Pre- and post-observation tools @ the (32m) Italian radio telescopes

A. Zanichelli, S. Righini, A. Orlati, K.-H. Mack, C. Knapic, M. Bartolini et al. from Bologna, Cagliari and Trieste
WHERE DID WE STAND?

Single-dish with the Medicina and Noto 32 m dishes:

- Field System: not suited for single-dish observations
- Backends: custom data formats, custom tools for data reduction
- No systematic feedback
- No systematic data archival
A MODERN RADIO OBSERVATORY

- Enhanced Single Dish Control System / Nuraghe: an common system for the Italian radio telescopes.

- ...But also:
  - Observation Preparation and Feedback
  - Data analysis (formats and tools)
  - Public Archive for radio data
Observation Preparation & Feedback

- The proposal
  - Evaluate exposure time
  - Observability
Observation Preparation & Feedback

- The proposal
  - Evaluate exposure time
  - Observability
  - Efficiency: data mining in the archive?

SINGLE-DISH EXPOSURE TIME CALCULATOR

version 1.0

The Exposure Time Calculator provides an estimate of the exposure time needed to reach a given sensitivity (or vice versa) under a set of assumptions on the telescope setup and the observing conditions.

This tool is intended to help planning the observations with the new Enhanced Single-Dish Control System (ESCS/Nuraghe), currently installed at the Medicina 32-m dish and at the Sardinia Radio Telescope. For this reason, the ETC is offered only for the observing setups currently implemented within this observing system. Further options will be included as soon as they will be available.

Details on the formulae used by this ETC and an explanation of the meaning of input/output parameters are given in the Exposure Time Calculator User Manual. For technical details, please consult the Medicina 32m and SRT User Manual. Tabulated values currently used by the ETC for the various instrumental setups can be found at this link.

Please report any result which may appear inconsistent, and let us know any comment which may help to improve this tool.

Select telescope and type of observation:

Medicina 32m Total Power →  GO

Send comments to: Alessandra Zanichelli  Last modified: 11/28/2014 14:41:29
The proposal

- Evaluate exposure time
- Observability
- Efficiency: data mining in the archive?
Observation Preparation & Feedback

CASTIA - Source Visibility

CASTIA is a software package able to check radio source visibility at a given date from a collection of international facilities. The tool outputs plots containing the visibility and the elevation of radio sources versus time. A special mark is used for the transit time and visual warnings are present when the azimuth rate is beyond the recommended limit or superposition with the sun/moon occurs. The query can be done by source name, sent to the SIMBAD name resolver for finding the corresponding right ascension and declination, or by giving coordinates for a single source or for a group of targets.

Parameters:

- Source(s):
- Date: 2015/10/21
- Site Name: Medicina
- Lower elevation: 10 deg
- Upper elevation: 80 deg

Release 3.1 September 2014

Inacuina M., Paccotta V., Pelizzoni A., Iacolina A., Tripi A. and the SRT Astrophysical Validation Team. contact: castia@oa.m EURAC
Observation Preparation & Feedback
Observation Preparation & Feedback

- The proposal
  - Evaluate exposure time
  - Observability

- The observations
  - Schedule creation and online observing tools
  - End of Mission Report: a feedback to the Observatory
**The proposal**
- Evaluate exposure time
- Observability

**Observation Preparation & Feedback**

**The observations**
- Schedule creation and online observing tools

**End of Mission Report: a feedback to the Observatory**
DATA ANALYSIS

- **Data Reduction Tools**
  - RFI flagging
  - OTF Cross Scans
  - OTF Maps
DATA ANALYSIS

➤ RFI is a most serious problem for the Italian radio telescopes.

➤ Medicina 32m: a *pathfinder* for the evolution of the RFI situation in other European regions?

➤ **Dish Washer**: a software tool to ease the identification and mitigation of RFI in single-dish data.

➤ Supported formats: FITS (and HDF5)

➤ *Tecno Project* financed by INAF in 2012 (PI K.-H. Mack)
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- **Data Formats**
  - Standard FITS for single-dish observations
  - Standard MBFITS (ongoing)
  - VLBI-IT data
FITS standard structure

File Edit Tools

Search for:

SIMPLE = T / file does conform to FITS standard
BITPIX = 0 / number of bits per data pixel
NAXIS = 0 / number of data axes
EXTEND = T / FITS dataset may contain extensions

