes parameter structure
.DATA_ARRAY(N,M)	_REAL	Stokes U array
.VARIANCE(N,M)	_REAL	Variance on U array

The DATA_ARRAY component shown here may actually be replaced by a structure which holds the data array and other components.

The TSP structure is a special case of the NDF (Extensible N-Dimensional Data Format) described in SGP/38. The main data array of the NDF structure contains the I or Intensity Stokes parameter data. A polarimetry extension structure contains up to 3 additional NDF structures corresponding to the Stokes parameters containing the polarization information. Any number from zero to three of these additional Stokes structures may be present. The above example has the two linear polarization Stokes parameters in structures STOKES_Q and STOKES_U. For circular polarization data a structure called STOKES_V would be used.

The STOKES NDF structures contain only DATA_ARRAY and optionally VARIANCE components. The axis, label and units information pertaining to the Stokes parameters is that in the main structure.

All the data arrays used in TSP are simple or primitive arrays. Other types of data arrays such as SCALED arrays, SPACED arrays etc. described in SGP/38 are not supported at present.

The TITLE, QUALITY and HISTORY components described in SGP/38 are not currently used by TSP. If present they will be propagated from input to output files.

TSP datasets may be one, two or three dimensional. A 1D dataset represents a polarization spectrum. The axis is a wavelength axis. As well as representing spectra the wavelength axis is also used to contain the wavelengths of a small number of broad band channels for data resulting from instruments such as the Hatfield Polarimeter.

2D datasets may be either time series polarization spectra, or polarization images. For time series polarization spectra the first axis is the wavelength axis, and the second axis is the time axis. The time is represented in the form of the Modified Julian Date (MJD = JD - 2400000.5) in a double precision array. Note that special cases of the time series dataset are those with a wavelength axis of size 1, and with no additional Stokes parameters. Thus simple time series photometry can be represented in this way.

3D datasets represent time series imaging (or imaging polarimetry) data.

4 Relationship to FIGARO

Although TSP normally uses the NDF format as described above, a number of commands access raw data from FIGARO format files as this is the raw data format produced by most AAO instruments. It used to be the case that Figaro used a different format from the Starlink NDF format but the latest version of Figaro supports both the old Figaro format (DST files) and the Starlink NDF format. TSP is intended to be used in conjunction with FIGARO for reducing spectropolarimetry data, with FIGARO being used for standard spectroscopy operations such as arc identification and wavelength calibration.

The environment variable or logical name FIGARO_FORMATS controls which of the two formats (DST or NDF) are used by TSP (and by Figaro) when accessing Figaro files. It is suggested that this name be set up as follows:

```
setenv FIGARO_FORMATS "NDF,DST"
```

Which will make the NDF format the default, but will also allow DST files to be read. With this setting it is possible to use Figaro commands on TSP files, but remember that Figaro operations will only apply to the main data array. Figaro will not see the additional data arrays containing the Stokes parameters.

There are a number of commands in TSP with the same name as commands in FIGARO (e.g. XCOPY, SCRUNCH, SPFLUX). This is deliberate as these commands do exactly the same as their FIGARO counterparts, but do it to TSP files rather than to FIGARO files.

5 Spectropolarimetry Reduction Algorithms

Spectropolarimetry reduction involves determining the polarization of the data from observations in two polarization states, the E and O rays produced by a polarizing prism, and two pockels cell states or waveplate positions (for each Stokes parameter) which are referred to as A and B. Thus the polarization is derived from four measurements AE, AO, BE and BO. The reduction should be such that it is insensitive to polarization within the spectrograph, and flat field effects which will give rise to systematic difference between the E and O states, and to time variations in transmission and seeing which will give rise to changes between A and B.

The IPCS2STOKES program uses the simple difference algorithm where the polarization is given by:

$$P = \frac{AE - BE - (AO - BO)}{AE + BE + AO + BO} \tag{1}$$

This algorithm does not fully correct for transmission changes between the polarization states, but since the Pockels cell polarimeter modulates rapidly such effects normally average out and do not cause problems.

The CCD2STOKES and CCD2POL programs give a choice of algorithms. The first algorithm, referred to as the OLD algorithm, since it is the original one used by these programs is a modification of the difference method where the O data is scaled by a factor F as follows:

$$F = \frac{AE + BE}{AO + BO} \tag{2}$$

$$P = \frac{AE - BE - F(AO - BO)}{AE + BE + F(AO + BO)} \tag{3}$$

This scaling makes the algorithm much less sensitive to transmission variations

The alternative algorithm is the RATIO algorithm which is as follows:

$$R^2 = \frac{AE/AO}{BE/BO} \tag{4}$$

$$P = \frac{R - 1}{R + 1} \tag{5}$$

The RATIO algorithm works very well on bright stars, but can fail on faint objects (or on 100% polarized calibration sources) through attempting to take the sqaure root of a negative number. Under these circumstances the OLD algorithm should be used.

6 AAT Pockels Cell Spectropolarimeter Data

6.1 Introduction

The AAT Pockels cell spectropolarimeter can be used with either CCD or IPCS detectors. However, for use with CCD detectors it is now superseded by the wave-plate polarimeter which is much more efficent. The normal mode of operation is to use a two hole decker above the slit defining star and sky apertures, together with a calcite beam splitter. This gives images containing four spectra, star and sky for each of the O and E modes of the calcite. Images of this type are recorded for the two Pockels cell states (referred to as A and B). In the case of IPCS data a single image contains both Pockels cell states. For CCD data two separate images are taken, one in each state. For a more detailed description of the instrument and its operation see McLean et al. (MNRAS **209**, 655, 1984), and the AAO spectropolarimetry manual (AAO UM 24).

A typical observing sequence would consist of observations of the object in two Stokes parameters (Q and U, obtained by inserting different quarter wave plates in the beam), and at two orientations of the instrument usually (90 and 135 degrees). In addition there will be calibration observations of a 100% polarized source (C waveplate position) to calibrate the efficiency of the system, and calibration lamp observations for wavelength calibration. Flux standards may also be observed if flux calibration is required.

6.2 Data reduction sequence

To reduce such a data set requires a combination of Figaro and TSP commands. Figaro is used for the standard spectroscopy parts of the reduction such as arc fitting, and reducing flux standards. TSP is used for the polarimetric parts of the reduction. The basic sequence of reductions is shown in figure 1.

The first step in the reduction is to identify the regions of the image containing the four spectra. Having done this the commands IPCS2STOKES or CCD2STOKES can be used to reduce the raw images to TSP format Stokes spectra. Different observations can then be combined. Note that rotating the instrument through 45 degrees effectively interchanges Q and U. Thus to obtain true Q and U the observations must be combined as follows:

$$Q = Q_{90} + U_{135} \tag{6}$$

$$U = Q_{135} - U_{90} \tag{7}$$

Thus when running IPCS2STOKES or CCD2STOKES the Stokes parameter should be specified as Q for a U_{135} observation and U for a Q_{135} observation. The sign of the U_{90} observation can be inverted with the FLIP command. The COMBINE command can be used to combine different observations in the same stokes parameter.

The Stokes parameter data can be plotted using the SPLOT command to check the progress of the reduction, and the consistency of different observations, before combining them.

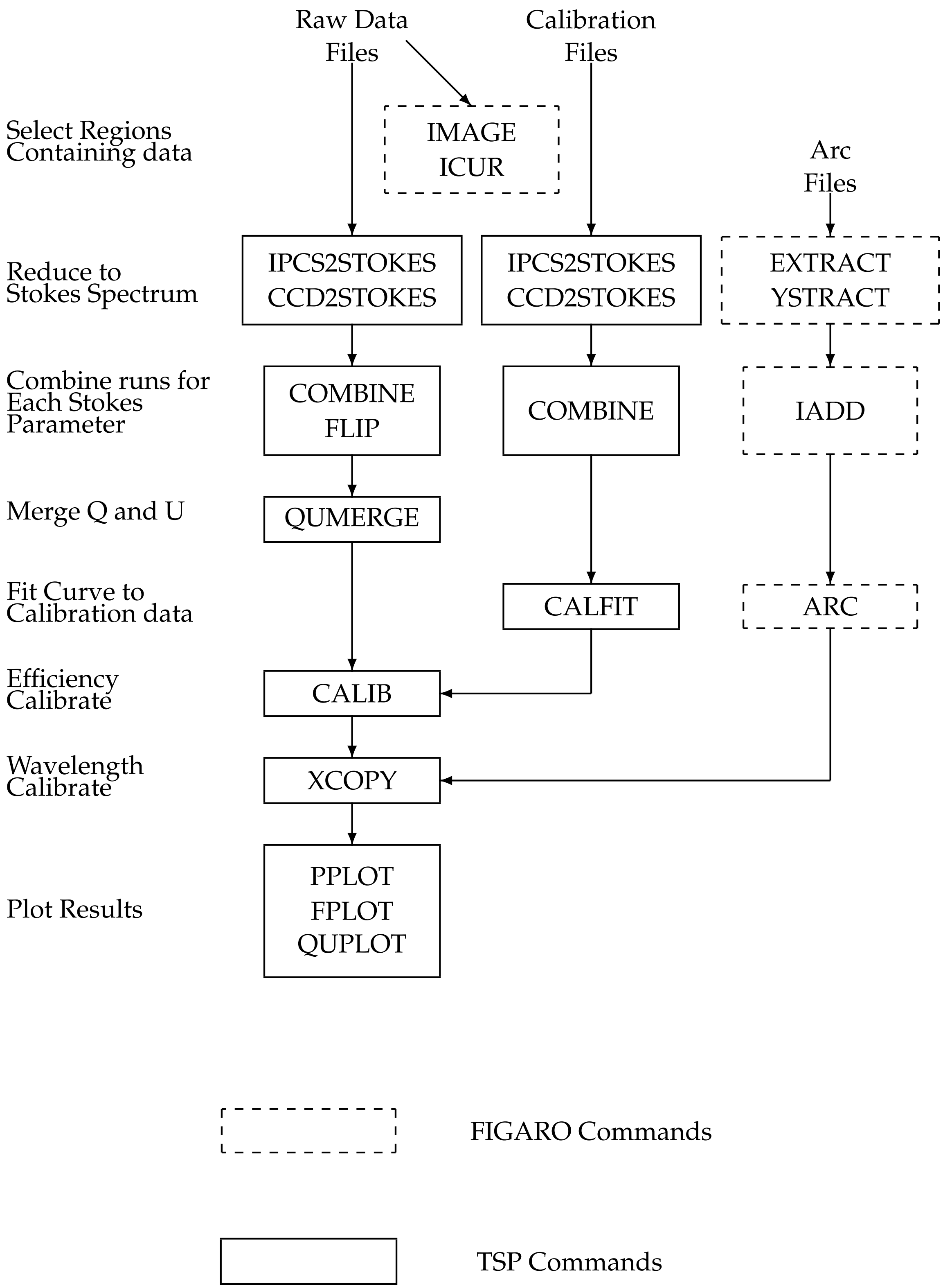
The Q and U observations can be combined into a single file with the QUMERGE command.

It may be found necessary to FLIP the signs of both Stokes parameters to obtain correct position angles (e.g. If the E and O spectra were not correctly identified). It is useful to have observations of polarized standard stars to check the position angle calibration.

6.3 Efficiency Calibration

The efficiency of the polarimetry system is not 100%, and varies with wavelength, particularly if a large wavelength range is being observed. Calibration observations with a 100% polarizer inserted can be used to calibrate this effect. Such observations are reduced using the CCD2STOKES

Figure 1: Procedure for Reduction of Pockels Cell Spectropolarimetry



or IPCS2STOKES commands, and then a Chebyshev polynomial is fitted to the data using the CALFIT command. This calibration curve can then be used to correct other data using the CALIB command.

6.4 Wavelength Calibration

Calibration lamp observations can be fitted using the Figaro ARC program, as described in the Figaro manual. The resulting wavelength calibration can then be copied to a TSP file using the TSP command XCOPY, which is similar to the Figaro command of the same name. If desired the TSP data can then be scrunched (rebinned to a linear wavelength scale) using the TSP SCRUNCH command.

6.5 Flux Calibration

Observations of standard stars can be used to derive a flux calibration curve using the methods described in the Figaro documentation. This calibration curve can then be applied to a TSP polarization spectrum to give a flux calibrated polarization spectrum. Note that TSP does not keep track of the total exposure time as spectra are combined, so the total value must be supplied as a parameter to SPFLUX.

6.6 Plotting Data

There are a number of commands to plot polarization spectra. SPLOT plots a single Stokes parameter, as percentage polarization, together with the intensity spectrum. PPLOT plots percentage polarization, position angle, and intensity. Both these programs use a variable binning technique, to give a constant polarization error per bin.

FPLOT plots data in the form of polarized intensity (or flux). QUPLOT plots a QU diagram.

