	<i>Heliophysics Integrated Observatory</i>
Project No.: 238969 Call: FP7-INFRA-2008-2	
Feature description <i>NRH 2D Radio Sources</i> <i>Draft</i>	

<i>Title:</i>	NRH 2D radio sources
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HELIO Filament tracking
Draft

Revision History

Version	Date	Released by	Detail
1.0	2011-11-07	Xavier Bonnin	First release
1.1	2011-12-20	Xavier Bonnin	Output files renamed with the extension _init and _feat instead of _obs and _par

Note: Any notes here.

Contents

Feature Description	5
Feature Code Characteristics	5
Output of the Feature Code.....	5
Observation file	6
Feature Recognition Code file	9
Feature Parameters file.....	9

List of acronyms

CSV: Comma-Separated Values
HELIO : Heliophysics Integrated Observatory
HFC : Heliospheric Feature Catalogue
FRC : Feature Recognition Code
IDL : Interactive Data Language
NRH : Nancay RadioHeliograph
SSW : Solar SoftWare
TBC : To Be Confirmed
TBD : To Be Defined

Relevant Documents

1. HELIO_HFC_V2.0 Description of the HFC

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Feature Description

This document presents the outputs produced by the NRH2D software, which is dedicated to the radio sources recognition on 2D images of the Nancay RadioHeliograph (NRH). NRH is a radio interferometer composed of 48 antennae with a T shaped base, allowing reconstructed 2D images of the Sun. The telescope produces daily observations of the Sun at high temporal cadence (i.e., ~10 sec) between 150 and 450 MHz ; which typically corresponds to radio emissions produced by features in the solar corona such as active regions, energetic particles (e.g., type III radio bursts), etc.

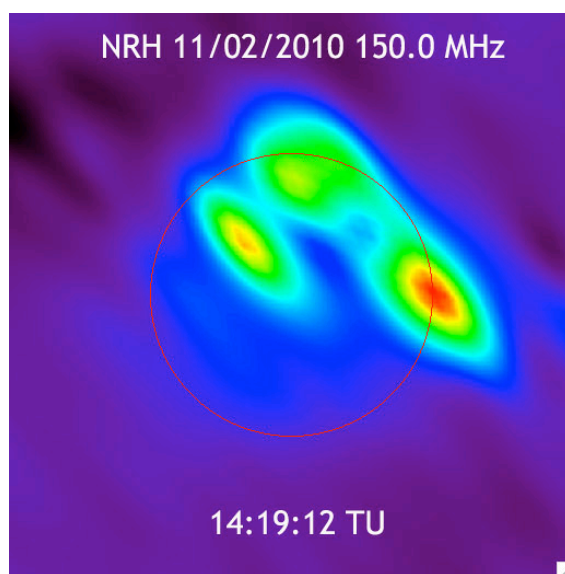


Figure 1: 2D image of the radio Sun observed at 150 MHz by the NRH, on February 11, 2010 at 14:19:12 (UT). Three radio sources particularly intense can be seen on the northwest region. (The radius of the visible Sun is indicated by the red circle on the figure.)

Feature Code Characteristics

NRH2D is a IDL code to extract radio sources observed on the 2D images of the NRH. Although the code can be run on every frequency channels, only the 150 MHz channel is actually used for detection. The algorithm is based on ellipse detections applying a Gaussian fitting method. The recognition itself is performed by IDL routines contained in the NRH package of the SSW.

Output of the Feature Code

NRH2D produces two ascii files of csv type for each image processed.
The nomenclatures of the files are:

```
nrh2d_yyyymmdd_ver_init.csv  
nrh2d_yyyymmdd_ver_feat.csv
```

In addition, the code returns one ascii file of csv type each time the code is run:

nrh2d_ *ver_frc*.csv

where *yyyymmdd* is the date of the corresponding dynamical spectrum (*yyyy* = year, *mm* = month, *dd* = day), and *ver* is the version of the code that generates files, and *init*, *frc*, and *feat* indicate the type of data written in the files. The content of output files is described in more details in the next sub-sections.

Observation file

The observation file (rabat2_ *yyyymmdd_ver_init*.csv) contains main information about the observation used for the detection.

