

# Improving Accuracy in DiFX

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# Overview

- 1 DiFX for geodesy/Geodesy tools for DiFX**
- 2 PCal extraction in DiFX**
- 3 Verification**
- 4 Bug Reports and Testing**
  - Unit testing

# difx2mark4

- It works!
- Some tidying up of the code to be done
  - fourfit reference time
  - observation number (different from the alphanumeric obscode)
- **lots** of scope for sharing code with difx2fits
  - Move code from difx2fits to difxio
- Generalise
  - Multiple scans converted at once
  - Multiple scans in a job

# Fourfit

- Highly desirable for geodesy work
- Also extremely useful for data checking
  - supercharged sniffer

# PCal extraction

(typically)  $1\mu\text{s}$  pulses injected (for 1 MHz picket fence in frequency space)

- VLBA (and field system?) extract tone amplitudes and phases at the station
- Most geodetic correlators (e.g. Bonn mk4) extract the tones from the baseband data during correlation
- 1 or 2 tones per sub-band (as specified in vex file<sup>1</sup>)

DiFX now supports pcal tone extraction!

- **All** tones in bandpass
- Same integration time (accumulation period) as the visibilities

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<sup>1</sup>bug in sched?

## PCal and fourfit

- fourfit already handles multiple ( $> 2$ ) tones per subband
- seems to be fine

## PCal and difx2fits

- AIPS expects two tones per IF
- If there are more it uses the outer two tones
  - This may not be desirable
- Idea is to have difx2fits select the only two tones to write out to fits
  - This is supported in the input file format and in a branch of difx2fits
  - Missing link is to have vex2difx read the correct tones from the vex file

Better may be to modify AIPS to allow selection of pcal tones to be used by PCCOR

# Advanced PCal

- Useful to be able to plot pcal amplitude vs. phase
- Useful to be able to plot pcal amplitude against Tsys
- Use all pcals to contribute to the solution
  - avoids necessity to fringe fit in PCCOR
- Use pcal amplitudes for amplitude calibration?
  - Global VLBI correlated at Socorro
  - EVN correlated in Bonn



## Loose Ends

- Cable Cal.
  - Works OK for VLBA (vestigial 'pcal' file)
- Sampler statistics etc.
- Getting a version of HOPS which is compatible with DiFX
  - DiFX subversion repository??

# Verifying DiFX for Geodesy

- Tingay et al. (2009) verified amplitude and phase
  - $\sim$  1 minute of data from the middle of a fringe finder scan for a few VLBA antennas
  - central 50% of the bandpass
  - almost perfect agreement in amplitude and phase
- Petrov has done some verification (seems to be happy)
- Would be good to do a direct comparison of Mark4 and DiFX
  - All data contributing to solution
  - PCal extraction
  - Model accountability
- Compare the final geodesy product (CALC/SOLVE database)

# Full Audit of differences between Mark4 and DiFX

- Sync'ing at the start of reading a baseband file
- Handling of errors in baseband data
- Integration times

# Questions?

# Bug Reports

- Please can we have a bug report system?
  - Web-based interface for reporting bugs
  - Email goes to all relevant developers
  - Assign priority
  - Feature requests?
  - resolutions posted to an FAQs?
- Really useful for beginners, advanced users and developers

# Unit testing

A set of tests built in to the source code to test for correct behaviour

- Bad for high-level tests (Adam's stuff covers this)
- Bad for performance testing
- Good for low-level tests (configuration, correctness of individual functions)

“Test-driven” or “Extreme Programming” (probably not what we want to do)

- Write the tests before the code

# Making a start with Unit testing

- Choose a framework<sup>2</sup>
- Start with some tests to check for model accountability
  - mpifxcorr and difx2fits use different code to calculate the model (e.g. combining clock and CALC delay)
  - Not likely that mpifxcorr will adapt to use difxio (?)
    - devise same tests for mpifxcorr and difxio
    - this would provide a check
- Integrate with Autotools (make check)
- Integrate with Subversion?

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<sup>2</sup>See [http://check.sourceforge.net/doc/check\\_html/check\\_2.html](http://check.sourceforge.net/doc/check_html/check_2.html) for an overview. Also Wettzell have their own system, available on request.

# Continuing with Unit testing

- Developers can add tests when they submit/triage/fix bugs
- Core developers will inevitably make assumptions which may break for some power users
  - VLBI2010 developers (for example) can add tests to avoid these problems



## References

Tingay, S. J., Alef, W., Graham, D., & Deller, A. T. 2009, *Journal of Geodesy*, 83, 1061