About Me

- Starting the 3rd year of my PhD at the Institute of Radioastronomy, Bologna
- Supervised by Mauro Nanni
- Studying radio astronomy data reduction

Contents

1 Why do we want a Correlator

Why do we want a Correlator?

Italian VLBI?

- Once the SRT is built there will be 4 Italian dishes
  - Sardinia
  - Medicina
  - Noto
  - Matera
- All will be fibre linked
  - Medicina has already participated in international e-VLBI experiments
- It should be possible to do Italian VLBI

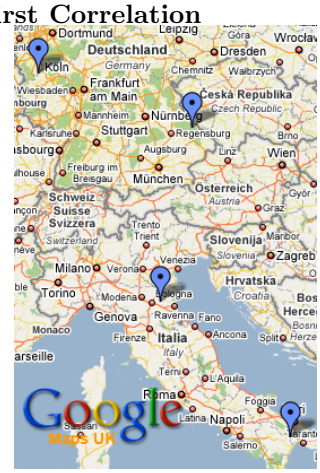
Advantages of Software Correlation

Flexibility!

- No hardware constraints on number of channels or integration time
  - Spectral-line VLBI
  - Wide-field VLBI
- Speed of correlation is only limited by computing power available
  - e-VLBI is possible if the correlator is real-time
- Several correlations can be done with different parameters
  - Can correlate the calibrator first
  - Can correlate several times shifting the centre of the field

2 First Correlation

First Correlation



- We scheduled a 4 station VLBI experiment
  - Observed in December 2007
    - Effelsburg
    - Wettzel
    - Medicina
    - Matera
  - 3 hour observation
  - 4×8 MHz bandwidth
  - 4×8 Mbit/s
  - $\sim$100GB per station

Do we have all the tools we need?

- Wrote a vex2calc convertor
  - Vex parser
- Wrote a few scripts to parse log files
- Wrote a script to write a flag file based on the vex file

3 Setting up a framework

Framework for an 'experimental' correlator

We want to be able to:-

- Set defaults
- Run from a command line or from a script
- Logging
- Integration with data reduction packages

Implementation

- Wrote everything in python
- Wrote python scripts to call 3rd-party programs
  - Set default values
  - Log output
  - Check for stupid errors

Framework for an 'experimental' correlator

Defaults

- Any input for any program can be:-
  - Set universally for all correlations
  - Set in a job-specific file
  - Set at the command line (or in the script)

Logging

- Uses the standard python logger
- Very flexible

Scripting

- Very Simple:-
  - A single class holding everything together
  - Functions to run all the tools
  - Functions to read and modify the input file/calc file

4 Scripting

Example pydifx file

```
c =  DifxJob('corr1')  # Create Correlator object
scans = [1, 19, 37]    # Choose a few scans
for i in scans:
    # Point to correct mk5 data for this scan
    for j in range(4):
        c.set_input('FILE 0/%d' % j,
                    'corr1ef_no%04d' % i))
    # Set correct time parameters in input file
    ...
    # Run correlator
    log.info('Correlating Scan ' + str(i))
    c.go()
    log.info('Correlator Finished')
    readfits()
```

Example pydifx file

```
def readfits():
    # read in fits files
    data = AIPSUVData(rootname, 'UVDIFX', 1, 1)
    fitld = AIPSTask('fitld')
    #convert to fits
    c.difx2fits(delete = True)
    fitld.infile = rootdir + rootname + '.FITS'
    fitld.outdata = data
    fitld.doconcat = 1
    fitld.go()
    os.rename(rootname + '.fits',
              rootname + '%02d.fits' % i
```

Example pydifx file

```
# Output concatenated fits file
fittp = AIPSTask('fittp')
fittp.indata = data
fittp.outfile = rootdir + rootname + 'CORR1.FITS'
fittp.format = 3
fittp.go()
```

Beyond Correlation

- We plan to install AIPS and ParselTongue on all nodes of our Cluster.

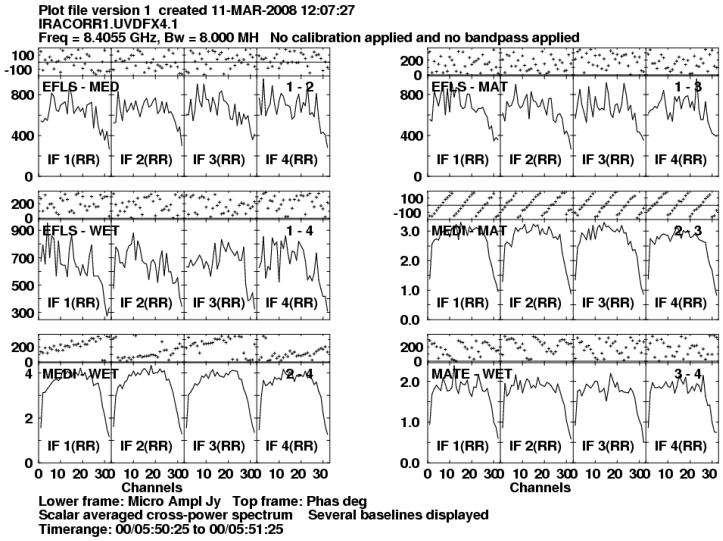
- Can look into parallel execution
- Can control the entire process from broadband data to imaging in a single script
- Correlation is just another step in the data reduction process

5 Results

Results

- With our (modest) test cluster
  - 4 machines with 2 × Intel Xeon 3GHz CPU
  - 4 machines with 2 × Dual Core AMD Opteron 270 2 GHz CPU
  - total of 24 cpu cores
- We can correlate a 6 minute observation in around 8 minutes
- 75% real time

Fringes



Next Steps

In the future:-

- Benchmarking:-
  - Experiment with different filesystems

  - Compare with other clusters
  - Combine with other clusters
- e-VLBI
  - Testing new fibres
- Grid/HPC
  - Cagliari

What do I want to get out of this conference?

- Fix the LO offset problem
- Learn more general stuff
- Discuss integrating with ParselTongue pipelines
- Vex files