OBSERVATORY;INSTRUMENT;TELESCOP;UNITS;WAVEMIN;WAVEMAX;WAVEN
AME;WAVEUNIT;SPECTRAL_NAME;OBS_TYPE;DATE_OBS;DATE_END;JDINT;JDF
RAC;C_ROTATION;NAXIS1;NAXIS2;CDELTA1;CDELTA2;CENTER_X;CENTER_Y;R_S
UN;EXP_TIME;BITPIX;FILENAME;PR_LOCFNAME;URL;COMMENT;RUN_DATE;VE
RSION_CODE;OBS_FILENAME

NAME	FORMAT	DESCRIPTION	CURRENT CONTENT
OBSERVATORY	VARCHAR(150)	Name of the observatory that performs observation.	"Nancay Observatory"
INSTRUMENT	VARCHAR(150)	Name of the radio instrument that performs observation.	"RadioHeliograph"
TELESCOP	VARCHAR(150)	Name of the telescope that produces data	"2d RadioHeliograph"
UNITS	VARCHAR(150)	Units of the radio flux on image	""
WAVEMIN	FLOAT	Minimum frequency of observation	150
WAVEMAX	FLOAT	Maximum frequency of observation	150

HELIO Filament tracking
Draft

WAVENAME	VARCHAR(150)	Name of the domain in the wavelength spectrum	"radio"
WAVEUNIT	VARCHAR(150)	Unit of the frequency for WAVEMAX and WAVEMIN fields	"MHz"
SPECTRAL_NAME	VARCHAR(150)	Spectral domain	"Metric"
OBS_TYPE	VARCHAR(150)	Type of observation	"remote sensing"
DATE_OBS	DATETIME	Starting date/time of the observation	"yyyy-mm-ddThh:nn:ss" format
DATE_END	DATETIME	Ending date/time of the observation	"yyyy-mm-ddThh:nn:ss" format
JDINT	LONG	Integer part of DATE_OBS in Julian days	
JDFRAC	DOUBLE	Fractional part of DATE_OBS in Julian days	
C_ROTATION	LONG	Carrington rotation number	
NAXIS1	LONG	Number of pixels along the X-axis	
NAXIS2	LONG	Number of pixels along the Y-axis	
CDELTA1	FLOAT	Spatial resolution in arcsec/pix along X-axis	

HELIO Filament tracking
Draft

CDELTA2	FLOAT	Spatial resolution in arcsec/pix along X-axis	
CENTER_X	FLOAT	X coordinate (in pixels) of the Sun centre.	
CENTER_Y	FLOAT	Y coordinate (in pixels) of the Sun centre.	
R_SUN	LONG	Radius of the visible Sun in pixels	
EXP_TIME	FLOAT	Exposure Time (in sec)	
BITPIX	LONG	Bits per pixel	
FILENAME	VARCHAR(150)	Name of the input file containing the observation.	
PR_LOCFNAME	VARCHAR(150)	Full path to the local input data file used for detection	
RUN_DATE	DATETIME	Date at which the code was run	"yyyy-mm-ddThh:nn:ss" format
URL	VARCHAR(150)	URL of the data file (when available)	
COMMENT	VARCHAR(150)	Any additional comment about data	
VERSION_CODE	FLOAT	Version of the code used	

OBS_FILENAME	VARCHAR(150)	Name of the output file containing information about the observation	
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Feature Recognition Code file

The Feature Recognition Code (FRC) file (nrh2d_*ver_frc*.csv) contains main information about the code execution. Contrary to the observation and feature parameters files, there is only one frc file by execution.

INSTITUTE;NAME_CODE;FEATURE,PERSON;ENC_MET;RUN_DATE;
VERSION_CODE;FRC_FILENAME

NAME	FORMAT	DESCRIPTION	CURRENT CONTENT
INSTITUTE	VARCHAR(150)	Name of the institute responsible of the feature recognition code.	MEUDON
NAME_CODE	VARCHAR(150)	Name of the FRC.	NRH2D
FEATURE_NAME	VARCHAR(150)	Feature concerned by detection.	Coronal radio emissions
PERSON	VARCHAR(150)	Person responsible of the recognition code execution.	Christian Renié
CONTACT	VARCHAR(150)	Corresponding contact	christian dot renie at obspm dot fr
ENC_MET	STRING	Encoding method	e.g., raster, chain code, none, etc.
RUN_DATE	DATETIME	Date at which the code was run	"yyyy-mm-ddThh:nn:ss" format
VERSION_CODE	FLOAT	Version of the feature code.	1.00
FRC_FILENAME	VARCHAR(150)	Name the output file containing information about frc	

Feature Parameters file

The feature parameters file (nrh2d_*yyyymmdd_ver_feat*.csv) contains the products of the code extraction.