7 AAT Wave-Plate Spectropolarimeter Data

7.1 Introduction

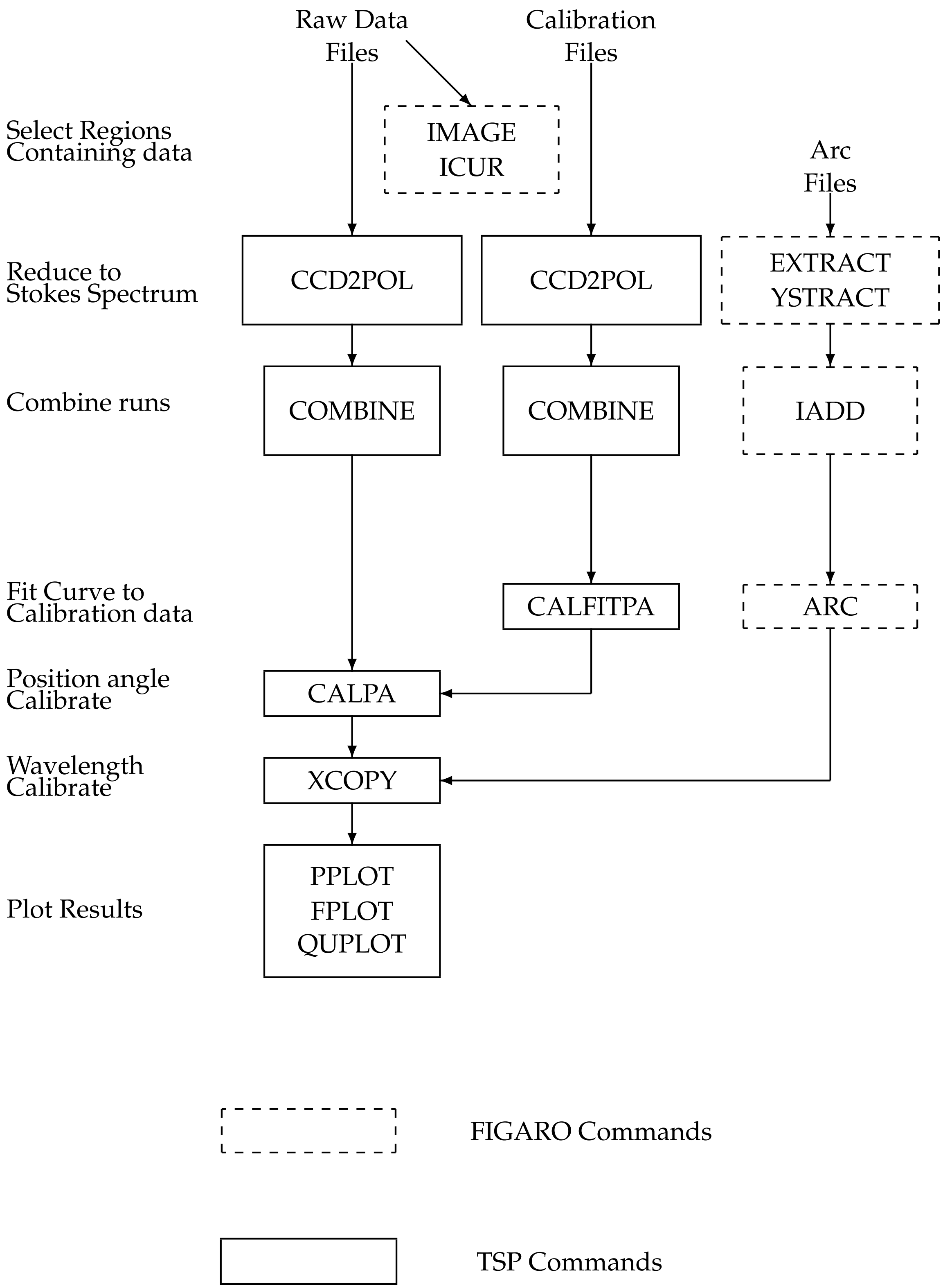
The AAT Wave-plate spectropolarimeter is normally used with CCD detectors. The normal mode of operation is to use a two hole decker above the slit defining star and sky apertures, together with a calcite beam splitter. This gives images containing four spectra, star and sky for each of the O and E modes of the calcite. Images of this type are recorded for four positions of the half-wave plate at angles 0.0, 45.0, 22.5, 67.5 degrees.

Calibration observations can be made by inserting calibration polarizers into the beam. Rotation of the instrument to different position angles is not necessary.

7.2 Data reduction sequence

To reduce such a data set requires a combination of Figaro and TSP commands. Figaro is used for the standard spectroscopy parts of the reduction such as arc fitting, and reducing flux standards.

Figure 2: Procedure for Reduction of Wave-Plate Spectropolarimetry



TSP is used for the polarimetric parts of the reduction. The basic sequence of reductions is shown in figure 2.

The first step in the reduction is to identify the regions of the image containing the four spectra. Having done this the command CCD2POL can be used to reduce the raw images for the four plate positions to TSP format polarization spectra. Different observations can then be combined using the COMBINE command.

The polarization data can be plotted using the PPLOT command to check the progress of the reduction, and the consistency of different observations, before combining them.

7.3 Efficiency Calibration

The efficiency of the wave-plate polarimeter system is very close to 100%, and thus efficiency correction is hardly necessary. If required it can be done with the CALFIT and CALIB commands as described for the Pockels cell polarimeter.

7.4 Position Angle Calibration

An additional complication with the wave-plate polarimeter is that the apparent position angle varies with wavelength as a consequence of the wavelength dependence of the position of the fast axis of the superachromatic plate. This effect can be calibrated by using observations with known position angle, either of a star through the calibration polarizer, or of a polarized standard star. The CALFITPA command can be used to fit a Chebyshev polynomial to the wavelength dependence of the position angle, and this calibration curve can then be applied to observations using the CALPA command.

7.5 Wavelength Calibration

Calibration lamp observations can be fitted using the Figaro ARC program, as described in the Figaro manual. The resulting wavelength calibration can then be copied to a TSP file using the TSP command XCOPY, which is similar to the Figaro command of the same name. If desired the TSP data can then be scrunched (rebinned to a linear wavelength scale) using the TSP SCRUNCH command.

7.6 Flux Calibration

Observations of standard stars can be used to derive a flux calibration curve using the methods described in the Figaro documentation. This calibration curve can then be applied to a TSP polarization spectrum to give a flux calibrated polarization spectrum. Note that TSP does not keep track of the total exposure time as spectra are combined, so the total value must be supplied as a parameter to SPFLUX.

7.7 Plotting Data

There are a number of commands to plot polarization spectra. SPLOT plots a single Stokes parameter, as percentage polarization, together with the intensity spectrum. PPLOT plots percentage polarization, position angle, and intensity. Both these programs use a variable binning technique, to give a constant polarization error per bin.

FPLOT plots data in the form of polarized intensity (or flux). QUPLOT plots a QU diagram.

8 CGS2 and CGS4 Spectropolarimetry Data

The UKIRT cooled grating spectrometers CGS4 and CGS2 can be used for spectropolarimetry in conjnuction with the IRPOL polarimetry module which is used to rotate a half-wave plate in front of the instrument. In conjunction with a wire grid polarizer in the dewar this results in data from which linear polarization can be derived. A typical procedure for reduction of such data is illustrated in figure 3. Note that the order of the various calibration steps is generally not critical (e.g. flux calibration may be done before PA and efficiency calibration).

The same procedure should be applicable to CVF spectropolarimetry data obtained with the UKT6 and UKT9 instruments.

8.1 Reducing CGS4 data

The program CGS4POL takes four CGS4 reduced group files containing observations at waveplate angles of 0, 45, 22.5 and 67.5 degrees and extracts the spectra to obtain a polarization spectrum. The data files should contain positive and negative spectra, obtained by sliding between two slit positions for the star. Parameters of CGS4POL are the positions of the two apretures to extract the star data from, and the name (A or B) of the aperture containing the star.

8.2 Reading CGS2 data files

The RCGS2 command reads raw CGS2 data files and produces TSP polarization spectra. RCGS2 can also perform despiking of data by specifying a cutoff level. Any points which deviate from the mean by more than this cutoff times the sigma for the wavelength are removed.

At this stage the data can be plotted using the EPLOT command to judge the quality of the data.

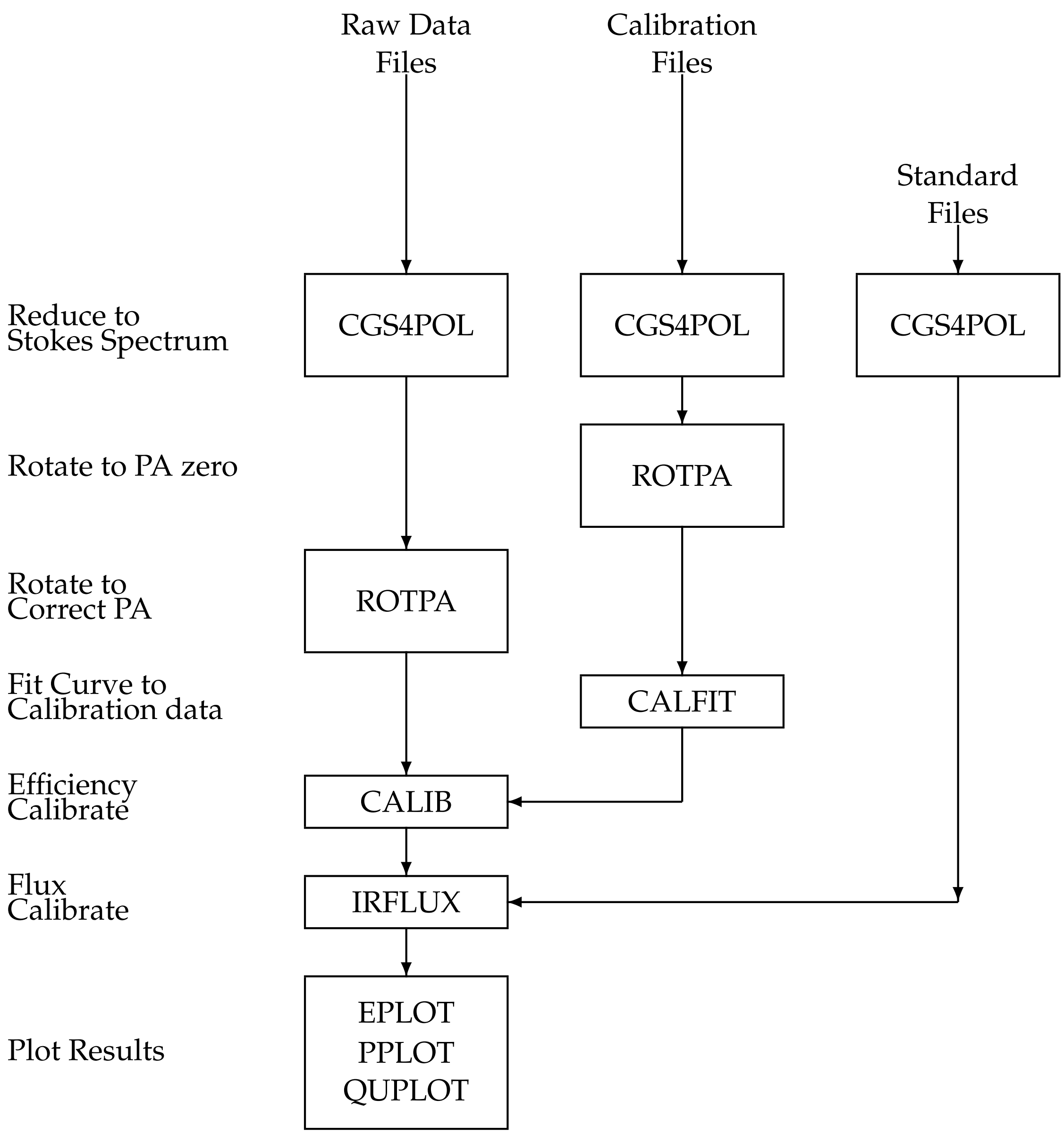
8.3 Position angle calibration

The only correction needed is a correction for position angle zero point. This can be determined by looking at an observation of a standard with known position angle, and then applied to the data using the ROTPA command, which rotates the position angle of a dataset through a specified angle. The PTHETA command may be useful in accurately determining the position angle for a section of the spectrum of a standard.

8.4 Efficiency calibration

The half-wave plates and wire grid polarizers used will not give 100% efficiency, and the efficiency will normally be wavelength dependent. To calibrate for this effect an observation of a 100% polarized source should be made using the calibration wire grid polarizer. This observation can be reduced using CGS4POL or RCGS2. It should then be rotated using ROTPA so that the position angle is zero which puts all the polarization into the Q Stokes parameter. CALFIT can then be used to fit a calibration curve to this data. The CALIB command is then used to apply this calibration curve to other datasets.

Figure 3: Procedure for Reduction of CGS4 Spectropolarimetry



8.5 Flux Calibration

The IRFLUX command can be used to flux calibrate data, using an observation of a standard star. IRFLUX models the standard star as a black body of a given temperature. The flux of the standard may be specified as a magnitude in one of the standard bands (JHKLM) or as a flux in mJy at a specified wavelength. The flux calibrated data is in mJy. It may be converted to F_λ using the FLCONV command if desired.

8.6 Plotting Data

IR spectropolarimetry may be plotted using any of the commands described for optical spectropolarimetry (PPLOT, FPLOT, QUPLOT). However with the smaller number of spectral points the EPLOT command, which plots flux, P and Theta with error bars, will often be found more appropriate than the constant error binning approach used by PPLOT. Data may be plotted at any stage in the reduction after RCGS2 or CGS4POL.

9 Time Series Data

9.1 Input of Data

Time series data handled by TSP can come from a variety of sources, and can range from simple single channel photometry, to multichannel polarimetric data. There are a number of routines which allow time series data to be read into the system:

RHATHSP — Reads high speed photometry data taken with the Hatfield polarimeter, working in its 5 channel photometer mode.

RHATPOL — Reads 6 channel polarimetry data taken with the Hatfield polarimeter.

RHSP3 — Reads tapes created with the HSP3 high speed photometry system at the AAT.

RIRPS — Reads time series infrared photometry obtained with the AAO Infrared Photometer Spectrometer (IRPS).

RTURKU — Reads files containing data from the University of TURKU UBVRI polarimeter. These data sets have 5 channels and can include either linear or linear plus circular polarization.

Time series photometry and polarimetry can also be extracted from time series imaging data as described later.

9.2 Processing Data

Processing of time series data includes the following options.

LTCORR — This corrects a time series dataset for light travel time, yielding a heliocentric or barycentric time axis.

TEXTIN — This corrects a time series dataset for atmospheric extinction.

TMERGE — This merges two time series datasets. The two datasets must have the same number of channels. Because TSP does not require the time axis of datasets to be evenly spaced it is possible to combine observations taken even years apart into a single file.

TBIN — Bin a time series into time bins of a specified size.

TDERIV — Calculate a new time series which is the time derivative of the intensity data in a time series.

9.3 Plotting Time Series Data

The following commands are available for plotting time series data:

TSPLOT — Plots time series data against time. There are lots of options to plot up to six items which can be different channels, polarization components etc. The plotted data can be binned if necessary.

