Prototype implementation for EVN Archive

Work in Progress

JIVE
Joint Institute for VLBI
ERIC

Mark Kettenis, 5 April 2024

EVN & JIVE

- EVN: European VLBI Network

  - Collaboration between radio observatories in Europe and beyond (South-Africa, Puerto-Rico, China, Korea)

  - Heterogeneous array

  - PI driven

- JIVE: Joint Instutute for VLBI ERIC

  - Support institute for the EVN

 - Operates the EVN correlator and hosts the EVN data archive
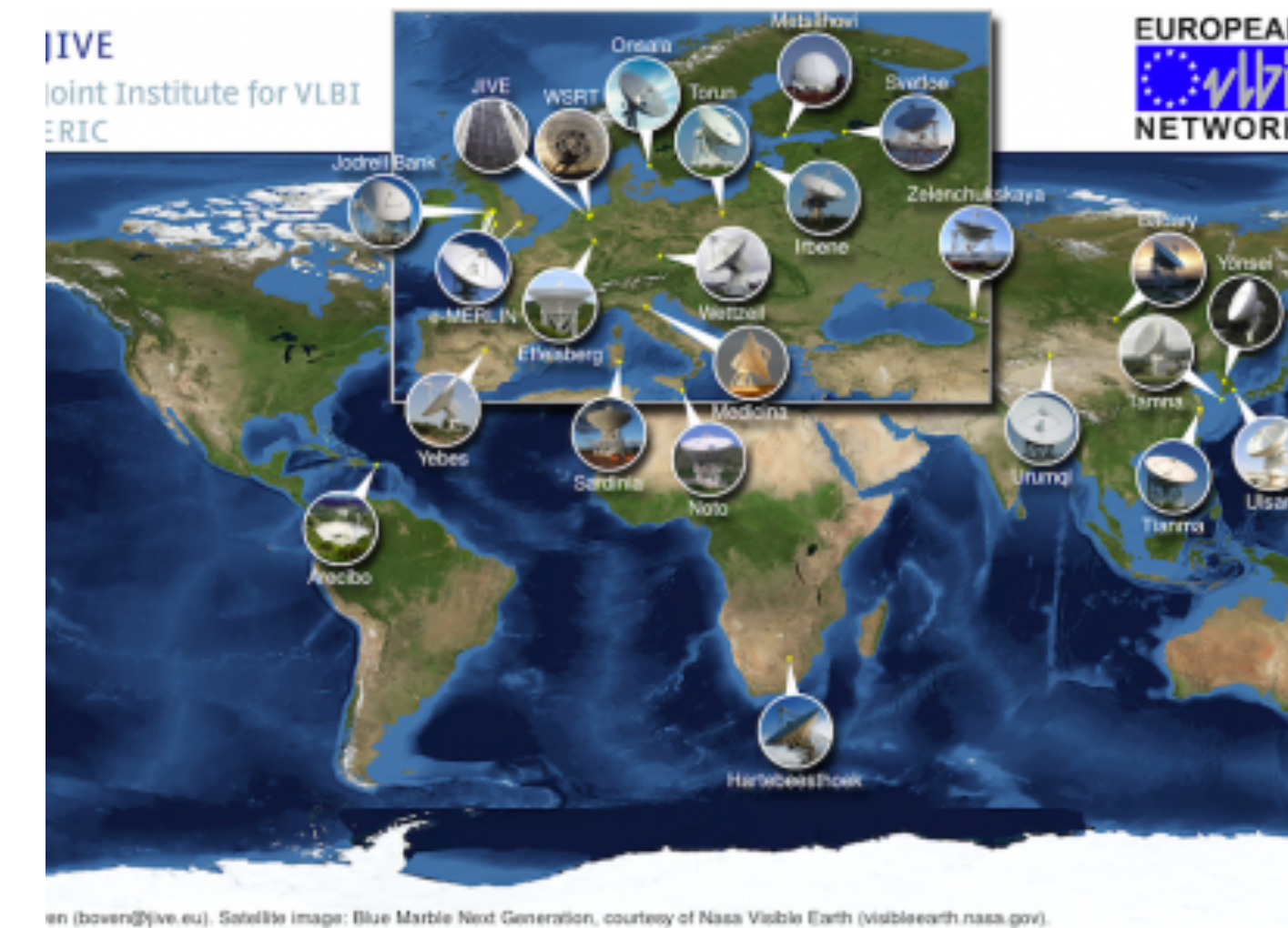
UV Characterisation

`uv_distance_max, uv_distribution_ecc, uv_distribution_fill`

- Extract UVW coordinates from FITS-IDI file

  - Instead of calculating based on schedule, some antennas may not observe

  - Time consuming (reads entire archive because FITS-IDI)

  - But can be done at the same time as calculating t_exposure

- Code uses Principle Component Analysis (PCA) from scikit-learn (sklearn)

