

FITS-IDI: Beyond circular polarization

Leonid Petrov

NASA GSFC

Problem statement:

1. FITS-IDI specifications provides exclusive list of polarization combinations:

TABLE 6: Numeric codes for Stokes parameters

<u>Code</u>	<u>Parameter</u>
1	I
2	Q
3	U
4	V
<hr/>	
-1	RR
-2	LL
-3	RL
-4	LR
<hr/>	
-5	XX
-6	YY
-7	XY
-8	YX

2. Existing FITS-IDI based post-processing software package supported cir-cir case only.

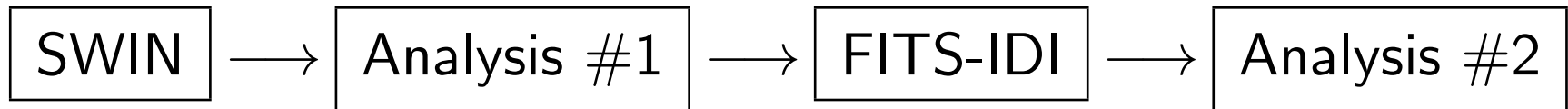
What is missing?

Missing:

- Support of HV pols
- Support of mixed mode: cir(RL), lin-hor(HV), lin-ra(XY)

Solutions:

1. To split analysis into two parts



2. To amend specifications

Amendments

TABLE 6: Numeric codes for Stokes parameters

<u>Code</u>	<u>Parameter</u>
1	I
2	Q
3	U
4	V
<hr/>	
-1	RR
-2	LL
-3	RL
-4	LR
<hr/>	
-5	XX
-6	YY
-7	XY
-8	YX
-9	According to POLTYA and POLTYB

Polarization types. The value in the POLTYA column shall be the feed polarization of feed A. This corresponds to polarization 1 in calibration tables. The value in the POLTYB column shall be the feed polarization of feed B (if any). See Section 2.5 on page 8. The two feeds may be either circularly or linearly polarized. ~~Mixtures of linear and circular polarizations are forbidden.~~ If two orthogonal polarizations are used, it is **strongly recommended** that feed A (POLTYA) be 'R' or 'X' and feed B (POLTYB) be 'L' or 'Y'.
required 'R', 'H', or 'X' and feed B (POLTYB) be 'L', 'V', or 'Y'.

Implications

Original specs allow only four practical cases:

1. single-pol RR;
2. single-pol LL;
3. dual-pol cir;
4. dual-pol lin with rotating feed.

It does not allow dual pol lin with fixed feed and explicitly prohibits mixed mode.

Amended specs are flexible and support all cases.

While old specs recommend R-L, X-Y order, new specs require it.

Cases code=-1, code=-5, dual-pol are equivalent to code=-9.

Compatibility is preserved!

Advantage

Native support of all polarization combinations.

Codebase for supporting cir cases can be used for supporting lin and mixed cases.

Disadvantage

Post-processing software should learn how to support non-cir polarizations.

Amendments should be standardized.

Implementation

Two new options have been added to difx2fits:

`--antpol` Use antenna-based polarization codes.

`--polxy2hv` Convert XY polarziation codes to HV codes.
Requires `--antpol` option.

vex2difx now recognizes H and V polarizations.

difx2fits creates a 2×2 polarization matrix $A_1A_2 \ B_1B_2 \ A_1B_2$
 B_1A_2 , where A and B are feeds for stations 1 and 2 defined in
POLTYA and POLTYB keywords.

Caveat: it creates a 2×2 polarization matrix padded with zero
even in a case of single-pol.

Visibility analysis

- read FITS-IDI → use orig. pols → generate bandpass
- read FITS-IDI, bandpass → create l-pol → fringe fit
- read FITS-IDI, bandpass, fringe fit → create any-pol comb
- load any-pol comb to difmap or AIPS → restore image
- load fringe fit → run geodesy parameter estimation

Current status

- difx2fits **committed** to trunk;
- Visibility analysis: **implemented** in *PIMA* ;
- All together: experimental NASA VLBI analysis pipeline: **under active development.**