PHASEPLOT — Plots time series data against phase on some period. There are similar options to those in TSPLOT.

QPLOT — A 'quick' version of TSPLOT with less options.

10 Imaging Polarimetry Data

TSP can be used to reduce imaging polarimetry data obtained with IRIS at the AAT. The command IRISPOL is used to generate a polarization image from a set of four observations at the four waveplate positions. IRISAP can be used to derive aperture polarimetry of a star from such a set of four images. See the AAO IRIS manual for more details.

IMPOL can be used to generate a polarization image from a single beam polarimeter such as IRPOL/IRCAM at UKIRT.

TSP polarization images can be plotted with the AAOPLOT program (not part of TSP but a separate ADAM package). ROTPA can be used to calibrate the position angle of an image and images can be combined with COMBINE.

These commands may also be found useful for other imaging polarimeters working at optical as well as IR wavelengths. Use IRISPOL for dual beam instruments which give simultaneous images in E and O states, and use IMPOL for single beam instruments.

11 Three dimensional data

TSP uses three dimensional datasets to represent time series images. There are two commands which enable such data to be read into TSP.

BUILD3D — This command is used to build a three dimensional dataset from a number of individual Figaro frames.

RCCDTS — Reads times series data obtained with the time series mode of the AAO CCD systems.

11.1 Displaying time series images

The DISPLAY command enables time series imaging data to be displayed on an image display device. Once displayed a COMMAND mode enables a number of options to be selected. Any indivdual frame may be displayed. A series of frames may be displayed as a movie. A cursor may be put up to read positions or data values.

11.2 Extracting Light Curves from Time Series Images

The commands described here are used to obtain the light curve of a star from a time series image. First it is necessary to subtract sky using the command SKYSUB which is based on the use of two sky areas on either side of a star.

CCDPHOT can then be used to perform aperture photometry of the star to obtain a light curve. CCDPOL is a similar command that obtains polarimetry from observed through an instrument such as the AAO faint object polarimeter which produces E and O images from a wollaston prism.

As an alternative to CCDPHOT, the commands TSPROFILE and TSEXTRACT can be used to determine a profile which is a smoothly varying function of time, and extract the photometry using an optimal weighted combination of pixels. The procedure is the 3 dimensional analogue of the optimal extraction technique for extracting spectra of stars from long slit data. For the technique to be succesful it is important that the image does not show rapid motion (e.g. due to seeing or tracking problems) that cannot be adequately represented by a low order polynomial fitted through the dataset.

11.3 Image motion and software tip/tilt correction

This pair of commands enable the image motion in a time series image to be studied and allow the software analogue of 'tip-tilt' correction to be applied to the data. When applied to a time series which consists of very short exposure images, the translational component of seeing can be removed enabling significant reduction in image sizes. This has enabled a FWHM for star images of 0.37 arc seconds to be achieved on data taken with infrared camera IRIS on the AAT.

12 Writing TSP programs

Programs to access TSP data files should be written to make use of the TSP subroutine library (TSPSUBS) rather than making direct use of the HDS DAT_ routines. The TSPSUBS routines are described in Appendices C and D. They allow the building of new TSP structures, the reading and writing of items from the structures, and the mapping of data arrays (data arrays are always accessed by mapping in TSP programs. The only DAT_ routines that are used in TSP programs are those associated with the ADAM parameter system such as DAT_CREAT and DAT_ASSOC, and also DAT_ANNUL. Below is an example of an ADAM A-task that makes a copy of a TSP data structure using the routine TSP_COPY

```
      SUBROUTINE COPY(STATUS)
*
*  Copy a TSP structure
*
      IMPLICIT NONE
      INTEGER STATUS
      INCLUDE 'SAE_PAR'
      CHARACTER*(DAT__SZLOC) LOC,LOC2


      CALL DAT_ASSOC('INPUT','READ',LOC,STATUS)
      CALL DAT_CREAT('OUTPUT','NDF',0,0,STATUS)
      CALL DAT_ASSOC('OUTPUT','WRITE',LOC2,STATUS)
      CALL TSP_COPY(LOC,LOC2,STATUS)
      CALL DAT_ANNUL(LOC,STATUS)
      CALL DAT_ANNUL(LOC2,STATUS)

      END
```

Such a program could be linked with the command

```
alink copy `tsp_link_adam`
```

on UNIX systems, and

```
$ ALINK COPY,TSP_DIR:TSPSUBS
```

on VAX/VMS systems.

13 New Features in TSP version 2.3

13.1 New Command

The command IRISPOLC to reduce imaging circular polarization data taken with IRIS has been added.

13.2 Bug fixes

A bug in the IRISPOL command when the OLD algorithm was used has been fixed.

13.3 Other Changes

The code has been revised to remove use of the NAG library, by replacing it with the PDA library. The code now compiles under linux.

14 New Features in TSP version 2.2

14.1 New Commands

The command SLIST can be used to list in the form of an ASCII file the data from a polarization spectrum. The IRISAPC command is similar to the IRISAP command but used for circular polarization data.

14.2 Bug Fixes

Errors in the interface files of some of the IRIS reduction programs have been corrected. A bug in CCDPOL which resulted in errors unmapping the data has been fixed.

15 New Features in TSP version 2.1

15.1 UNIX version

TSP 2.1 is the first UNIX release of TSP. All features of the VAX/VMS version are now available on UNIX systems. On UNIX commands are entered directly from the shell rather than from ICL, and must be entered in lower case.

15.2 Imaging Polarimetry Commands

The commands IRISPOL and IRISAP have been added to reduce imaging polarimetry data obtained with IRIS at the AAT. The IMPOL command can be used to reduce data from single beam polarimeters such as IRCAM/IRPOL at UKIRT. Other commands such as ROTPA and COMBINE have been enhanced to handle imaging as well as spectropolarimetry data.

15.3 CGS4 Spectropolarimetry

The command CGS4POL has been added for reduction of spectropolarimetry data obtained with the CGS4 instrument at UKIRT.

16 New Features in TSP version 2.0

16.1 New Commands

16.1.1 Commands for spectropolarimetry reduction

CALFITPA — Fit a calibration curve to polarization position angle

CALPA — Position angle calibrate a polarization spectrum

CCD2POL — Reduce CCD Spectropolarimetry Data

DIVIDE — Divide a polarization spectrum by an intensity spectrum

EXTIN — Correct a polarization spectrum for extinction

FLCONV — Convert a flux calibrated spectrum to F-lambda

LMERGE — Merge two polarization spectra

16.1.2 IR Spectropolarimetry

EPLOT — Plot a polarization spectrum as P, Theta with error bars

IRFLUX — Apply Flux calibration to an infrared polarization spectrum

RCGS2 — Read CGS2 Polarimetry data

ROTPA — Rotate position angle of a polarization spectrum

16.1.3 Time Series Data

LHATPOL — List Hatfield Polarimeter Infrared Data

RHATPOL — Read Hatfield Polarimeter Data

TEXTIN — Correct a time series dataset for extinction

TLIST — List time series data to a file

TSETBAD — Inteactively mark bad points in a time series

16.1.4 Time Series Imaging Data

BUILD3D — Insert a Figaro frame into a time series image

CCDPHOT — Photometry of a star on a time series image

CCDPOL — Polarimetry of a star on a time series image

DISPLAY — Display a time series image on an image display device

IMOTION — Analyze the image motion in a time series image

RCCDTS — Read AAO CCD Time Series data

SKYSUB — Subtract sky from a time series image

SHIFTADD — Add frames correcting for image motion

TSEXTRACT — Optimal extraction of a light curve from a time series image

TSPROFILE — Determine a spatial profile from a time series image

16.1.5 General

DSTOKES — Delete a Stokes Parameter from a dataset

16.2 TSPSUBS library

The TSPSUBS library has been extended to support 3 dimensional datasets (time series images) and rewritten to make use of the NDF package rather than direct calls to HDS. This means that TSP now supports SIMPLE as well as PRIMITIVE NDFs and will benefit from subsequent additions to the NDF package.

16.3 Figaro File access

All access to Figaro files is now through the DSA package, allowing TSP to benefit from the new Figaro 3.0 feature of accessing NDF files as well as DST files. Now that Figaro supports NDF it is not strictly necessary for TSP to use DSA at all, since it could access Figaro files via NDF. However, for the moment the use of DSA has been retained to allow DST files to be accessed as well, which is particularly convenient when working on old data.

16.4 Bad Pixel Handling

Most TSP commands now support the handling and propagation of bad pixels.

A TSP commands

`BUILD3D`: Insert a figaro frame into a time series image

`CALFIT`: Fit a calibration curve to a polarization spectrum

`CALIB`: Efficiency Calibrate a Polarization Spectrum

`CALPA`: Position Angle Calibrate a Polarization Spectrum

`CCD2POL`: Reduce `CCD` spectropolarimetry data.

`CCD2STOKES`: Reduce `CCD` spectropolarimetry data.

`CCDPHOT`: Photometry of a star on a time series image

`CCDPOL`: Polarimetry of a star on a time series image

`CGS4POL`: Reduce `CGS4` spectropolarimetry data.

`CMULT`: Multiply a polarization spectrum by a constant

`COMBINE`: Combine two Polarization Datasets

`DIVIDE`: Divide a polarization spectrum by an intensity spectrum

`DSTOKES`: Delete a Stokes parameter from a dataset.

`EPLOT`: Plot a polarization spectrum as P, Theta with error bars

`EXTIN`: Correct a polarization spectrum for extinction

`FLCONV`: Convert a flux calibrated spectrum to f-lambda

`FLIP`: Invert the sign of the Stokes parameter in a spectrum.

`FPLOT`: Plot a polarization spectrum as Polarized Intensity

`IMOTION`: Analyze the image motion in a time series image

`IMPOL`: Reduce `IR` Polarization images

`IPCS2STOKES`: Reduce `IPCS` spectropolarimetry data.

`IRFLUX`: Apply flux calibration to an infrared polarization spectrum

`IRISAP`: Measure polarization within an aperture for `IRIS` data

`IRISAPC`: Measure circular polarization within an aperture for `IRIS` data

`IRISPOL`: Reduce `IRIS` imaging polarimetry data.

`LHATPOL`: List Hatfield Polarimeter Infrared Data

`LMERGE`: Merge two polarization spectra.

`LTCORR`: Apply Light Time corrections to the time axis of a data set.

`PHASEPLOT`: Plot time series data against phase.

`PPLOT`: Plot a polarization spectrum as P, Theta

`PTHETA`: Output the P and Theta values for a polarization spectrum

`QPLOT`: Quick plot of time series data.

`QUMERGE`: Merge Q and U spectra into single dataset.

`QUPLOT`: Plot a polarization spectrum in the Q,U plane.

`QUSUB`: Subtract a Q,U vector from a polarization spectrum.

`RCCDTS`: Read `AAO` `CCD` Time Series data

`RCGS2`: Read `CGS2` Polarimetry Data

`REVERSE`: Reverse a spectrum in the wavelength axis.

`RFIGARO`: Read a Stokes Parameter Spectrum from a Figaro image

`RHATHSP`: Read Hatfield Polarimeter High Speed Photometry Data

`RHATPOL`: Read Hatfield Polarimeter Data

`RHDSPLOT`: Read `ASCII` files of Hatfield Polarimeter Data.

`RHSP3`: Read an `HSP3` tape

`RIRPS`: Read `IRPS` Photometry Data

`ROTPA`: Rotate the Position Angle of a Polarization Dataset

`RTURKU`: Read `ASCII` files of Data from the Turku `UBVRI` Polarimeter.

`SCRUNCH`: Rebin a Polarization Spectrum.

`SKYSUB`: Subtract Sky from a time series image dataset

`SPFLUX`: Apply flux calibration to a polarization spectrum

`SPLOT`: Plot a polarization spectrum with a single Stokes parameter

`SUBSET`: Take a subset of a dataset in wavelength or time axes.

`SUBTRACT`: Subtract two Polarization spectra.

`TBIN`: Bin a time series

`TCADD`: Add Channels of a time series dataset

`TDERIV`: Calculate Time Derivative of a Dataset.

`TEXTIN`: Correct a time series dataset for extinction.

`TLIST`**:** List time series data to a file.

`TMERGE`**:** Merge two time series datasets.

`TSETBAD`**:** Interactively mark bad points in time series

`TSEXTRACT`**:** Optimal extraction of a light curve from a time series image

`TSHIFT`**:** Apply a time shift to a dataset.

`TSPLOT`**:** Plot time series data.

`TSPROFILE`**:** Determine a spatial profile from a time series image

`XCOPY`**:** Copy Wavelength Data from a Figaro Spectrum

`IMPOL`**:** Reduce `IR` Polarization images

`IRISAPC`**:** Measure circular polarization within an aperture for `IRIS` data

`IRISPOLC`**:** Reduce `IRIS` imaging circular polarimetry data.

B Detailed Command Descriptions

These command descriptions (and the TSPSUBS descriptions) were generated from comments in the source code using William Lupton's MAN utility. In the parameter lists numbers indicate positions of parameters on the command line. H indicates a hidden parameter, one that is not prompted for but must be explicitly specified on the command line. C indicates a parameter which is conditional on the value of some other parameter (i.e. MAX is only prompted for if AUTO is False).

BUILD3D
Insert a figaro frame into a time series image

Function

Insert a figaro frame into a time series image

Description

BUILD3D is used to create a time series image from a number of figaro images. Each invocation of BUILD3D inserts one frame into the time series. A new time series dataset can be created by specifying the NEW parameter and the required number of frames The date and time of each frame is obtained from the FITS header if possible - otherwise it is prompted for.

