ASKAP update for May 2022

In this issue we discuss consolidation workshops, CRACO development, and RACS.

Consolidation workshops

Between now and the start of full surveys, our key goals is to make improvements necessary to achieve performance targets and science outcomes. Based on operational experience and Survey Science Team feedback from Pilot Surveys, we recently prepared a consolidation plan that identifies 28 issues of concern. One of these is considered vital to the commencement of survey operations (the commissioning of ASKAP operations on Pawsey's new supercomputer, Setonix). A further 12 of these issues limit data quality or our ability to meet science goals. The rest impact our operational efficiency and our chance of completing the full surveys within 5 years.

On the 4th of May, we held the first in a series of internal workshops designed to plan technical solutions or mitigation strategies for these issues. The first workshop concerned holography observations and how to fully integrate them into ASKAP's operational workflow.

Holography measurements of ASKAP's primary beam shapes have become a key part of science processing. These measurements are used during linear mosaicking and are important for accurately determining properties such as the flux scale and off-axis polarisation characteristics. Holography requires special beamformer weights, due to its use of a reference antenna that acts differently to the antennas under test. Currently, these weights are made outside of ASKAP's weights archive service. ASKAP Operations and engineering team members discussed how to support holography weights in the archive and how to add a function that can construct these unique weights based on simple input parameters. These improvements will help track holography observations and ensure that all ASKAP beams have a corresponding shape measurement.

Another workshop discussed the long-standing issue of correlator dropouts. Data from a few spectral channels still goes missing occasionally, and the number of dropped channels accumulates over time. It has proven difficult to diagnose or solve this problem in the correlator firmware, so recent discussion has focussed on mitigation strategies. Since dropouts accumulate, more frequent correlator resets would minimise their impact. However, this also puts the hardware's power supply under strain and could potentially reduce the lifetime of the correlator.

We also discussed ways to improve the traceability of lost channels to specific hardware components, so that resets can be issued where they are most needed.

Towards full surveys

Alongside the consolidation workshops, other preparations for the full surveys continue in earnest.

Setonix commissioning

Pawsey staff are now preparing Setonix Phase I for user access. The ASKAP Science Data Processing team's last sprint focussed on our transition strategy. The goal is to be ready with software containers and tools as soon as access is granted, so we can ramp up to full scale tests as quickly as possible.

Commensal processing discussions

With the outcome of the RASSP having locked in large-area surveys in both the low and mid frequency bands, discussions between teams with commensal plans can now converge on final survey strategies. EMU and POSSUM are developing a joint survey strategy in the low

band and would also like to make use of WALLABY continuum and polarisation data from the mid-band.

CRACO development

The CRAFT Coherent (CRACO) upgrade project is progressing well on the path to commensal operations during ASKAP's full surveys. This new fast transient system will provide more sensitive triggering for the existing voltage capture mechanism, increasing the number of FRBs that ASKAP can detect and localise. The coherent system operates on a new data tap from the correlator, rather than the beamformer filter-bank outputs currently used. ASKAP's correlator firmware has been modified for this purpose, so careful testing is required to ensure that imaging modes are unaffected. This regression testing is underway, and the CRAFT team have already sent the first data packets to their new Alveo/FPGA-based processing cluster at the MRO.

Using fast-output visibility data to search for FRBs presents some new calibration challenges. It should be possible to use solutions derived from the primary imaging pipeline, which are updated about once per day.

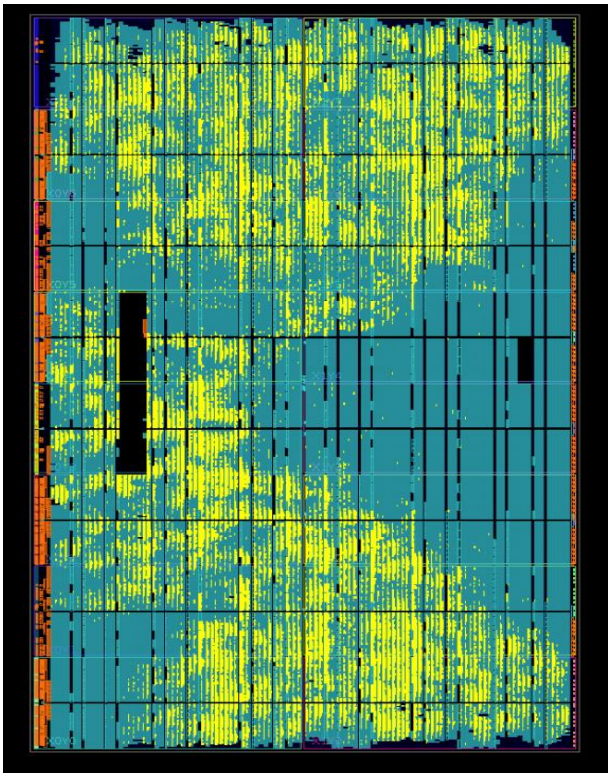

Figure 1: Logic map of the CRACO correlator firmware showing placement of networks within the FPGA devices. Figure provided by John Tuthill.

As part of other consolidation work, we are developing calibration methods based on comparisons with the RACS sky model. This technique may be able to provide prompt calibration solutions for any field the telescope happens to be observing when a fast transient alert is triggered.

RACS busy week

Early in May, the Rapid ASKAP Continuum Survey team held a busy week in Marsfield, with the goal of investigating some of the issues arising from processing and quality control. Observations and processing of a second RACS-low pass are now almost complete. RACS-mid and -high have been observed and processed and are now undergoing quality control. We can therefore look for common systematic trends across all three bands.

Both RACS-high and -low2 have a full set of holography observations for the beams used. RACS-mid has only partial holography coverage and will be augmented with source-based flux scale corrections like the original release of RACS-low.

Analysis of RACS-high and -low2 shows that there is still a small offset in our holography-based primary beam corrections, which manifests as a shift of the overall footprint by about an arcminute in Declination. The source of the offset is currently unknown, but under investigation. Due to the high degree of overlap between adjacent beams, it is only the edges of the field that suffer from errors in the flux scale of more than a few percent. Mosaicking of adjacent fields (one of the post-processing steps performed when all fields have been observed) will further mitigate this.

There is also a small astrometry offset of about 0.5 arcseconds, which is not understood. One possibility is an error in the fringe rotator's correction for atmospheric refraction. This is also under active investigation. The offset is less than a pixel in all RACS bands. The results of these comprehensive data quality tests will be published in survey description papers, with the current plan being to publish one paper per band/epoch.

We hope to make the most fundamental products from these three new data sets (mosaicked images and source-finding output from each individual field) available in CASDA over the next month or two. Curated catalogues will take longer to prepare and publish.

Having all three bands observed and processed also allows work on a frequency-dependent sky model to begin. This will be key to future calibration strategies and will be of major scientific interest.

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