1 NAPS: NAncay Preprocessing Software (written by Patrice Renaud)

NRT autocorrelator data reduction, calibration, exportation in SIR and FITS formats. (Document prepared by Jean-Michel Martin & Pierre Colom (V2 2008/03/26 - LaTeX 26-MAR-2008) This document is based on the on-line NAPS help file, written by P. Renaud. A manual (in french) is located in the folder `/home/renaud/naps/works` :

```
naps_userguide.doc   (Feb. 2007 version)
naps_userguide.pdf   (    "       "    )
```

1.1 Definitions

- `SCAN` : raw observation of a source.
  Data written in `nnnXXXXX.UIC` files, with :
  `nnn` backend type (nco, fil...)
  `XXXXX` SCAN NUMBER
  `UIC` TELESCOPE USER ID

  A SCAN includes some headers and one or several CYCLEs.

- `CYCLE` : Includes several PHASEs. A classical observation in position-switch mode would involve four phases :
  - one calibration phase (on source),
  - one ON source acquisition phase,
  - one calibration phase (off source),
  - one OFF source acquisition phase.
  Some peculiar telescope setup files may involve more phases.
  Each PHASE is made of several INTEGRATIONs (1 2 4 8 16 or 32 sec).
  Each INTEGRATION contains 2 to 8 spectra, as the receiver may observe up to 4 frequencies, 1 to 4 polarization parameters

1.1.1 What is NAPS doing ?

Shortly, once a SCAN is selected, the software :
- eliminates bad integrations (in the acquisition phases) - if required
- averages all integrations for each acquisition phase
- performs the phase arithmetic (for instance ON-OFF/OFF) for each cycle
- performs the flux density scale calibration
- averages the cycles
- displays and saves the result on disk (if required) in FITS format or in the NRT SIR data processing specific format.

1.2 Commands summary (with examples)

(NAPS commands may be typed in upper case or lower case characters.)
When entering in NAPS, your .configdep file is read; see Miscellaneous section.

1.2.1 SCAN (observation number == raw data files) selection

```
-- LIST SCAN      Lists the available scan numbers
-- SET DUIC       Selects the user ID of the scans to be processed
                  SET DUIC 171
-- SET SCAN       Selects the scan numbers to be processed
                  SET SCAN 10210 11222-11320
                  SET SCAN *
-- SET SOU,  SET COMP,  SET REF  selects the phase numbers for the
                  ON, OFF and REFERENCE phases.
                  (ON-OFF)/OFF is calculated for each cycle.
-- SET NOSOU, SET NOCOMP, SET NOREF
                  after SET NOREF, NAPS calculates only (ON-OFF)
                   for each cycle.
                  after SET NOSOU (and SET NOREF), the OFF phase is
                   kept for each cycle.
-- SHOW SESSION   Shows session parameters
-- SET DIRDATA, SET DIRSIR, SET DIRFITS   selects working directories
                  SET DIRDATA /data1/guest3
                  SET DIRDATA /data2/calib   (for raw test or cal. data)
-- SHOW SESSION   Shows session parameters
```

1.2.2 Data visualisation (1D)

```
-- SHOW CYCLE     Displays one cycle (from one to all correlator banks)
                  SHOW CYCLE 1
                  SHOW CYCLE 1-10       (use NEXT to display the cycles 2-10)
                  SHOW CYCLE 2, BATT=3  (third correlator bank -- BATTerie
                     in french)
-- NEXT           Displays the next cycle
-- SHOW SPECTRE   Displays the integrations (elementary spectra)
                  SHOW SPECTRE CYCLE=1, PHASE=2, INTE=3
                  SHSPEC 1,2,3   (shortcut)
-- SHOW FILTRE    Displays the broad band filter data
                  SHOW FILTRE 1   (all filters, CYCLE 1)
                  SHOW FILTRE 1,4 (filter number 4, CYCLE 1)
-- SET X          Sets the units for the abscissa axis
                  Arguments are : CHAN (channels)
                                  FREQ (frequencies)
                                  VEL  (velocity)
```

```
                  SET X VEL
-- SET YPR        Sets the Y Plot Range
                  SET YPR 3  (range = +/- 3 sigmas)
-- ENA VISU, DISA VISU  enables or disables the graphic display
-- ENA WNEW       a new graphic window is created for each plot
-- DISA WNEW      disables the WNEW mode
-- SET PSYM       selects the symbol used for the plots
-- PLOT           writes the plot in a POSTSCRIPT file
```

1.2.3 2D Data display and processing

(2D time frequency display of each correlator bank.)

```
-- DISP MODE=1    Displays all cal. and acquisition integrations
-- DISP MODE=2    Displays the acquisition integrations and marks the
                     channels which show radio interferences
-- DISP MODE=3    Displays the acquisition integrations using an ON-OFF
                     algorithm (cleans the 'OFF' which is substracted to
                     each integration)
-- DISP MODE=4    Same, displays a cleaned ON-OFF spectrum and the percentage
                     of removed data for each channel.
-- DISP MODE=5    Displays all cycles after ON-OFF arithmetics.
                  DISP MODE=1, BATT=1
-- ENA/DISA CLR   Enables/disables the RFI detection algorithm
-- INTE2D         Same as command INTE, with RFI cleaning algorithm working
                     in each cycle
-- SAVE2D         Same as command SAVE, with RFI cleaning algorithm working
                     in each cycle
-- SET YPR        Curve min and max fixed, below each 2D image
```