Parameters

1	FIGARO	Char	The Figaro files to insert.
2	FRAME	Integer	The frame number at which to insert it.
3	NEW	Logical	TRUE to create a new time series.
4	OUTPUT	TSP, 3D	The output time series dataset.
	FRAMES	Integer	The number of frames in the time series.
	UTDATE	Char	The UT date of the frame
	UT	Char	The UT time of the frame

Support

Jeremy Bailey, AAO

Version date

07/03/1992

CALFIT

Fit a calibration curve to a polarization spectrum

Function

Fit a calibration curve to a polarization spectrum

Description

The AAO Spectropolarimeter allows the insertion of a polarizer which gives a 100% circular polarization for calibrating the efficiency of the instrument. CALFIT is used to fit a Chebyshev polynomial to an observed stokes parameter spectrum obtained with this calibrator. The fitted curve is output as another Stokes spectrum which may be used to calibrate other datasets using the CALIB command.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum with one Stokes parameter which will be fitted.
2	DEGREE	Integer	The degree of the polynomial to be fitted.
3	OUTPUT	TSP, 1D	The output dataset, equivalent in structure to INPUT, but with Intensity array set to unity, and the Stokes array containing the fitted curve. The variance is set to zero.

Support

Jeremy Bailey, AAO

Version date

28/4/1988

CALIB
Efficiency Calibrate a Polarization Spectrum

Function

Efficiency Calibrate a Polarization Spectrum

Description

A polarization spectrum is corrected for instrument efficiency by applying a calibration curve obtained using the CALFIT command. The spectrum to be corrected may have any number of Stokes Parameters.

CALIB leaves the intensity data unafected, but scales the Stokes parameters according to the calibration curve, and the variances of the Stokes parameters by the square of the calibration value.

Parameters

1	INPUT	TSP, 1D	The Polarization spectrum to be corrected.
2	CALIB	TSP, 1D	The calibration spectrum.
3	OUTPUT	TSP, 1D	The output corrected dataset.

Support

Jeremy Bailey, AAO

Version date

19/11/1991

CALPA
Position Angle Calibrate a Polarization Spectrum

Function

Position Angle Calibrate a Polarization Spectrum

Description

A polarization spectrum is corrected for wavelength dependent position angle zero point by applying a calibration curve obtained using the CALFITPA command.

This command is needed for polarimeters which are based on the use of a superachromatic half-wave plate, since such a plate shows significant cyclic wavelength variations of the position of its fast axis.

Parameters

1	INPUT	TSP, 1D	The Polarization spectrum to be corrected.
2	CALIB	TSP, 1D	The calibration spectrum.
3	OUTPUT	TSP, 1D	The output corrected dataset.

Support

Jeremy Bailey, AAO

Version date

20/11/1991

CCD2POL
Reduce CCD spectropolarimetry data.

Function

Reduce CCD spectropolarimetry data.

Description

CCD2POL reduces data obtained with the AAO Half-wave plate spectropolarimeter with the CCD as detector. The data for a single observation consists of four Figaro files containing the frames for plate position 0, 45, 22.5 and 67.5 degrees. Within each frame there are four spectra corresponding to the O and E rays for each of two apertures (A and B). These spectra are combined to derive a polarization spectrum in TSP format. The CCD data are expected to be in raw CCD format which is the wrong way round for Figaro. i.e. the Y axis is the dispersion direction. Thus if the data is preprocessed using Figaro it will have to be rotated back.

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

The variances on the polarization data are calculated from photon statistics plus readout noise.

If the spectra are laid out in columns with the aperture A spectrum in columns 5 to 7 (O) and columns 17 to 19 (E) and the aperture B spectrum in columns 30 to 32 (O) and 42 to 44 (E) then the parameters should be set as follows ASTART=5, BSTART=30, OESEP=12, WIDTH=3.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 45.0.
3	POS3	Char	The Figaro data file for position 22.5.
4	POS4	Char	The Figaro data file for position 67.5.
	ASTART	Integer	The Start column for the A aperture data.
	BSTART	Integer	The Start column for the B aperture data.
	OESEP	Integer	The distance in columns from the start of the O spectrum to the start of the E spectrum.
	WIDTH	Integer	The number of columns to include in each extracted spectrum.
	APERTURE	Char	The aperture containing the star (A or B).
	BIAS	Real	Bias level to be subtracted from data.
	READNOISE	Real	CCD readout noise (electrons/pixel).
	PHOTADU	Real	Photons per ADU for the CCD data.
	ALGORITHM	Char	The Algorithm to use for stokes parameter calculation (OLD, RATIO)
	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

2/10/1991

CCD2STOKES
Reduce CCD spectropolarimetry data.

Function

Reduce CCD spectropolarimetry data.

Description

CCD2STOKES reduces data obtained with the AAO Pockels cell spectropolarimeter with the CCD as detector. The data for a single observation consists of two Figaro files containing the A and B state frames. Within each A and B frame there are four spectra corresponding to the O and E rays for each of two apertures (A and B). These spectra are combined to derive a Stokes parameter spectrum in TSP format. The CCD data are expected to be in raw CCD format which is the wrong way round for Figaro. i.e. the Y axis is the dispersion direction. Thus if the data is preprocessed using Figaro it will have to be rotated back.

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

CCD2STOKES can also be used to reduce circular polarization data obtained with the wave-plate polarimeter. The equivalent of the A and B state data are the frames taken at two positions of a quarter-wave plate spaced by 90 degrees.

Parameters

1	AFIGARO	Char	The Figaro A-state data file.
2	BFIGARO	Char	The Figaro B-state data file.
	ASTART	Integer	The Start column for the A aperture data.
	BSTART	Integer	The Start column for the B aperture data.
	OESEP	Integer	The distance in columns from the start of the O spectrum to the start of the E spectrum.
	WIDTH	Integer	The number of columns to include in each extracted spectrum.
	APERTURE	Char	The aperture containing the star (A or B).
	BIAS	Real	Bias level to be subtracted from data.
	READNOISE	Real	CCD readout noise (electrons/pixel).
	PHOTADU	Real	Photons per ADU for the CCD data.
	STOKESPAR	Char	The Stokes parameter (Q,U,V).
	ALGORITHM	Char	The Algorithm to use for stokes parameter calculation (OLD, RATIO)
	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

20/11/1991

CCDPHOT
Photometry of a star on a time series image

Function

Photometry of a star on a time series image

Description

Measure the brightness of a star on each frame of a time series image, and generate a 2D TSP dataset containing the resulting time series photometry. The data should previously have been sky subtracted.

The photometry is done by means of summing the signal within a specified aperture. An alternative method is to use the commands TSPROFILE and TSEXTRACT which perform photometry weighting according to a smoothed spatial profile.

Parameters

1	INPUT	TSP, 3D	The time series image dataset.
2	OUTPUT	TSP, 2D	The output photometry dataset
3	X	Real	X position of centre of star
4	Y	Real	Y position of centre of star
5	RADIUS	Real	Radius of aperture (pixels)
6	LAMBDA	Real	Wavelength of observation (microns)
7	FLUXCAL	Real	Counts per Jansky

Support

Jeremy Bailey, AAO

Version date

20/11/1991

CCDPOL
Polarimetry of a star on a time series image

Function

Polarimetry of a star on a time series image

Description

Measure the brightness of the O and E images of a star on each frame of a time series image, and generate a 2D TSP dataset containing the resulting time series polarimetry. The data should previously have been sky subtracted.

Aperture photometry is performed on each of the two star images and used to derive the polarization. A polarization offset can be applied to correct for instrumental effects.

Parameters

1	INPUT	TSP, 3D	The time series image dataset.
2	OUTPUT	TSP, 2D	The output photometry dataset
3	XE	Real	X position of centre of E image
4	YE	Real	Y position of centre of E image
5	RADIUS	Real	Radius of aperture (pixels)
6	XO	Real	X position of centre of O image
7	YO	Real	Y position of centre of O image
8	LAMBDA	Real	Wavelength of observation (microns)
9	STOKESPAR	Real	Stokes Parameter (Q,U,V)
10	OFFSET	Real	Polarization offset (per cent)
11	FLUXCAL	Real	Counts per Jansky

Support

Jeremy Bailey, AAO

Version date

2/4/1995

CGS4POL
Reduce CGS4 spectropolarimetry data.

Function

Reduce CGS4 spectropolarimetry data.

Description

CGS4POL reduces data obtained with the CGS4 instrument at UKIRT used in its spectropolarimetry mode. The data for a single observation consists of four Figaro files containing the frames for plate position 0, 45, 22.5 and 67.5 degrees. Within each frame there should be two spectra corresponding to two slit positions. These spectra are combined to derive a polarization spectrum in TSP format.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 45.0.
3	POS3	Char	The Figaro data file for position 22.5.
4	POS4	Char	The Figaro data file for position 67.5.
	ASTART	Integer	The Start channel for the A aperture data.
	BSTART	Integer	The Start channel for the B aperture data.
	WIDTH	Integer	The number of channels to include in each spectrum.
	APERTURE	Char	The aperture containing the star (A or B).
	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

10/11/1992

CMULT
Multiply a polarization spectrum by a constant

Function

Multiply a polarization spectrum by a constant

Description

The intensity and stokes parameters are multiplied by the specified factor and the variances are multiplied by the square of the specified factor

Parameters

1	INPUT	TSP, 1D	The input spectrum to be multiplied.
2	FACTOR	Real	Factor to multiply by
3	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

20/11/1990

COMBINE
Combine two Polarization Datasets

Function

Combine two Polarization Datasets

Description

Two Polarization datasets are added to form a new one of higher signal to noise ratio. Any number of Stokes parameters may be present in the data, but only Stokes parameters present in both spectra will appear in the output.

`COMBINE` adds the intensity, Stokes parameters and variances and is therefore appropriate for combining data in the form of `IPCS` or `CCD` counts, but not for combining flux calibrated data.

Parameters

1	`INPUT1`	`TSP`, nD	The first input dataset.
2	`INPUT2`	`TSP`, nD	The second input dataset.
3	`OUTPUT`	`TSP`, nD	The output dataset.

Support

Jeremy Bailey, `AAO`

Version date

8/5/1993

`DIVIDE`
Divide a polarization spectrum by an intensity spectrum

Function

Divide a polarization spectrum by an intensity spectrum

Description

Divide a polarization spectrum by the intensity spectrum from another dataset. This can be used to divide data by a smooth spectrum star to remove atmospheric features.

The intensity and Stokes parameters of the first spectrum are divided by the intensity of the second spectrum. The variances are also scaled accordingly. The spectrum being divided by is assumed to have no errors.

Parameters

1	INPUT1	TSP, 1D	The input spectrum to be divided.
2	INPUT2	TSP, 1D	The spectrum to divide by.
3	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

5/12/1991

DSTOKES
Delete a Stokes parameter from a dataset.

Function

Delete a Stokes parameter from a dataset.

Description

Delete a Stokes component from the polarimetry extension of a data structure.

Parameters

1	INPUT	TSP, nD	The input Stokes dataset.
2	STOKESPAR	Char	The Stokes parameter (Q, U or V)
3	OUTPUT	TSP, nD	The output dataset.

Support

Jeremy Bailey, AAO

Version date

8/3/1992

EPLOT

Plot a polarization spectrum as P, Theta with error bars

Function

Plot a polarization spectrum as P, Theta with error bars

Description

EPLOT produces a plot of a polarization spectrum. The plot is divided into three panels. The lower panel is the total intensity, the center panel is the percentage polarization, the top panel is the position angle in degrees. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum which must have Q and U Stokes parameters present.
2	DEVICE	Device	The Graphics device (any valid GKS device).
3	LABEL	Char	A label for the plot.
	AUTO	Logical	True if plot is to be autoscaled.
C	IMIN	Real	Minimum Intensity level to plot.
C	IMAX	Real	Maximum Intensity level to plot.
C	PMIN	Real	Minimum Polarization level to plot.
C	PMAX	Real	Maximum Polarization level to plot.
H	THETA	Real	Shift in angle to apply to theta plot. Plot range is THETA to 180+THETA.

Support

Jeremy Bailey, AAO

Version date

6/12/1991

EXTIN
Correct a polarization spectrum for extinction

Function

Correct a polarization spectrum for extinction

Description

Correct a polarization spectrum for extinction using a coefficient spectrum containing the interpolated extinxtion coefficients over the wavelength range of the spectrum. This can be generated using Figaro as described in the section on extinction in the Figaro manual.

Parameters

1	INPUT	TSP, 1D	The input spectrum to be corrected.
2	COEFF	Char	The name of the Figaro file containing the coefficient spectrum.
3	AIRMASS	Real	The air-mass (approximately sec z) of the observation.
4	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

6/12/1991

FLCONV
Convert a flux calibrated spectrum to f-lambda

Function

Convert a flux calibrated spectrum to f-lambda

Description

A polarization spectrum flux calibrated in f-nu (Jy, mJy or micro-Jy) is converted to f-lambda (ergs/sec/cm**2/A). The units of the original data are sensed from the UNITS field of the axis structure. The spectrum must have a wavelength axis in Angstroms.

This program is similar to the Figaro command of the same name, but applies the calibration to the Stokes parameters as well as to the intensity data.

Parameters

1	INPUT	TSP, 1D	The input spectrum to be converted.
2	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

6/12/1991

FLIP
Invert the sign of the Stokes parameter in a spectrum.

Function

Invert the sign of the Stokes parameter in a spectrum.

Description

The Stokes array in the input dataset is sign changed to produce the Stokes array of the output dataset.

Parameters

1	INPUT	TSP, 1D	The input Stokes dataset.
2	OUTPUT	TSP, 1D	The output dataset.

Support

Jeremy Bailey, AAO

Version date

27/4/1988

FPLOT
Plot a polarization spectrum as Polarized Intensity

Function

Plot a polarization spectrum as Polarized Intensity

Description

FPLOT produces a plot of a polarization spectrum. The plot is divided into two panels. The lower panel is the total intensity, the top panel is the polarized intensity (or polarized flux).

The polarized intensity data is binned into fixed size bins of size specified by the BINSIZE parameter. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum which must have both Q and U Stokes parameters or the V Stokes parameter present.
2	BINSIZE	Integer	The number of spectral channels per bin
3	DEVICE	Device	The Graphics device (any valid GKS device).
4	LABEL	Char	A label for the plot.
	AUTO	Logical	True if plot is to be autoscaled.
C	IMIN	Real	Minimum Intensity level to plot.
C	IMAX	Real	Maximum Intensity level to plot.
C	PMIN	Real	Minimum Polarization level to plot.
C	PMAX	Real	Maximum Polarization level to plot.

