ASKAP update for July 2021

In this issue we report on the POSSUM team's efforts to verify ASKAP's off-axis polarisation leakage calibration method, the first images from the RACS mid-band survey and other recent updates.

POSSUM busy week #9 report

During the week of June 14 to 18, the POSSUM team held a busy week with the goal of closing the gap between Pilot Survey Phase I and the data products needed to achieve their science goals for the full POSSUM survey.

One of the key tasks was to verify the method of off-axis polarisation leakage calibration developed for ASKAP operations. This method uses full-polarisation holography to map the leakage surface of each beam and apply a corresponding correction to the Stokes parameters during linear mosaicking.

POSSUM team members have also been developing a source-based leakage surface measurement technique, which can verify and possibly supplement the holography-based method.

Ultimately, prior knowledge of the beam properties for off-axis leakage correction will be required for application in the data processing pipeline.
Initial comparison of the two different methods showed encouraging agreement, after realising that they differ by an intrinsic factor of the Stokes I primary beam due to the way holography measurements are made. The correction methodology appears to substantially improve Stokes Q, while Stokes U and V are both less problematic and more challenging to correct.

We are now investigating some inconsistencies in the sign of Stokes Q and U in holography data across antennas and frequency channels.

CASDA exceeds 1 PB of stored data

The CSIRO ASKAP Science Data Archive recently crossed an important threshold. For the first time since its creation, CASDA's data archive occupied over 1 PB of stored images, cubes, continuum-averaged visibilities, catalogues, and spectra.

We have seen a rapid increase in CASDA's growth since the beginning of pilot surveys. The steady-state intake rate is expected to be around 25 TB per day on average during full surveys.

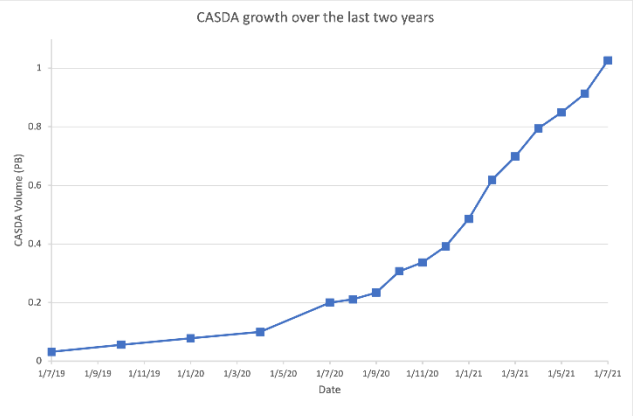

Figure 1: CASDA data volume growth over the last two years, showing a steady increase during pilot surveys. Graph made by Minh Huynh.

For those not yet familiar with CASDA and the services it provides, documentation is available online: https://research.csiro.au/casda/

Unfortunately, the hierarchical storage manager used by CASDA experienced some hardware problems over the last week. This has prevented both the upload of new data from the telescope and access to the existing archive. The Pawsey centre resolved this issue on the 12th of July, and we have now cleared the backlog of deposits.

RACS processing and high-band tests

Preparations for bulk processing of RACS mid-band observations continue. Newly arrived CSIRO postdoc Stefan Duchesne has been learning all about the RACS processing pipeline, checking calibrator observations, and creating test images in preparation for the first full-scale run. We hope to reduce the number of passes required compared to RACS-low and make the images and catalogues available even more quickly.

We have also been conducting holography measurements of the RACS footprint to ensure that an appropriate primary beam correction can be used from the beginning. This should avoid the image-plane flux scale correction that was needed for RACS-low observations., as described in McConnell et al. (2020).

While preparing to process the mid-band data we have also been planning high-band observations. The first RACS high-band test fields were observed at 1656 MHz on the 11th of July. The resulting images are very encouraging, with a PSF around 6" and sensitivity of 150 µJy/beam.

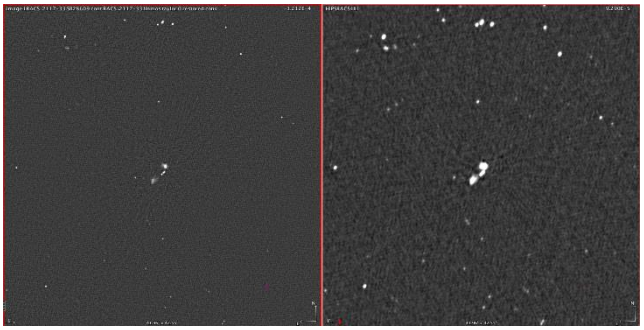

Figure 2: Comparison of a RACS high-band test field at 1656 MHz (left) with the same field observed in RACS-low at 888 MHz (right). Image made by Emil Lenc.

Obtaining high-quality images in the upper band is encouraging given that few observations have been done in this configuration before (and most of those used high frequency resolution zoom modes). Although some satellite RFI is present, most of the band is usable.

Firmware development update

Over the last two weeks the firmware team has been testing a new data stream alignment mechanism. This new firmware module uses more information from incoming data streams and initial tests show that one of the assumptions built into the existing alignment module is not always valid in practice. This could lead to frame slips that may degrade data quality.

Although great care was taken to match the length of all physical hardware signal paths, we observed a larger spread of relative frame arrival times at the correlator input than expected. Further investigation revealed ways to reduce this internal time dispersion in the firmware itself, making it easier to meet alignment requirements.

Although these changes are still experimental, it is likely that they will lead to a more reliable production firmware build in future.

Automatic SEFD calculation

As part of efforts to automate ASKAP's data processing software using a new event-driven framework, we have added a much-requested feature to the workflow. Each bandpass calibration observation will now automatically trigger a script that calculates the System Equivalent Flux Density (SEFD) of each beam when it arrives on disk.

The resulting output is stored in an HDF5 file and will be copied to the validation folder by the imaging pipeline when the calibrator is used on a science field. This validation folder is uploaded to CASDA alongside the science products.

In future we will also provide a diagnostic plot that will be visible in CASDA's web interface. SEFD information provides another way to assess the quality of ASKAP's beams and can be used to cross-check pre-flagging statistics.

ASKAPsoft 1.2 released

The latest update to ASKAPsoft improves memory management, which should allow more jobs to be run on a single cluster node. This improves overall computing efficiency. Issues with the stability of the 3rd party library used to determine calibration solutions have also been resolved. This should reduce the number of jobs that fail and improve overall throughput.

ASKAP at the ASA

Last week, the Astronomical Society of Australia hosted its Annual Science Meeting in a hybrid format. It was encouraging to see a wide range of talks describing the science resulting from Pilot Surveys Phase I. We also congratulate Keith Bannister (and the CRAFT team) for winning the Anne Green prize for the first localisation of a Fast Radio Burst using ASKAP's transient buffer system.

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