1.2.4 SCANs process

```
-- PROC SCAN      Scan processing (Tsys are shown at the end)
                     CLIP, WIN and ILR constraints are used
-- DUMP MAP, DUMP SOU, DUMP SCAN, DUMP TABCAL, LIST TABCAL
-- DISA/ENA BREAK Save all the selected SCANs, with one SAVE command.
                  ENA BREAK (default)
```

1.2.5 USING a MASK for estimating the TSYS

```
-- SET MASK       SET MASK 100-200, BATT=1-4
                     channels 100 to 200, in spectra type 1 to 4
-- ENA MASK       Enables MASK, necessary after MASK definition
-- DISA MASK      Disables MASK
-- SET DEFMASK    Back to default mask: 5 first and last points
-- SET NOMASK     Deletes the default mask
```

1.2.6 Suppress cycles/banks

```
-- SUP CYCLE      (shortcut SUPC) suppress cycles
                  SUP CYCLE 2-3 4,batt=4
                  SUPC 2-3 4,0,0,4
-- SET CLIP       Sets a limit for the cycles'Tsys.
                  SET CLIP 100              (for all banks)
                  SET CLIP 100 150 100 200  (for each bank)
-- ENA/DISA CLIP  Enables/disables the CLIPping
                  DISA CLIP (default)
-- SET WIN        Sets a Tsys window, in order to reject cycles
                  in units of rms (rms of the cycle's Tsys)
                  SET WIN -2 2
                  The CLIP action is done before the WIN rejection.
-- ENA/DISA WIN   Enables/disables the WINdow-based selection.
                  DISA WIN (default)
```

1.2.7 Automatic removal of integrations

```
(use with care : this algorithm deletes always a certain percentage of
integrations in every phases/cycles)
-- SET ILR        Sets the ILR (Integration Limit Rms)
                  SET ILR 1.2
-- ENA/DISA ILR   Enables/disables this mode. 'Worst integrations'
                     removal is performed by the command PROC SCAN
                  DISA ILR (default)
-- DUMP SCAN      Displays the flag array for all the integrations
-- RESET          Resets flagged integrations
-- RESET ALL      Resets all cycles
```

1.2.8 Automatic removal of 'bad' channels

```
(see also the DISP, INTE2D and SAVE2D commands)
-- SET CLR        Sets the CLR (Channel Limit Rms)
-- ENA/DISA CLR   Enables/disables this mode.
                  ENA CLR (default)
```

1.2.9 Integration and creation of final spectra (result files)

```
-- INTE           Averages cycles  (possibly after PROC SCAN) + display
-- INTE2D         Averages cycles using the 2D cleaning algorithm + display
-- SAVE           INTE + creation of a disk file (FITS or SIR format)
-- SAVE2D         INTE2D + creation of a disk file (FITS or SIR format)
-- SAVE CYCLE     Saves each cycle on disk (FITS or SIR format)
-- SAVE INTE      Saves each integration on disk (FITS or SIR format)
```

```
                (Be careful : you may create hundreds of disk files!)
-- GO           Next scan
```

1.2.10 Miscellaneous

```
NAPS can work with script files. The script file names must include the
extension .naps.
-- CALL myscriptfile
-- SET IDENT      Changes the default NAPS identification of the final
                    result file (for SIR format outputs only)
-- ENA/DISA CAL   Enables/disables the K-Jy calibration.
-- ENA/DISA EFFI  Takes into account (default) or not the radio telescope
                    efficiency variation on declination in the calibration
                    calculus.
-- ENA/DISA TABCAL  Prints the attenuation and Noise Diode values used
                      by PROC SCAN
-- ENA/DISA RHO     Prints the rho(0) (first point of the autocorrelation
                      function) values used by PROC SCAN.
-- DUMP FREQ        Prints the receiver's frequency setups.
-- ENA/DISA FREQ    Writes in addition the spectra with FREQuency axis
                     (usefull for SIR format outputs) in the same SIR
                     result files.

Example of a .configdep file. (one line only !)
/data2/171/2008A/ /home/colom/sir/resultat/def/
/home/colom/sir/sorties/ /ps /ps /home/colom/fitsdata/

This file can be edited with a standard editor, or with the FIP tool.
```

1.3 More explanations Start of a Reference Manual

LIST SCAN Lists the scan numbers which are in the selected folder. This folder may be selected via the file `.configdep`, located in the user's home directory, or with the command `SET DIRDATA`. The file `.configdep` is created by the FIP software, and can be modified by the user.
Example for user dupont with the data on `/data2/uic/2008A/` (holds on one line):

```
/data2/uic/2008A/   /home/dupont/sir/resultat/groupe1/
/home/dupont/sir/sorties/  /ps /ps /home/dupont/fitsdata/
```

where uic is the id 3 digits number of user dupont, and 2008A the semester of the observations. Do not forget the last / sign in the definitions.

SET DUIC Selects the user ID of the scan to process. The default DUIC is the standard UNIX/NRT user ID.

SET SCAN Selects the scan numbers to be processed. The character * selects all the scans available in the raw data folder. Example :

```
NAPS> SET SCAN 1435 10-20
```

The scan number 1435 and the scans with numbers between 10 and 20 will be processed successively. The first valid scan is selected and the system temperatures of the scan are typed.

NAPS applies a calibration (Jy) on the autocorrelator *and* the filter data, using calibration data obtained from systematic observations of series of standard radio sources.

Since November 13th 2000, the noise diode calibration sequences are recorded with both the autocorrelator and the filter bank. Each noise diode sequence is stored as three autocorrelator integrations of 1 second each (and three filter bank data points as well). With these integrations, it is possible to calibrate all polarisation setups, including the cross-polar ones like EW, EW*, using the $\rho(0)$ power which is written after each spectrum.