Support

Jeremy Bailey, AAO

Version date

9/12/1991

IMOTION
Analyze the image motion in a time series image

Function

Analyze the image motion in a time series image

Description

Given a time series image produce an output time series which is a measure of the image motion in the 2 axes. The first channel of the output time series is the image motion in X and the second channel is the image motion in Y

Parameters

1	INPUT	TSP, 3D	The time series image dataset.
2	TEMPLATE	TSP, 2D	An image to be used as a template against which motion will be measured.
3	OUTPUT	TSP, 2D	The output photometry dataset.
4	X	Real	X position of centre of star
5	Y	Real	Y position of centre of star
6	RADIUS	Real	Radius of aperture (pixels)
7	BPIXEL	Logical	Use brightest pixel (rather than centroid)

Support

Jeremy Bailey, AAO

Version date

4/5/1994

IMPOL
Reduce IR Polarization images

Function

Reduce IR Polarization images

Description

IMPOL derives a polarization image from a set of four observations made with a rotating half-wave plate polarimeter at angles of 0, 22.5, 45 and 67.5 degrees. It is used to reduce polarization imaging data obtained with the IRIS IR camera and half-wave plate polarimeter at the AAT or the IRPOL/IRCAM polarimeter at UKIRT. It should also be useable with other similar instruments (not necessarily in the IR).

The input images should be NDF files (not Figaro .DST files).

Parameters

1	POS1	Char	The input image for position 0.0.
2	POS2	Char	The input image for position 45.0.
3	POS3	Char	The input image for position 22.5.
4	POS4	Char	The input image for position 67.5.
	OUTPUT	TSP, 2D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

2/6/1992

IMPOL
Reduce IR Polarization images

Function

Reduce IR Polarization images

Description

IMPOL derives a polarization image from a set of four observations made with a rotating half-wave plate polarimeter at angles of 0, 22.5, 45 and 67.5 degrees. It is used to reduce polarization imaging data obtained with the IRIS IR camera and half-wave plate polarimeter at the AAT or the IRPOL/IRCAM polarimeter at UKIRT. It should also be useable with other similar instruments (not necessarily in the IR).

The input images should be NDF files (not Figaro .DST files).

Parameters

1	`POS1`	Char	The input image for position 0.0.
2	`POS2`	Char	The input image for position 45.0.
3	`POS3`	Char	The input image for position 22.5.
4	`POS4`	Char	The input image for position 67.5.
	`OUTPUT`	`TSP, 2D`	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

2/6/1992

IPCS2STOKES
Reduce IPCS spectropolarimetry data.

Function

Reduce IPCS spectropolarimetry data.

Description

IPCS2STOKES reduces data obtained with the AAO Pockels cell spectropolarimeter with the IPCS as detector. The data is read in the form of Figaro files each containing a pair of A and B state frames forming a single observation. Within each A and B frame there are four spectra corresponding to the O and E rays for each of two apertures (A and B). These spectra are combined to derive a Stokes parameter spectrum in TSP format.

Parameters

1	FIGARO	Char	The input Figaro data file.
	ASTART	Integer	The Start column for the A aperture data.
	BSTART	Integer	The Start column for the B aperture data.
	OESEP	Integer	The distance in columns from the start of the O spectrum to the start of the E spectrum.
	WIDTH	Integer	The number of columns to include in each extracted spectrum.
	APERTURE	Char	The aperture containing the star (A or B).
	STOKESPAR	Char	The Stokes parameter (Q,U,V).
	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

27/4/1988

IRFLUX
Apply flux calibration to an infrared polarization spectrum

Function

Apply flux calibration to an infrared polarization spectrum

Description

IRFLUX flux calibrates a polarization spectrum using a calibration spectrum (normally a standard star observation) which is assumed to be a black body. The parameters of the black body are specified as a temperature, and magnitude in one of the standard bands. As an alternative to the magnitude the flux at a specified wavelength may be given.

Parameters

1	INPUT	TSP, 1D	The input spectrum to be calibrated.
2	CALSPECT	TSP, 1D	The calibration spectrum.
3	TEMP	Real	Temperature of black body.
4	CALTYPE	Char	The type of calibration data. A single character as follows:

J	Magnitude in J band
H	Magnitude in H band
K	Magnitude in H band
L	Magnitude in L′ band
M	Magnitude in M band
F	Flux at specified wavelength

5	MAG	Real	The magnitude of the standard.
	FLUX	Real	Flux of standard at calibration wavelength.
	WAVE	Real	Calibration wavelength.
6	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

20/9/1990

IRISAP
Measure polarization within an aperture for IRIS data

Function

Measure polarization within an aperture for IRIS data

Description

IRISAP reduces data obtained with the AAT IRIS polarimeter using the wollaston prism polarizer. The data for a single observation consists of four Figaro files containing the frames for plate position 0, 45, 22.5 and 67.5 degrees. Within each frame are selected two star images corresponding to the O and E rays for the same star. The polarization is derived for these

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 45.0.
3	POS3	Char	The Figaro data file for position 22.5.
4	POS4	Char	The Figaro data file for position 67.5.
	X	Integer	X coordinate of centre of aperture
	Y	Integer	Y coordinate of centre of aperture
	R	Real	Radius of aperture
	XSEP	Integer	OE separation vector in X
	YSEP	Integer	OE separation vector in Y

Support

Jeremy Bailey, AAO

Version date

4/5/1993

IRISAPC

Measure circular polarization within an aperture for IRIS data

Function

Measure circular polarization within an aperture for IRIS data

Description

IRISAP reduces data obtained with the AAT IRIS polarimeter using the wollaston prism polarizer. The data for a single observation consists of two Figaro files containing the frames for plate position 0 and 90 degrees. Within each frame are selected two star images corresponding to the O and E rays for the same star. The polarization is derived for these.

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 90.0.
	X	Integer	X coordinate of centre of aperture
	Y	Integer	Y coordinate of centre of aperture
	R	Real	Radius of aperture
	XSEP	Integer	OE separation vector in X
	YSEP	Integer	OE separation vector in Y

Support

Jeremy Bailey, AAO

Version date

25/5/1994

IRISAPC
Measure circular polarization within an aperture for IRIS data

Function

Measure circular polarization within an aperture for IRIS data

Description

IRISAP reduces data obtained with the AAT IRIS polarimeter using the wollaston prism polarizer. The data for a single observation consists of two Figaro files containing the frames for plate position 0 and 90 degrees. Within each frame are selected two star images corresponding to the O and E rays for the same star. The polarization is derived for these.

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 90.0.
	X	Integer	X coordinate of centre of aperture
	Y	Integer	Y coordinate of centre of aperture
	R	Real	Radius of aperture
	XSEP	Integer	OE separation vector in X
	YSEP	Integer	OE separation vector in Y

Support

Jeremy Bailey, AAO

Version date

25/5/1994

IRISPOL
Reduce IRIS imaging polarimetry data.

Function

Reduce IRIS imaging polarimetry data.

Description

IRISPOL reduces data obtained with the AAT IRIS polarimeter using the wolaston prism poarizer. The data for a single observation consists of four Figaro files containing the frames for plate position 0, 45, 22.5 and 67.5 degrees. Within each frame are selected two images corresponding to the O and E rays for a siingle mask slot. These spectra are combined to derive a polarization image in TSP format.

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

The variances on the polarization data are calculated from photon statistics plus readout noise.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 45.0.
3	POS3	Char	The Figaro data file for position 22.5.
4	POS4	Char	The Figaro data file for position 67.5.
	X1	Integer	X coordinate of the bottom left corner of block
	Y1	Integer	Y coordinate of the bottom left corner of block
	WIDTH	Integer	Width of the block
	HEIGHT	Integer	Height of the block
	XSEP	Integer	OE separation vector in X
	YSEP	Integer	OE separation vector in Y
	ALGORITHM	Char	The Algorithm to use for stokes parameter calculation (OLD, RATIO)
	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

3/5/1993

IRISPOLC
Reduce IRIS imaging circular polarimetry data.

Function

Reduce IRIS imaging circular polarimetry data.

Description

IRISPOL reduces data obtained with the AAT IRIS polarimeter using the wollaston prism poarizer. The data for a single observation consists of two Figaro files containing the frames for plate positions 90 degrees apart degrees. Within each frame are selected two images corresponding to the O and E rays for a single mask slot. These spectra are combined to derive a polarization image in TSP format.

Two different algorithms may be selected for the polarimetry reduction. The two algorithms differ in the method used to compensate for transparency variations between the observations at the two plate positions.

The variances on the polarization data are calculated from photon statistics plus readout noise.

Parameters

1	POS1	Char	The Figaro data file for position 0.0.
2	POS2	Char	The Figaro data file for position 90.0.
	X1	Integer	X coordinate of the bottom left corner of block
	Y1	Integer	Y coordinate of the bottom left corner of block
	WIDTH	Integer	Width of the block
	HEIGHT	Integer	Height of the block
	XSEP	Integer	OE separation vector in X
	YSEP	Integer	OE separation vector in Y
	ALGORITHM	Char	The Algorithm to use for stokes parameter calculation (OLD, RATIO)
	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

17/5/1995

LHATPOL
List Hatfield Polarimeter Infrared Data

Function

List Hatfield Polarimeter Infrared Data

Description

LHATPOL lists the IR data files in Figaro format as produced by the Hatfield Polarimeter systems on UKIRT. Its principal use is to detect spikes for subsequent removal using TSETBAD.

LHATPOL works on the original Figaro format file produced by the data acquisition system. However, the spikes must be removed from the data by using TSETBAD on the TSP file obtained by inporting the data using RHATPOL.

Parameters

1	FIGARO	Char	The IRPS Figaro file to read.
2	FILE	File	Name of listing file.

Support

Jeremy Bailey, AAO

Version date

1/4/1990

LMERGE

Merge two polarization spectra.

Function

Merge two polarization spectra.

Description

LMERGE merges two polarization spectra covering different wavelength ranges, to form a single dataset.

LMERGE simply appends the data from the second dataset to the first. There is no guarantee that the output data will thus be in order of increasing wavelength and this may cause problems for some other programs. To ensure this does not occur the two datasets can be SUBSETed or SCRUNCHed before merging so that they do not overlap, and should be merged with the higher wavelength dataset as the second input file.

Parameters

1	INPUT1	TSP, 1D	The first input dataset.
2	INPUT2	TSP, 1D	The second input dataset.
3	OUTPUT	TSP, 1D	The output merged dataset.

Support

Jeremy Bailey, JAC

Version date

15/8/1990

LTCORR
Apply Light Time corrections to the time axis of a data set.

Function

Apply Light Time corrections to the time axis of a data set.

Description

LTCORR applies light time corrections to the time axis of a data set, converting observed times to heliocentric or barycentric times. If the parameter SINGLE is true a single correction is calculated for the mid point time of the dataset, and applied to all points in the dataset. If SINGLE is false the correction is recalculated for each data point.

Parameters

1	INPUT	TSP, 2D	The input time series dataset with observed times.
2	OUTPUT	TSP, 2D	The output corrected dataset with heliocentric or barycentric times.
3	RA	Char	The B1950 mean Right Ascension of the observed source.
4	DEC	Char	The B1950 mean declination of the observed source.
	BARY	Logical	If True, correction is to the solar system Barycentre. If False, to the heliocentre.
	SINGLE	Logical	If True, a single correction is calculated for the mid point time of the dataset. If False, the correction is recalculated for each point.
	REVERSE	Logical	If True, a reverse correction is performed. e.g. heliocentric times are converted to observed times.

Support

Jeremy Bailey, AAO

Version date

27/2/1988

PHASEPLOT

Plot time series data against phase.

Function

Plot time series data against phase.

Description

PHASEPLOT plots time series data against the phase of a periodic variation. Up to six items may be plotted against the same phase axis. Each item may be a different channel or Stokes parameter etc. The data may be binned (all points in a given phase bin averaged) or simply folded (each indivdual time point plotted). The plotted phase may range from -1.0 to +2.0 allowing more than one cycle. Plotting is done with the NCAR/SGS/GKS graphics system.

Specifying the FILE parameter as TRUE causes the data points to be output as a text file, which can then be used in other plotting packages such as MONGO to provide greater control over the final plot.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	NPLOTS	Integer	The number of items to plot (max 6).
3	DEVICE	Device	The Graphics device (any valid GKS device).
	WHOLE	Logical	If TRUE, All time points are used.
C	XSTART	Double	First time value (MJD) to use.
C	XEND	Double	Last time value (MJD) to use.
	EPOCH	Double	The Epoch of phase zero (MJD).
	PERIOD	Double	The Period (days).
	PHSTART	Double	Starting Phase to plot.
	PHEND	Double	End Phase to plot.
	CHANn	Integer	Channel for nth plot. This and the following parameters repeat for n = 1 to NPLOTS.
	ITEMn	Char	Item for nth plot (I,FLUX,MAG,Q,U,V,P,THETA)
	AUTOn	Logical	If True nth plot is autoscaled.
	BINn	Double	Bin size (negative for no binning).
	PLABELn	Char	Label for plot n.
C	MINn	Real	Minimum scaling level for plot n.
C	MAXn	Real	Maximum scaling level for plot n.
	LABEL	Char	Label for Diagram.
H	ERRORS	Logical	If True (default), Error bars are plotted.
H	LINE	Logical	If True, the points are joined by a continuous line. (Default False).
H	PEN	Integer	SGS Pen number to plot in. (Default 1).
H	SIZE	Real	Scaling Factor for character sizes (Default 1).
H	PTOP	Real	Position of top of diagram. (Default 0.9).
H	PBOTTOM	Real	Position of bottom of diagram. (Default 0.1).
H	FILE	Logical	If true generate a text file of data.