  - Based on code from Mattia Mancini (ASTRON)
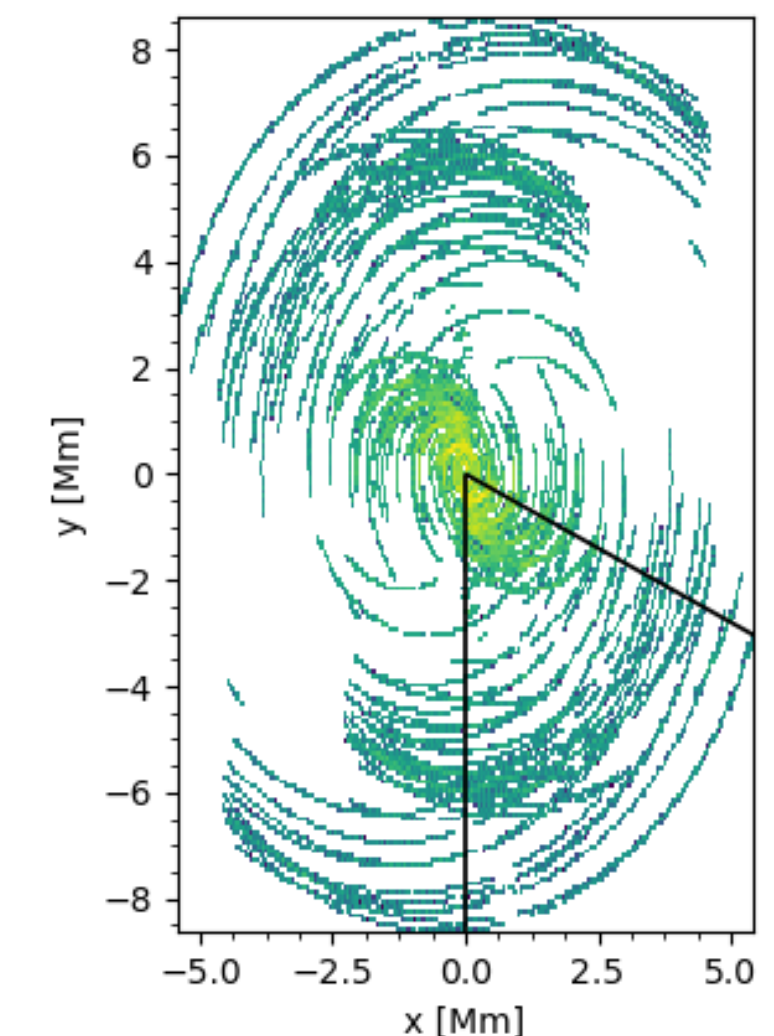
Spatial Characterisation

`s_resolution_max, s_resolution_min`

- Easily calculated once you have uv_distribution_ecc

- But somewhat confusing; _min is the "maximum" (best) resoltion

- Alternative is probably worse

`s_fov_min, s_fov_max`

- not implemented yes, should be easy

`s_maximum_angular_scale`

- Easily calculated from "`uv_distribution_min`"

Frequency/Time Parameters

`f_min, f_max, f_resolution`

- Provided by metadata in FITS-IDI files

`t_exp_min, t_exp_max, t_exp_mean`

- While (effective) integration times may vary, the variation is not meaningful for VLBI

- Wrong names? (Should be `t_resolution_xxx` ?)

Instrument Parameters

`intrument_ant_count, instrument_ant_min_dist, instrument_ant_max_dist`

- Can be provided but not really useful for VLBI

`intrument_ant_diameter`

- Can't do; multiple antennas with different diameters

`intrument_feed`

- Can't do; different receivers on different antennas

EVN Archive VO Service

- We use DaCHs to implement TAP (ObsCore) and DataLink

- FITScrawler script parses FITS-IDI and generates .csv file

- DaCHs resource descriptor populates database from .csv file

  - Creates evn.main table

  - Creates ivoa.obscore "view" on that table

Prototype VO Service

- DaCHs 2.9 provides experimental obs_radio#publish "mixin"

  - No support for `f_min, f_max`

- Added new columns to evn.main table

- Use this "mixin" to create ivoa.obs_radio "view" on evn.main table

  - Only a few additional lines needed in resource descriptor to map columns

- Natural joins work great:

```
SELECT obs_id, target_name, uv_distribution_fill FROM
ivoa.obscore NATURAL JOIN ivoa.obs_radio WHERE …
```

Interferometry Use Cases

- Give me high-resolution data on possible persistent radio sources with an arc second ofFRB 121102

  ```
  SELECT * FROM ivoa.obscore NATURAL JOIN ivoa.obs_radio WHERE
  CONTAINS(POINT(s_ra,s_dec),CIRCLE(82.99458, 33.14794,0.0003)) =
  1)) AND s_reolution_max < 0.000000003
  ```

- Give me data on extended HI emission around the source XYZ that can be imaged with reasonable fidelity:

  ```
  SELECT * FROM ivoa.obscore NATURAL JOIN ivoa.obs_radio WHERE
  CONTAINS(POINT(s_ra,s_dec),CIRCLE(82.99458, 33.14794,0.0003)) =
  1)) AND s_maximum_angular_scale > 0.018 AND
  uv_distribution_fill > 0.5 and uv_distribution_ecc > 0.5
  ```

Conclusion

- Most proposed columns can easily be provided

- Some columns will not be very useful in the VLBI case

- A few columns can't be provided for an inhomogeneous array

- DaCHS 2.9 support is already mostly there

  - Changes will be needed if we update the standard