FEAT_ID;FEAT_X_PIX;FEAT_Y_PIX;FEAT_X_ARCSEC;FEAT_Y_ARCSEC;FEAT_HG_LONG_DEG;FEAT_HG_LAT_DEG;FEAT_CARR_LONG_DEG;FEAT_CARR_LAT_DEG;BR_X0_PIX;BR_Y0_PIX;BR_X1_PIX;BR_Y1_PIX;BR_X2_PIX;BR_Y2_PIX;BR_X3_PIX;BR_Y3_PIX;BR_X0_ARCSEC;BR_Y0_ARCSEC;BR_X1_ARCSEC;BR_Y1_ARCSEC;BR_X2_ARCSEC;BR_Y2_ARCSEC;BR_X3_ARCSEC;BR_Y3_ARCSEC;BR_HG_LONG0_DEG;BR_HG_LAT0_DEG;BR_HG_LONG1_DEG;BR_HG_LAT1_DEG;BR_HG_LONG2_DEG;BR_HG_LAT2_DEG;BR_HG_LONG3_DEG;BR_HG_LAT3_DEG;BR_CARR_LONG0_DEG;BR_CARR_LAT0_DEG;BR_CARR_LONG1_DEG;BR_CARR_LAT1_DEG;BR_CARR_LONG2_DEG;BR_CARR_LAT2_DEG;BR_CARR_LONG3_DEG;BR_CARR_LAT3_DEG;FEAT_MAX_INT;FEAT_MEAN_INT;FEAT_AREA_PIX;FEAT_AREA_DEG2;FEAT_AREA_MM2;EL_AXIS1;EL_AXIS2;EL_ANGLE;CC_X_PIX;CC_Y_PIX;CC_X_ARCSEC;CC_Y_ARCSEC;CC_LENGTH;RUN_DATE;VERSION;PAR_FILENAME

NAME	FORMAT	DESCRIPTION	NOTES
FEAT_ID	LONG	Primary index	
FEAT_X_PIX	LONG	X coordinate (in pixels) of the feature gravity centre.	
FEAT_Y_PIX	LONG	Y coordinate (in pixels) of the feature gravity centre.	
FEAT_X_ARCSEC	DOUBLE	X coordinate (in arcsec) of the feature gravity centre.	
FEAT_Y_ARCSEC	DOUBLE	Y coordinate (in arcsec) of the feature gravity centre.	
FEAT_HG_LONG_DEG	FLOAT	Heliographic longitude (in degrees) of the feature gravity centre.	
FEAT_HG_LAT_DEG	FLOAT	Heliographic latitude (in degrees) of the feature gravity centre.	

HELIO Filament tracking
Draft

FEAT_CARR_LONG_DEG	FLOAT	Carrington longitude (in degrees) of the feature gravity centre.	
FEAT_CARR_LAT_DEG	FLOAT	Carrington latitude (in degrees) of the feature gravity centre.	
BR_X0_PIX	LONG	X coordinate of the lower left corner of the bounding rectangle (in pixels)	
BR_Y0_PIX	LONG	Y coordinate of the lower left corner of the bounding rectangle (in pixels)	
BR_X1_PIX	LONG	X coordinate of the upper left corner of the bounding rectangle (in pixels)	
BR_Y1_PIX	LONG	Y coordinate of the upper left corner of the bounding rectangle (in pixels)	
BR_X2_PIX	LONG	X coordinate of the lower right corner of the bounding rectangle (in pixels)	
BR_Y2_PIX	LONG	Y coordinate of the lower right corner of the bounding rectangle (in pixels)	
BR_X3_PIX	LONG	X coordinate of the upper right corner of the bounding rectangle (in pixels)	
BR_Y3_PIX	LONG	Y coordinate of the upper right corner of the bounding rectangle (in pixels)	