Support

Jeremy Bailey, AAO

Version date

1/3/1990

PPLOT
Plot a polarization spectrum as P, Theta

Function

Plot a polarization spectrum as P, Theta

Description

PPLOT produces a plot of a polarization spectrum. The plot is divided into three panels. The lower panel is the total intensity, the center panel is the percentage polarization, the top panel is the position angle in degrees. The polarization data is binned into variable size bins to give a constant polarization error per bin. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum which must have Q and U Stokes parameters present.
2	BINERR	Real	The percentage error for each polarization bin.
3	DEVICE	Device	The Graphics device (any valid GKS device).
4	LABEL	Char	A label for the plot.
	AUTO	Logical	True if plot is to be autoscaled.
C	IMIN	Real	Minimum Intensity level to plot.
C	IMAX	Real	Maximum Intensity level to plot.
C	PMIN	Real	Minimum Polarization level to plot.
C	PMAX	Real	Maximum Polarization level to plot.
H	THETA	Real	Shift in angle to apply to theta plot. Plot range is THETA to 180+THETA.
H	TMIN	Real	Minimum position angle to plot
H	TMAX	Real	Maximum position angle to plot

Support

Jeremy Bailey, AAO

Version date

15/8/1990

PTHETA

Output the P and Theta values for a polarization spectrum

Function

Output the P and Theta values for a polarization spectrum

Description

The polarization and position angle corresponding to a specified wavelength range of a polarization spectrum are calculated and output.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum which must have Q and U Stokes parameters present.
2	LSTART	Real	The starting wavelength for the section to be used.
3	LEND	Real	The end wavelength for the section.

Support

Jeremy Bailey, AAO

Version date

15/6/1988

QPLOT
Quick plot of time series data.

Function

Quick plot of time series data.

Description

QPLOT provides a quick means of plotting one item from a time series data set, but without the many options provided by TSPLOT. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	DEVICE	Device	The Graphics device (any valid GKS device).
3	CHAN	Integer	Channel to plot.
4	ITEM	Char	Item to plot (I,Q,U,V)
	LABEL	Char	Label for Diagram.
	AUTOn	Logical	If True plot is autoscaled.
C	MIN	Real	Minimum level for scaling.
C	MAX	Real	Maximum level for scaling.
	WHOLE	Logical	If TRUE, All time points are used.
C	XSTART	Double	First time value (MJD) to use.
C	XEND	Double	Last time value (MJD) to use.
H	ERRORS	Logical	If True (default), Error bars are plotted.
H	LINE	Logical	If True, the points are joined by a continuous line. (Default False).
H	PEN	Integer	SGS Pen number to plot in. (Default 1).

Support

Jeremy Bailey, AAO

Version date

28/2/1988

QUMERGE
Merge Q and U spectra into single dataset.

Function

Merge Q and U spectra into single dataset.

Description

QUMERGE merges two separate datasets containing Q and U Stokes parameters to form a single dataset containing Q and U. It can be used to combine data obtained with IPCS2STOKES or CCD2STOKES where the two stokes parameters have been obtained independently.

The program CCD2POL is equivalent to using CC2STOKES to derive the two Stokes parameters, and then combining them with QUMERGE.

Parameters

1	QQ	TSP, 1D	The input Q dataset.
2	U	TSP, 1D	The input U dataset.
3	OUTPUT	TSP, 1D	The output merged dataset.

Support

Jeremy Bailey, AAO

Version date

19/8/1988

QUPLOT
Plot a polarization spectrum in the Q,U plane.

Function

Plot a polarization spectrum in the Q,U plane.

Description

QUPLOT produces a plot of the polarization spectrum in the Q,U plane. The polarization data is first binned to a constant percentage polarization error per bin, and the resulting points are plotted. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum which must have Q and U Stokes parameters present.
2	BINERR	Real	The percentage error for each polarization bin.
3	DEVICE	Device	The Graphics device (any valid GKS device).
4	LABEL	Char	A label for the plot.
	AUTO	Logical	True if plot is to be autoscaled.
C	QMIN	Real	Minimum Q level to plot.
C	QMAX	Real	Maximum Q level to plot.
C	UMIN	Real	Minimum U level to plot.
C	UMAX	Real	Maximum U level to plot.

Support

Jeremy Bailey, AAO

Version date

26/2/1988

QUSUB
Subtract a Q,U vector from a polarization spectrum.

Function

Subtract a Q,U vector from a polarization spectrum.

Description

QUSUB subtracts a percentage polarization expressed as a Q,U vector from a polarization spectrum. This can be used as a crude correction for interstellar polarization.

Parameters

INPUT	TSP, 1D	The input dataset, a spectrum which must have Q and U Stokes parameters present.
QVAL	Real	The Q value (per cent) to subtract.
UVAL	Real	The U value (per cent) to subtract.
OUTPUT	TSP, 1D	The corrected dataset.

Support

Jeremy Bailey, AAO

Version date

28/2/1988

RCCDTS
Read AAO CCD Time Series data

Function

Read AAO CCD Time Series data

Description

Read an AAO CCD time series data set from the raw figaro file and build a 3D TSP dataset.

The AAO time series mode takes a time series of data by shifting data out of the CCD on some regular period. The whole time series is treated as a single readout and therefore appears as a two dimensional array in which slices of the array are each indivdual frames of the time series. RCCDTS takes these frames out of the 2D array and builds a 3D TSP dataset to represent the resulting time series image. It also creates a time axis from the timing information contained in the FITS header.

Parameters

1	FIGARO	Char	The Figaro file containing the time series data
2	OUTPUT	TSP, 3D	The output time series dataset.

Support

Jeremy Bailey, JAC

Version date

26/10/1989

RCGS2
Read CGS2 Polarimetry Data

Function

Read CGS2 Polarimetry Data

Description

RCGS2 reads a polarimetry data file in Figaro format as produced by the CGS2 Polarimetry system at UKIRT and reduces it to a TSP polarization spectrum.

The CGS2 Figaro files are 4 dimensional arrays produced by the DRT, in which the dimensions are: WAVEPLATE POSITIONS by SPECTRAL CHANNELS by BEAMS (i.e. OFFSET or MAIN) by CYCLES.

Parameters

1	FIGARO	Char	The IRPS Figaro file to read.
2	OUTPUT	TSP, 1D	The output time series dataset.
3	NSIGMA	Real	Sigma level for despiking.

Support

Jeremy Bailey, AAO

Version date

28/8/1990

REVERSE
Reverse a spectrum in the wavelength axis.

Function

Reverse a spectrum in the wavelength axis.

Description

All the data arrays contained in a polarization spectrum are reversed in order along the wavelength axis.

Parameters

1	INPUT	TSP, 1D	The input dataset.
2	OUTPUT	TSP, 1D	The output dataset.

Support

Jeremy Bailey, AAO

Version date

27/4/1988

RFIGARO
Read a Stokes Parameter Spectrum from a Figaro image

Function

Read a Stokes Parameter Spectrum from a Figaro image

Description

RFIGARO reads an n by 3 Figaro image and creates a TSP Stokes parameter spectrum. The First row of the image becomes the intensity spectrum. The second row becomes the Stokes spectrum and the third row becomes the Stokes variance. It allows data files created by the old VISTA BASIC spectropolarimetry package to be read into TSP.

Parameters

1	FIGARO	Char	The input Figaro data file.
2	STOKESPAR	Char	The Stokes parameter (Q,U,V) for the output data.
3	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

26/2/1988

RHATHSP
Read Hatfield Polarimeter High Speed Photometry Data

Function

Read Hatfield Polarimeter High Speed Photometry Data

Description

RHATHSP reads data files in Figaro format as produced by the Hatfield Polarimeter at the AAT running in its 5 channel high speed photometry mode.

It outputs a 5 channel TSP time series dataset containing the light curves in each of the five channels. An accurate time axis array is created using the approximate start time and the additional timing information written to the sixth channel of the data array.

Parameters

1	FIGARO	Char	The Hatfield Figaro file to read.
2	OUTPUT	TSP, 2D	The output time series dataset.

Support

Jeremy Bailey, AAO

Version date

2/12/1988

RHATPOL
Read Hatfield Polarimeter Data

Function

Read Hatfield Polarimeter Data

Description

RHATPOL reads polarimetry data files in Figaro format as produced by the Hatfield Polarimeter systems on UKIRT or the AAT. A time series dataset is created containing the reduced linear or linear+circular polarimetry data.

A calibration file is used to specify the values of calibration parameters (efficiency, position angle zero point, photometric zero point, anc circular calibration).

Parameters

1	FIGARO	Char	The IRPS Figaro file to read.
2	NPTS	Integer	Number of points per cycle (1 or 2).
3	LINEAR	Logical	True for linear data, false for circular.
4	OUTPUT	TSP, 2D	The output time series dataset.
5	CFILE	File	Name of calibration file.

Support

Jeremy Bailey, AAO

Version date

3/3/1990

RHDSPLOT
Read ASCII files of Hatfield Polarimeter Data.

Function

Read ASCII files of Hatfield Polarimeter Data.

Description

RHDSPLOT reads ASCII files created by Tim Peacock's HDSPLOT program from raw Hatfield Polarimeter Data. It outputs time series datasets with either 3 or 6 wavelengths channels, depending on which version of the polarimeter the data came from.

This command is superseded by RHATPOL which can reduce Hatfield polarimetry data directly from the raw data files.

Parameters

FILENAME	Char	The name of the HDSPLOT file to be read.
NCHANS	Integer	The number of wavelength channels.
OUTPUT	TSP, 2D	The output dataset to be created.
CHANNEL	Char	Name of channel.
WAVELENGTH	Real	Wavelength of channel.

Support

Jeremy Bailey, AAO

Version date

27/2/1988

RHSP3
Read an HSP3 tape

Function

Read an HSP3 tape

Description

RHSP3 reads tapes produced by the HSP3 high speed photometry software at the AAT. The current version is limited to 16 bit single channel data, and handles a maximum of 200000 time bins.

Parameters

DRIVE	Device	The tape drive to read from.
MJDZERO	Double	The MJD at 0h U.T. on the night of observation.
OUTPUT	TSP, 2D	The output time series dataset.

Support

Jeremy Bailey, AAO

Version date

27/2/1988

RIRPS
Read IRPS Photometry Data

Function

Read IRPS Photometry Data

Description

RIRPS reads photometry data files in Figaro format as produced by the IRPS (AAO Infrared Photometer Spectrometer) ADAM system. A time series dataset is created. Either P1 or P4 data may be read.

Parameters

1	FIGARO	Char	The IRPS Figaro file to read.
2	NDWELLS	Integer	The Number of IRPS dwells to use for each data point (1,2 or 4).
3	OUTPUT	TSP, 2D	The output time series dataset.
	ZEROPT	Real	Magnitude zero point.

Support

Jeremy Bailey, AAO

Version date

27/2/1988

ROTPA

Rotate the Position Angle of a Polarization Dataset

Function

Rotate the Position Angle of a Polarization Dataset

Description

Rotate the position angle of a polarization Dataset through a specified amount

This propgram can be used to correct the position angle for a constant (wavelength independent) calibration errror

Parameters

1	INPUT	TSP, nD	The Polarization dataset to be corrected.
2	THETA	Real	Angle to rotate through (degrees).
3	OUTPUT	TSP, nD	The output corrected dataset.

Support

Jeremy Bailey, AAO

Version date

8/5/1993

RTURKU

Read ASCII files of Data from the Turku UBVRI Polarimeter.

Function

Read ASCII files of Data from the Turku UBVRI Polarimeter.

Description

RTURKU reads ASCII files of data from the Turku University UBVRI polarimeter. The raw data must first be reduced using the POLRED (for linear polarimetery) or CIRLIN (for simultaneous circular/linear polarimetry) programs. The resulting files are read by RTURKU (one file for the linear case, two for the circular/linear case). The data on a given star is selected from the file by specifying its number, and output as a TSP time series dataset.

Parameters

CIRLIN	Logical	TRUE for circular+linear data FALSE for linear only data.
LINFILE	Char	The name of the linear data input file.
CIRFILE	Char	The name of the circular data input file.
STAR	Integer	The Star Number
OUTPUT	TSP, 2D	The output dataset to be created.

Support

Jeremy Bailey, AAO

Version date

4/11/1988

SCRUNCH
Rebin a Polarization Spectrum.

Function

Rebin a Polarization Spectrum.

Description

SCRUNCH rebins a polarization spectrum onto a linear or logarithmic wavelength scale. SCRUNCH is closely based on the FIGARO program of the same name, and uses the same subroutine to perform the rebinning.

Parameters

1	INPUT	TSP, nD	The input spectrum to be scrunched.
2	WSTART	Real	The wavelength of the center of the first bin of the resulting scrunched spectrum.
3	WEND	Real	The wavelength of the center of the final bin of the resulting scrunched spectrum. If WEND is less than WSTART, then SCRUNCH assumes that it is the increment that is being specified rather than the final value. If the scrunch is logarithmic and WSTART is greater than WEND, SCRUNCH assumes that the WEND value represents a velocity in km/s.
4	BINS	Integer	The number of bins for the resulting spectrum.
5	OUTPUT	TSP, nD	The Output rebinned spectrum.
	LOG	Logical	Bin into logarithmic wavelength bins.
	MEAN	Logical	Conserve mean data level rather than flux.
	QUAD	Logical	Use quadratic (rather than linear) interpolation.

Support

Jeremy Bailey, AAO

Version date

10/8/1988

SKYSUB

Subtract Sky from a time series image dataset

Function

Subtract Sky from a time series image dataset

Description

Sky subtraction from each frame of a time series image is performed by selecting two areas on each side of a star to be observed and linearly interpolating between the mean or median of the values in these.