COMMENT FITS (Flexible Image Transport System) format is defined in 'Astronomy
COMMENT and Astrophysics', volume 376, page 359, bibcode 2001A&A...376..359H
COMMENT V 1.0 Created by S. Rigolini, M. Bartolini & A. Orlati
HISTORY V 0.8 First output standard for Italian radio telescopes
HISTORY V 0.92 The keys column in data table replaced with the Tart table, it re
HISTORY puts the keys measurement for each input of each section
HISTORY V 0.9.9 The section table has been splitted into two tables: sections and
HISTORY of inputs table
HISTORY V 0.91 Added the flux column in section table
HISTORY V 0.9 SubStanType added as primary header: keyword
HISTORY V 1.0 Added new table to store position of subreflector e primary focus
HISTORY receivers: SERVO Table

DXT = '2014-03-09T10:50:33' / file creation date (YYYY-MM-DDThh:mm:ss UT)
HIERARCH Project_Name = 'OSI06G' / Name of the project
OBSERVER = ' ' / Name of the observer
ANTENNA = ' ' / Name of the station
HIERARCH SiteName = 0.16130419373679 / Longitude of the site (radians)
HIERARCH SiteName = 0.692983579621821 / Latitude of the site (radians)
HIERARCH SiteHeight = 650. / Height of the site (meters)
HIERARCH SiteNumber = 2 / Total number of sections
HIERARCH SiteName = 0.16130419373679 / Longitude of the site (radians)
HIERARCH SiteName = 0.692983579621821 / Latitude of the site (radians)
HIERARCH SiteHeight = 650. / Height of the site (meters)
HIERARCH SiteNumber = 2 / Total number of sections

Data

Index Extension Type Dimension View

0 Primary Image 0 Header Image Table
1 SECTION TABLE Binary 5 cols X 2 rows
2 RF INPUTS Binary 9 cols X 2 rows
3 FEED TABLE Binary 4 cols X 1 rows
4 DATA TABLE Binary 12 cols X 364 rows
5 ANTENNA TEMP TABLE Binary 2 cols X 364 rows
6 SERVO TABLE Binary 8 cols X 364 rows

Horizontal frame
Polar frame
Cartesian frame
Equatorial frame
Spherical frame
Ecliptic frame
Spherical frame

Type based on telescope m
FITS standard structure

- Extension 1
- Extension 2
- Extension 3
DATA ANALYSIS

- Data Reduction Tools
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  - OTF Cross Scans
  - OTF Maps

- Data Formats
  - Standard FITS for single-dish observations
  - Standard MBFITS (ongoing)
  - Converters to other common formats (e.g., to CLASS)

ERATec - Single-dish user support tools

VLBI-IT
Summary file
THE DATA ARCHIVE

- Collaboration with IA2: INAF Astronomical Archives Service
  - Web based interface, query on selected parameters
  - Data policy: private and/or public access (SSO)
  - VO compliant data and catalogs publication, pipeline management

- Radio Archive contents
  - Single-Dish data from the 32m antennas (and SRT), FITS/MBFITS
  - VLBI-IT data
THE DATA ARCHIVE
NADIR

- Based on TANGO Distributed Control System
- Development of services in the major OO Languages (C++, Java, Python)
- Handling of different data format (FITS/MBFITS/HDF5/XML)
- Flexible revision of policy and versions
- Strong logging and error handling
- Open source
- Maintained at IA2

**NADIR** is a configurable and flexible software that answer the challenging problem of archiving software reuse and scalability. It can also handle calibrated data.

NADIR Mandatory Requirements:
- INSTRUMENT;
- OBS DATE;

NADIR functional requirements:
- ProjID;
- PINAME;

Data delivery depends on ingestion date and policy. Policy depends on OWNERSHIP.
Radio Archive

File name

RA00.00.00.000 Dec00.00.00.000 Radius2000

Observation Date
From 2015-01-01 To 2015-09-30

Frequency
MIN 4800.0 MAX

Project ID

VLBI-IT

Backend XARCODE

Search Reset
THE DATA ARCHIVE

Radio Archive

File name
RA 13:31:08.287
Dec 03:30:32.06
Radius
Observation Date
From 2015-01-01 To 2015-09-30
Frequency
MIN 1300.0 MAX
Project ID
Telescope
VLBI-IT
PI Name
Giroletti
Exposure Time
3600
Antennas
Any
Data Rate

Search
Reset
THE DATA ARCHIVE

Radio Archive

<table>
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<th>File</th>
<th>Date</th>
<th>Ra (hh:mm:ss.s)</th>
<th>Dec (dd:mm:ss.s)</th>
<th>Project Id</th>
<th>Frequency</th>
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Grazie!