HELIO Filament tracking
Draft

BR_X0_ARCSEC	DOUBLE	X coordinate of the lower left corner of the bounding rectangle (in arcsec)	
BR_Y0_ARCSEC	DOUBLE	Y coordinate of the lower left corner of the bounding rectangle (in arcsec)	
BR_X1_ARCSEC	DOUBLE	X coordinate of the upper left corner of the bounding rectangle (in arcsec)	
BR_Y1_ARCSEC	DOUBLE	Y coordinate of the upper left corner of the bounding rectangle (in arcsec)	
BR_X2_ARCSEC	DOUBLE	X coordinate of the lower right corner of the bounding rectangle (in arcsec)	
BR_Y2_ARCSEC	DOUBLE	Y coordinate of the lower right corner of the bounding rectangle (in arcsec)	
BR_X3_ARCSEC	DOUBLE	X coordinate of the upper right corner of the bounding rectangle (in arcsec)	
BR_Y3_ARCSEC	DOUBLE	Y coordinate of the upper right corner of the bounding rectangle (in arcsec)	
BR_HG_LONG0_DEG	FLOAT	Heliographic longitude of the lower left corner of the bounding rectangle (in degrees)	

HELIO Filament tracking
Draft

BR_HG_LAT0_DEG	FLOAT	Heliographic latitude of the lower left corner of the bounding rectangle (in degrees)	
BR_HG_LONG1_DEG	FLOAT	Heliographic longitude of the upper left corner of the bounding rectangle (in degrees)	
BR_HG_LAT1_DEG	FLOAT	Heliographic latitude of the upper left corner of the bounding rectangle (in degrees)	
BR_HG_LONG2_DEG	FLOAT	Heliographic longitude of the lower right corner of the bounding rectangle (in degrees)	
BR_HG_LAT2_DEG	FLOAT	Heliographic latitude of the lower right corner of the bounding rectangle (in degrees)	
BR_HG_LONG3_DEG	FLOAT	Heliographic longitude of the upper right corner of the bounding rectangle (in degrees)	
BR_HG_LAT3_DEG	FLOAT	Heliographic latitude of the upper right corner of the bounding rectangle (in degrees)	
BR_CARR_LONG0_DEG	FLOAT	Carrington longitude of the lower left corner of the bounding rectangle (in degrees)	

HELIO Filament tracking
Draft

BR_CARR_LAT0_DEG	FLOAT	Carrington latitude of the lower left corner of the bounding rectangle (in degrees)	
BR_CARR_LONG1_DEG	FLOAT	Carrington longitude of the upper left corner of the bounding rectangle (in degrees)	
BR_CARR_LAT1_DEG	FLOAT	Carrington latitude of the upper left corner of the bounding rectangle (in degrees)	
BR_CARR_LONG2_DEG	FLOAT	Carrington longitude of the lower right corner of the bounding rectangle (in degrees)	
BR_CARR_LAT2_DEG	FLOAT	Carrington latitude of the lower right corner of the bounding rectangle (in degrees)	
BR_CARR_LONG3_DEG	FLOAT	Carrington longitude of the upper right corner of the bounding rectangle (in degrees)	
BR_CARR_LAT3_DEG	FLOAT	Carrington latitude of the upper right corner of the bounding rectangle (in degrees)	
FEAT_MAX_INT	FLOAT	Maximum feature intensity (in flux units)	
FEAT_MEAN_INT	FLOAT	Mean feature intensity (in flux units)	

HELIO Filament tracking
Draft

FEAT_AREA_PIX	LONG	Feature area in pixels number	
FEAT_AREA_DEG2	FLOAT	Feature area in square degree	
FEAT_AREA_MM2	FLOAT	Feature area in square megameter	
EL_AXIS1	LONG	Ellipse long axis (in pixels)	
EL_AXIS2	LONG	Ellipse short axis (in pixels)	
EL_ANGLE	FLOAT	Ellipse direction angle (in degrees)	
CC_X_PIX	LONG	Coding 1st position in pixels, X axis	
CC_Y_PIX	LONG	Coding 1st position in pixels, Y axis	
CC_X_ARCSEC	DOUBLE	Coding 1st position in arcsec, X axis	
CC_Y_ARCSEC	DOUBLE	Coding 1st position in arcsec, Y axis	
CC	VARCHAR(150)	Chain code of the feature boundary	
CC_LENGTH	LONG	Length of the chain code	
RUN_DATE	DATETIME	Date at which the code was run	"yyyy-mm-ddThh:nn:ss" format
VERSION_CODE	FLOAT	Version of the code used	
PAR_FILENAME	VARCHAR(150)	Name of the output file containing the features parameters	