Parameters

1	`INPUT`	`TSP, 3D`	The time series dataset to be sky subtracted.
2	`OUTPUT`	`TSP, 3D`	The dataset after sky subtraction.
3	`Y1`	Integer	Lowest Y value to use
4	`Y2`	Integer	Highest Y value to use
5	`XL1`	Integer	Lowest X value for left sky region
6	`XL2`	Integer	Highest X value for left sky region
7	`XR1`	Integer	Lowest X value for right sky region
8	`XR2`	Integer	Highest X value for right sky region
9	`MEDIAN`	Logical	Use median rather than mean

Support

Jeremy Bailey, `AAO`

Version date

26/10/1989

SPFLUX
Apply flux calibration to a polarization spectrum

Function

Apply flux calibration to a polarization spectrum

Description

SPFLUX is equivalent to the Figaro program of the same name. It applies a Figaro flux calibration spectrum to a TSP polarization spectrum to generate a flux calibrated spectrum. The flux calibration spectrum can be generated using the techniques described in the section on fluxing in the Figaro manual.

Parameters

1	INPUT	TSP, 1D	The input spectrum to be calibrated.
2	CALSPECT	Char	The Figaro file containing flux calibration spectrum.
3	TIME	Real	Integration time in seconds for the spectrum to be calibrated.
4	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

16/8/1990

SPLOT
Plot a polarization spectrum with a single Stokes parameter

Function

Plot a polarization spectrum with a single Stokes parameter

Description

SPLOT produces a plot of a polarization spectrum. The plot is divided into two panels. The lower panel is the total intensity, the top panel is the percentage polarization for a single Stokes parameter. If the dataset contains only one Stokes parameter that Stokes parameter is plotted. If the spectrum contains more than one Stokes parameter any one of them may be chosen for plotting. The polarization data is binned into variable size bins to give a constant polarization error per bin. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 1D	The input dataset, a spectrum which must have at least one Stokes parameter.
2	BINERR	Real	The percentage error for each polarization bin.
3	DEVICE	Device	The Graphics device (any valid GKS device).
4	LABEL	Char	A label for the plot.
	STOKESPAR	Char	The Stokes parameter to be plotted (Q,U,V).
	AUTO	Logical	True if plot is to be autoscaled.
C	IMIN	Real	Minimum Intensity level to plot.
C	IMAX	Real	Maximum Intensity level to plot.
C	PMIN	Real	Minimum Polarization level to plot.
C	PMAX	Real	Maximum Polarization level to plot.

Support

Jeremy Bailey, AAO

Version date

19/8/1988

SUBSET

Take a subset of a dataset in wavelength or time axes.

Function

Take a subset of a dataset in wavelength or time axes.

Description

A subset of the input file is taken covering a specified range in wavelength and time. The command works on either 1D or 2D data.

Parameters

1	INPUT	TSP, nD	The input dataset.
2	LSTART	Real	Starting wavelength for subset.
3	LEND	Real	End wavelength for subset.
C	TSTART	Double	Starting Time for subset.
C	TEND	Double	End Time for subset.
4	OUTPUT	TSP, nD	The output dataset.

Support

Jeremy Bailey, AAO

Version date

30/4/1988

SUBTRACT
Subtract two Polarization spectra.

Function

Subtract two Polarization spectra.

Description

Two Polarization spectra covering the same wavelength range are subtracted to form a new spectrum giving the difference of the intensity and Stokes parameters.

Any number of Stokes parameters may be present in the spectra, but only Stokes parameters present in both spectra will appear in the output spectrum.

Parameters

1	INPUT1	TSP, 1D	The first input Stokes spectrum.
2	INPUT2	TSP, 1D	The second input Stokes spectrum.
3	OUTPUT	TSP, 1D	The output dataset.

Support

Jeremy Bailey, AAO

Version date

4/12/1988

TBIN
Bin a time series

Function

Bin a time series

Description

TBIN creates a new time series by binning an input time series into bins of a specified size. All the points falling within one bin are averaged, and their time value is averaged to create the new bin time. Note that this means that the output is not necessarily equally spaced in time. It depends where the points fall within the bin.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
	BIN	Double	The bin size (days).
	WHOLE	Logical	If TRUE, All time points are used.
C	XSTART	Double	First time value (MJD) to use.
C	XEND	Double	Last time value (MJD) to use.
	OUTPUT	TSP, 2D	The output binned dataset.

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TCADD
Add Channels of a time series dataset

Function

Add Channels of a time series dataset

Description

TCADD adds a range of channels of a time series dataset to produce a 1-dimensional output array. The number of channels can be one so it can be used to extract a single channel.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
	FIRST	Integer	First channel to extract.
	LAST	Integer	Last channel to extract.
	OUTPUT	TSP, 1D	The output binned dataset.

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TDERIV
Calculate Time Derivative of a Dataset.

Function

Calculate Time Derivative of a Dataset.

Description

TDERIV calculates the time derivative of the intensity data in a dataset and outputs it as a new dataset. For each point in the time series the slope of a straight line fitted through n points is used to obtain the derivative.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	NPOINTS	Integer	Number of points for line fit.
3	OUTPUT	TSP, 2D	The output corrected dataset.

Support

Jeremy Bailey, AAO

Version date

1/3/1988

TEXTIN
Correct a time series dataset for extinction.

Function

Correct a time series dataset for extinction.

Description

Correct a dataset for extinction by calculating the airmass of each point and correcting the intensity to a value for airmass 1.

The extinction coefficients (magnitude per airmass) for each channel must be provided.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	OUTPUT	TSP, 2D	The output extinction corrected dataset.
3	RA	Char	The B1950 mean Right Ascension of the observed source.
4	DEC	Char	The B1950 mean declination of the observed source.
5	OBS	Char	Observing station (? for list), NO to give longitude and latitude explicitly.
	LONG	Double	Longitude of site (degrees, west +ve)
	LAT	Double	Geodetic latitude of site (degrees, north +ve)
	EXTCOEF	Real	Extinction coefficient (prompt is repeated for each channel).

Support

Jeremy Bailey, AAO

Version date

24/2/1992

TLIST
List time series data to a file.

Function

List time series data to a file.

Description

List the time, intensity and percentage stokes parameters for a specified channel of a time series data set to an ASCII file

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	CHAN	Integer	Channel to plot.
	WHOLE	Logical	If TRUE, All time points are used.
C	XSTART	Double	First time value (MJD) to use.
C	XEND	Double	Last time value (MJD) to use.
	FILE	File	Name of file for output

Support

Jeremy Bailey, AAO

Version date

27/2/1990

TMERGE
Merge two time series datasets.

Function

Merge two time series datasets.

Description

TMERGE merges two time series datasets covering different times but with the same number of wavelength channels, to form a single dataset. The files should be merged in their time order, i.e. INPUT1 should be earlier than INPUT2 to retain increasing time in the merged dataset. The operation can be applied to both 2D or 3D datasets

Parameters

1	INPUT1	TSP, 2D or 3D	The first input dataset.
2	INPUT2	TSP, 2D or 3D	The second input dataset.
3	OUTPUT	TSP, 2D or 3D	The output merged dataset.

Support

Jeremy Bailey, AAO

Version date

31/10/1989

TSETBAD
Interactively mark bad points in time series

Function

Interactively mark bad points in time series

Description

Mark points in a time series as bad by specifying the channel number and time point number. The intensity and Stokes parameter values for the selected data points are flagged with a bad value which will be ignored by subsequent applications.

Parameters

1	INPUT	TSP, 2D	The input time series dataset
2	OUTPUT	TSP, 2D	The output dataset with bad points flagged.
	CHAN	Integer	Channel number of point.
	X	Integer	Time bin number of point.

Support

Jeremy Bailey, AAO

Version date

1/3/1990

TSEXTRACT
Optimal extraction of a light curve from a time series image

Function

Optimal extraction of a light curve from a time series image

Description

This command performs optimal extraction of a light curve of a star from a time series image, using an algorithm which is a 3 dimensional analogue of Horne's algorithm for optimal extraction of spectra from long slit data. The extraction is performed using a profile time series which is obtained using the TSPROFILE command.

This command is an alternative to CCDPHOT which performs the same procedure using simple aperture photometry.

Parameters

1	INPUT	TSP, 3D	The time series image dataset.
2	PROFILE	TSP, 3D	The spatial profile dataset.
3	OUTPUT	TSP, 2D	The output photometry dataset.
4	LAMBDA	Real	Wavelength of observation (microns)
5	FLUXCAL	Real	Counts per Jansky

Support

Jeremy Bailey, AAO

Version date

16/11/1991

TSHIFT
Apply a time shift to a dataset.

Function

Apply a time shift to a dataset.

Description

TSHIFT adds a constant to the time axis values of a time series dataset. It can be used to correct for time errors in the original data.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	SHIFT	Double	Time shift to apply (days).
3	OUTPUT	TSP, 2D	The output corrected dataset.

Support

Jeremy Bailey, AAO

Version date

28/2/1988

TSPLOT

Plot time series data.

Function

Plot time series data.

Description

TSPLOT plots time series data against time. Up to six items may be plotted. Each item may be a different channel or Stokes parameter etc. The data may be binned (all points in a given time bin averaged). or points plotted individually. Plotting is done with the NCAR/SGS/GKS graphics system.

Parameters

1	INPUT	TSP, 2D	The input time series dataset.
2	NPLOTS	Integer	The number of items to plot (max 6).
3	DEVICE	Device	The Graphics device (any valid GKS device).
	WHOLE	Logical	If TRUE, All time points are used.
C	XSTART	Double	First time value (MJD) to use.
C	XEND	Double	Last time value (MJD) to use.
	CHANn	Integer	Channel for nth plot. This and the following parameters repeat for n = 1 to NPLOTS.
	ITEMn	Char	Item for nth plot (I,FLUX,MAG,Q,U,V,P,THETA)
	AUTOn	Logical	If True nth plot is autoscaled.
	BINn	Double	Bin size (negative for no binning).
	PLABELn	Char	Label for plot n.
C	MINn	Real	Minimum scaling level for plot n.
C	MAXn	Real	Maximum scaling level for plot n.
	LABEL	Char	Label for Diagram.
H	ERRORS	Logical	If True (default), Error bars are plotted.
H	LINE	Logical	If True, the points are joined by a continuous line. (Default False).
H	PEN	Integer	SGS Pen number to plot in. (Default 1).

Support

Jeremy Bailey, AAO

Version date

28/2/1988

TSPROFILE
Determine a spatial profile from a time series image

Function

Determine a spatial profile from a time series image

Description

This command is used to generate a spatial profile time series image which is a smoothed representation of the actual stellar profile. The profile can be used for subsequent optimal extraction of a light curve of the star using the TSEXTRACT command.

Parameters

1	INPUT	TSP, 3D	The time series image dataset
2	PROFILE	TSP, 3D	The output profile
3	RESIDUALS	TSP, 3D	The residuals file
4	X	Integer	X position of centre of star
5	Y	Integer	Y position of centre of star
6	SIZE	Integer	Size of box to determine profile over
7	DEGREE	Integer	Degree of polynomial

Support

Jeremy Bailey, AAO

Version date

14/11/1991

XCOPY
Copy Wavelength Data from a Figaro Spectrum

Function

Copy Wavelength Data from a Figaro Spectrum

Description

XCOPY is equivalent to the Figaro program of the same name and copies the wavelength axis information from a Figaro spectrum to a TSP Polarization spectrum. This provides the basic method of wavelength calibrating TSP data. First do the Arc analysis using the Figaro arc fitting programs and then XCOPY the resulting calibration to the TSP polarization spectra.

Parameters

1	INPUT	TSP, 1D	The input spectrum to be calibrated.
2	ARC	Char	The Figaro file containing the wavelengths.
3	OUTPUT	TSP, 1D	The Output dataset.

Support

Jeremy Bailey, AAO

Version date

16/8/1990

C TSPSUBS routines

C.1 TSPSUBS — Routines to Create New Structures

TSP_COPY: Copy a TSP structure from one locator to another

TSP_CREATE_1D: Create a 1D TSP structure

TSP_CREATE_2D: Create a 2D TSP structure

TSP_CREATE_3D: Create a 3D TSP structure

TSP_TEMP: Create a temporary array.

C.2 TSPSUBS — Routines to Find or Create Stokes Components

TSP_GET_STOKES: Get locator to a Stokes component of a polarimetry structure.

TSP_STOKES: Find out which Stokes parameters are present in a dataset

TSP_ADD_STOKES: Add a new Stokes component to a polarimetry structure.

TSP_DELETE_STOKES: Delete a Stokes component from a polarimetry structure.

C.3 TSPSUBS — Routines to Map or Unmap Data Arrays

TSP_MAP_DATA: Map the data array of an NDF structure

TSP_MAP_SLICE: Map a slice of the data array of an NDF structure

TSP_MAP_VSLICE: Map a slice of the variance array of an NDF structure

TSP_MAP_VAR: Map the variance array of an NDF structure

TSP_MAP_LAMBDA: Map the wavelength axis of a TSP structure

TSP_MAP_X: Map the X axis of a TSP structure

TSP_MAP_Y: Map the Y axis of a TSP structure

TSP_MAP_TIME: Map the time axis of a TSP structure

TSP_UNMAP: Unmap a mapped data array

C.4 TSPSUBS — Routines to Inquire or Alter the Data Array Size

TSP_RESIZE: Change the size of all the data arrays in a structure

TSP_SIZE: Return the dimensions of a TSP structure

C.5 TSPSUBS — Routines to Read or Write LABEL and UNITS strings

TSP_RLU: Read the LABEL and UNITS of a structure

TSP_RLU_LAMBDA: Read the LABEL and UNITS of a the wavelength axis

TSP_RLU_X: Read the LABEL and UNITS of the X axis

TSP_RLU_Y: Read the LABEL and UNITS of the Y axis

TSP_RLU_TIME: Read the LABEL and UNITS of the time axis

TSP_WLU: Write the LABEL and UNITS of a structure

TSP_WLU_LAMBDA: Write the LABEL and UNITS of the wavelength axis

TSP_WLU_X: Write the LABEL and UNITS of the X axis

TSP_WLU_Y: Write the LABEL and UNITS of the Y axis

TSP_WLU_TIME: Write the LABEL and UNITS of the time axis

D Detailed description of TSPSUBS routines

TSP_ADD_STOKES
Add a new Stokes component to a polarimetry structure.

Function

Add a new Stokes component to a polarimetry structure.

Description

Given a locator to a polarimetry structure, add a new Stokes component to it.

Language

FORTRAN

Call

CALL TSP_ADD_STOKES (LOC,STOKES,V,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the polarimetry structure.
>	STOKES	Fixed string,descr	The name of the Stokes parameter (’Q’, ’U’ or ’V’)
>	V	Logical,ref	True if a variance array is to be included.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines, TSP_SIZE

Support

Jeremy Bailey, AAO

Version date

30/4/1988

TSP_COPY
Copy a TSP structure from one locator to another

Function

Copy a TSP structure from one locator to another

Description

Given a locator to a TSP structure, a complete copy of the structure is created at a second locator.

Language

FORTRAN

Call

CALL TSP_COPY (LOC,LOC2,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the top level of the object to be copied (e.g. supplied by DAT_ASSOC)
>	LOC2	Fixed string,descr	A locator to the top level object of an empty structure in which the copy will be created (e.g. supplied by DAT_CREAT)
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_CREATE_1D
Create a 1D TSP structure

Function

Create a 1D TSP structure

Description

A 1D TSP structure (representing a polarization spectrum) is created of the specified size.

Language

FORTRAN

Call

CALL TSP_CREATE_1D (LOC,SIZE,STOKES,VI,VS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the top level of the object to be created (e.g. supplied by DAT_CREAT)
>	SIZE	Integer,ref	The size of the array to be created.
>	STOKES	Fixed string,descr	A string specifying which Stokes parameters are to be included in the structure. This must contain some combination of the letters 'Q', 'U' and 'V'
>	VI	Logical,ref	True if the variance of the intensity is to be included in the structure.
>	VS	Logical,ref	True if the variance of the Stokes parameters is to be included in the structure.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_CREATE_2D
Create a 2D TSP structure

Function

Create a 2D TSP structure

Description

A 2D TSP structure (representing a time series polarization spectrum) is created of the specified size.

Language

FORTRAN

Call

CALL TSP_CREATE_2D (LOC,LSIZE,TSIZE,STOKES,VI,VS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the top level of the object to be created (e.g. supplied by DAT_CREAT)
>	LSIZE	Integer,ref	The size of the array to be created in the wavelength axis.
>	TSIZE	Integer,ref	The size of the array to be created in the wavelength axis.
>	STOKES	Fixed string,descr	A string specifying which Stokes parameters are to be included in the structure. This must contain some combination of the letters 'Q', 'U' and 'V'
>	VI	Logical,ref	True if the variance of the intensity is to be included in the structure.
>	VS	Logical,ref	True if the variance of the Stokes parameters is to be included in the structure.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_CREATE_3D
Create a 3D TSP structure

Function

Create a 3D TSP structure

Description

A 3D TSP structure (representing a time series image) is created of the specified size.

Language

FORTRAN

Call

CALL TSP_CREATE_3D (LOC,XSIZE,YSIZE,TSIZE,STOKES,VI,VS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the top level of the object to be created (e.g. supplied by DAT_CREAT)
>	XSIZE	Integer,ref	The size of the array to be created in the X axis.
>	YSIZE	Integer,ref	The size of the array to be created in the Y axis.
>	TSIZE	Integer,ref	The size of the array to be created in the time axis.
>	STOKES	Fixed string,descr	A string specifying which Stokes parameters are to be included in the structure. This must contain some combination of the letters 'Q', 'U' and 'V'
>	VI	Logical,ref	True if the variance of the intensity is to be included in the structure.
>	VS	Logical,ref	True if the variance of the Stokes parameters is to be included in the structure.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989

TSP_DELETE_STOKES

Delete a Stokes component from a polarimetry structure.

Function

Delete a Stokes component from a polarimetry structure.

Description

Given a locator to a polarimetry structure, Delete a specified Stokes component from it.

Language

FORTRAN

Call

CALL TSP_DELETE_STOKES (LOC,STOKES,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the polarimetry structure.
>	STOKES	Fixed string,descr	The name of the Stokes parameter ('Q', 'U' or 'V')
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

11/8/1988

TSP_GET_STOKES
Get locator to a Stokes component of a polarimetry structure.

Function

Get locator to a Stokes component of a polarimetry structure.

Description

Given a locator to a polarimetry structure, return a locator to one of its Stokes parameters.

Language

FORTRAN

Call

CALL TSP_GET_STOKES (LOC,STOKES,LOC2,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the polarimetry structure.
>	STOKES	Fixed string,descr	The name of the Stokes parameter (’Q’, ’U’ or ’V’)
<	LOC2	Fixed string,descr	The locator to the Stokes NDF object.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_MAP_DATA
Map the data array of an NDF structure

Function

Map the data array of an NDF structure

Description

Given a locator to an NDF structure map its main DATA_ARRAY.

Language

FORTRAN

Call

CALL TSP_MAP_DATA (LOC,MODE,PTR,LOC2,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_MAP_LAMBDA
Map the wavelength axis of a TSP structure

Function

Map the wavelength axis of a TSP structure

Description

Given a locator to an TSP structure map its wavelength axis data.

Language

FORTRAN

Call

CALL TSP_MAP_LAMBDA (LOC,MODE,PTR,LOC2,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_MAP_DATA, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_MAP_SLICE
Map a slice of the data array of an NDF structure

Function

Map a slice of the data array of an NDF structure

Description

Given a locator to an NDF structure map a slice of its main DATA_ARRAY.

Language

FORTRAN

Call

CALL TSP_MAP_SLICE (LOC,NDIMS,LOWER,UPPER,MODE,PTR,LOC2,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	NDIMS	Integer,ref	The number of dimensions.
>	LOWER	Integer array,ref	Array of lower bounds for the slice.
>	UPPER	Integer array,ref	Array of upper bounds for the slice.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_MAP_TIME
Map the time axis of a TSP structure

Function

Map the time axis of a TSP structure

Description

Given a locator to an TSP structure, map its time axis data.

Language

FORTRAN

Call

CALL TSP_MAP_TIME (LOC,MODE,PTR,LOC2,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data. A double precision array of MJD.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_MAP_VAR
Map the variance array of an NDF structure

Function

Map the variance array of an NDF structure

Description

Given a locator to an NDF structure map its VARIANCE array.

Language

FORTRAN

Call

CALL TSP_MAP_VAR (LOC,MODE,PTR,LOC2,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

26/2/1988

TSP_MAP_VSLICE
Map a slice of the variance array of an NDF structure

Function

Map a slice of the variance array of an NDF structure

Description

Given a locator to an NDF structure map a slice of its VARIANCE array.

Language

FORTRAN

Call

CALL TSP_MAP_VSLICE (LOC,NDIMS,LOWER,UPPER,MODE,PTR,LOC2,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	NDIMS	Integer,ref	The number of dimensions.
>	LOWER	Integer array,ref	Array of lower bounds for the slice.
>	UPPER	Integer array,ref	Array of upper bounds for the slice.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

28/2/1988

TSP_MAP_X
Map the X axis of a TSP structure

Function

Map the X axis of a TSP structure

Description

Given a locator to a 3D TSP structure map its X axis data.

Language

FORTRAN

Call

CALL TSP_MAP_X (LOC,MODE,PTR,LOC2,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_MAP_DATA, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989

TSP_MAP_Y
Map the Y axis of a TSP structure

Function

Map the Y axis of a TSP structure

Description

Given a locator to a 3D TSP structure map its Y axis data.

Language

FORTRAN

Call

CALL TSP_MAP_Y (LOC,MODE,PTR,LOC2,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MODE	Fixed string,descr	The access mode, 'READ','WRITE' or 'UPDATE'.
<	PTR	Integer,ref	Pointer to the mapped data.
<	LOC2	Fixed string,descr	The locator to the mapped data object - needed so that it can be unmapped.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_MAP_DATA, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989

TSP_RESIZE
Change the size of all the data arrays in a structure

Function

Change the size of all the data arrays in a structure

Description

Given a locator to a polarimetry structure, change the size of the arrays in the structure. If the change consists solely of a change to the last dimension then data in the arrays will retain values from corresponding components in the original array. With more complex changes the data values will be lost. Axis arrays will retain their values where still present in the output array.

Language

FORTRAN

Call

CALL TSP_RESIZE (LOC,NDIM,DIMS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the polarimetry structure.
>	NDIM	Integer,ref	The new number of Dimensions for the structure
>	DIMS	Integer Array,ref	The new dimensions for the structure.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

1/3/1988

TSP_RLU
Read the LABEL and UNITS of a structure

Function

Read the LABEL and UNITS of a structure

Description

Given a locator to an TSP structure, return the LABEL and UNITS of the data array.

Language

FORTRAN

Call

CALL TSP_RLU (LOC,LABEL,UNITS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

11/3/1988

TSP_RLU_LAMBDA
Read the LABEL and UNITS of a the wavelength axis

Function

Read the LABEL and UNITS of a the wavelength axis

Description

Given a locator to an TSP structure, return the LABEL and UNITS of the wavelength axis.

Language

FORTRAN

Call

CALL TSP_RLU_LAMBDA (LOC,LABEL,UNITS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_RLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_RLU_TIME
Read the LABEL and UNITS of the time axis

Function

Read the LABEL and UNITS of the time axis

Description

Given a locator to an TSP structure, return the LABEL and UNITS of the time axis.

Language

FORTRAN

Call

CALL TSP_RLU_TIME (LOC,LABEL,UNITS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_RLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_RLU_X
Read the LABEL and UNITS of the X axis

Function

Read the LABEL and UNITS of the X axis

Description

Given a locator to an TSP structure, return the LABEL and UNITS of the X axis.

Language

FORTRAN

Call

CALL TSP_RLU_X (LOC,LABEL,UNITS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_RLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989

TSP_RLU_Y
Read the LABEL and UNITS of the Y axis

Function

Read the LABEL and UNITS of the Y axis

Description

Given a locator to an TSP structure, return the LABEL and UNITS of the Y axis.

Language

FORTRAN

Call

CALL TSP_RLU_Y (LOC,LABEL,UNITS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_RLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989

TSP_SIZE
Return the dimensions of a TSP structure

Function

Return the dimensions of a TSP structure

Description

Given a locator to an TSP structure, return the dimensions and number of dimensions.

Language

FORTRAN

Call

CALL TSP_SIZE (LOC,MAXDIM,DIMS,ACTDIM,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
>	MAXDIM	Integer,ref	Size of DIMS
<	DIMS	Integer array,ref	Array to receive the size of each dimension.
<	ACTDIM	Integer,ref	Actual number of dimensions.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_STOKES
Find out which Stokes parameters are present in a dataset

Function

Find out which Stokes parameters are present in a dataset

Description

Given a locator to a polarimetry structure, return the number of Stokes parameters, and their identities.

Language

FORTRAN

Call

CALL TSP_STOKES (LOC,NUM,Q,U,V,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the polarimetry structure.
<	NUM	Integer,ref	The number of Stokes parameters in the dataset
<	Q	Logical,ref	True if the Q Stokes parameter is present
<	U	Logical,ref	True if the U Stokes parameter is present
<	V	Logical,ref	True if the V Stokes parameter is present
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

29/2/1988

TSP_TEMP
Create a temporary array.

Function

Create a temporary array.

Description

Create a temporary array, map it, and return a pointer to it.

Language

FORTRAN

Call

CALL TSP_TEMP (SIZE,TYPE,PTR,LOC,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	SIZE	Integer,ref	The size of the array to be created.
>	TYPE	Fixed string,descr	The type of the array - one of the HDS primitive type names.
<	PTR	Integer,ref	Pointer to the array created.
<	LOC	Fixed string,descr	A locator to the array structure (so that it can be unmapped).
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_UNMAP
Unmap a mapped data array

Function

Unmap a mapped data array

Description

Given a locator to a mapped object, unmap it, and annul the locator.

Language

FORTRAN

Call

CALL TSP_UNMAP(LOC,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to a mapped object - returned by one of the TSP_MAP... routines
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_WLU
Write the LABEL and UNITS of a structure

Function

Write the LABEL and UNITS of a structure

Description

Given a locator to an TSP structure, write values for the LABEL and UNITS of the data array.

Language

FORTRAN

Call

CALL TSP_WLU (LOC,LABEL,UNITS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_WLU_LAMBDA
Write the LABEL and UNITS of the wavelength axis

Function

Write the LABEL and UNITS of the wavelength axis

Description

Given a locator to an TSP structure, write values for the LABEL and UNITS of the wavelength axis.

Language

FORTRAN

Call

CALL TSP_WLU_LAMBDA (LOC,LABEL,UNITS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_WLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_WLU_TIME
Write the LABEL and UNITS of the time axis

Function

Write the LABEL and UNITS of the time axis

Description

Given a locator to an TSP structure, write values for the LABEL and UNITS of the time axis.

Language

FORTRAN

Call

CALL TSP_WLU_TIME (LOC,LABEL,UNITS,STATUS)

Parameters

(">" input, "!" modified, "W" workspace, "<" output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_WLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

27/2/1988

TSP_WLU_X
Write the LABEL and UNITS of the X axis

Function

Write the LABEL and UNITS of the X axis

Description

Given a locator to an TSP structure, write values for the LABEL and UNITS of the X axis.

Language

FORTRAN

Call

CALL TSP_WLU_Y (LOC,LABEL,UNITS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_WLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989

TSP_WLU_Y
Write the LABEL and UNITS of the Y axis

Function

Write the LABEL and UNITS of the Y axis

Description

Given a locator to an TSP structure, write values for the LABEL and UNITS of the Y axis.

Language

FORTRAN

Call

CALL TSP_WLU_Y (LOC,LABEL,UNITS,STATUS)

Parameters

(“>” input, “!” modified, “W” workspace, “<” output)

>	LOC	Fixed string,descr	A locator to the NDF structure.
<	LABEL	Fixed string,descr	Label string.
<	UNITS	Fixed string,descr	Units string.
!	STATUS	Integer,ref	The Status

External subroutines / functions used

TSP_WLU, Various NDF routines

Support

Jeremy Bailey, AAO

Version date

19/10/1989