ASKAP update for March 2021

In this issue we discuss the challenges and benefits of commensal observing, report on the latest technical test progress and provide updated information on data processing for Pilot Surveys Phase I.

Commensal observing strategies

ASKAP's large-scale survey science projects involve a major investment of observing time and our goal has always been to conduct them as efficiently as possible.

Maximising efficiency ideally involves commensal observing, in which a single scheduling block supplies data to two or more teams. Recent cross-team discussions have outlined some of the expectations for commensality, bringing us a step closer to understanding what full survey operations may look like for ASKAP.

During Pilot Surveys Phase I, we focused on meeting data quality requirements for each team individually. As part of Pilot Surveys Phase II, we want to improve efficiency while maintaining data quality.

ASKAP's current survey science plans include five projects that need all-sky observations (EMU, POSSUM, WALLABY, VAST and FLASH), one project that is designed to be fully commensal by using low-level data products and an independent processing pipeline (CRAFT), and two more that need tailored observations of specific regions (GASKAP and DINGO). All-sky surveys require the largest fraction of observing time and the deepest surveys are EMU, POSSUM and WALLABY, so this is where the greatest efficiency improvements can be made.

Joint outcomes vs additional effort

Commensality can save a great deal of observing time (reducing five all-sky surveys to two, under ideal circumstances), but this may come at the expense of increased data processing load. Understanding the trade-off between these two factors and the compatibility of observing modes will be important when deciding the optimal approach.

Over the last year, plans have converged on the need to conduct at least two all-sky surveys, in ASKAP's lowest and mid-frequency band (around 888 and 1296 MHz). Ideally, these two surveys would provide all the necessary data for EMU, WALLABY, POSSUM and VAST, but there will be significant challenges in achieving this optimal outcome. WALLABY must observe the neutral hydrogen line and therefore has no flexibility in its band selection. EMU and POSSUM would prefer to observe in the lower frequency range to improve source counts and avoid satellite RFI as much as possible. Even with independent processing (running the science pipeline twice with different parameters on the same measurement set), combining

EMU and POSSUM observations would save half the observing time, but very little processing time (only some processing tasks would be shared). EMU and POSSUM would also benefit from access to WALLABY data in the mid-band, but this would require additional processing.

WALLABY is unlikely to need polarisation information, but POSSUM needs images for all four stokes parameters and additional calibration steps. EMU requires continuum Stokes I images, which are produced for WALLABY as an intermediate product to enable continuum subtraction. However, it is unclear whether the parameters used to create the WALLABY continuum image match EMU's preferred strategy.

VAST could also use data from any observation, but their focus on transient science imposes constraints on temporal coverage. These are unlikely to be compatible with the simple approach of observing each field once for as long as required to reach sensitivity limits. Making multiple snapshot images from a long integration is also very computationally intensive since each snapshot requires the full gridding and deconvolution process and cannot be done in real time for short integrations.

Pilot Surveys Phase II processing strategies

Ultimately, we must demonstrate a viable processing strategy that will keep pace with observations. Software improvements and the Pawsey hardware refresh will improve our processing capacity in future, so the focus for Phase II will be ensuring that the various strategies are compatible. We may not be able to produce commensal data products from all Phase II observations, but we will ensure that representative tests are done.

Technical test progress

New observations of a test field in the upper frequency band using zoom 32x mode (providing ASKAP's highest frequency resolution at the expense of bandwidth) have been processed and imaged. The GASKAP OH team report that self-calibration solutions are stable on all baselines and fewer imaging artifacts are present. This confirms that the fix to fringe rotation in zoom modes is working as intended, though it has yet to be deployed operationally.

Observations are underway to test a new method of primary beam correction integrated with the linear mosaicking process. Several teams including EMU, POSSUM and WALLABY have identified this new method of primary beam correction as a key requirement for Pilot Surveys Phase II, due to the improvements demonstrated by a similar method during RACS processing.

An operational implementation of holography primary beam correction should be available in the standard processing pipeline within a few weeks. We will gain more experience with the method throughout Pilot Surveys Phase II while developing beam map management tools.

ASKAP's digital engineering team has taken a big step towards identifying the source of occasional NaN (Not a Number) values appearing in the correlator output data stream. This arises from systematic corruption of a few samples due to metadata being incorrectly injected into the signal path.

To isolate the source of 1 MHz spectral jumps seen in FLASH data we have conducted test observations that should distinguish between beamforming or calibration intervals. These data are currently being processed.

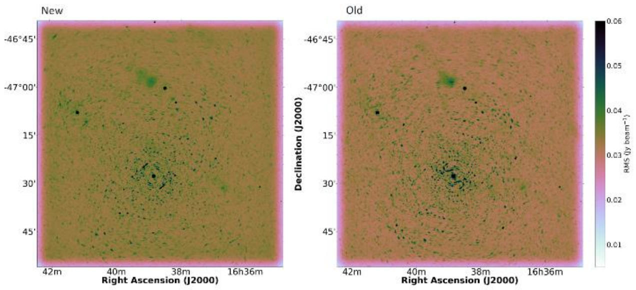

Image showing a comparison of a GASKAP test field before and after the firmware fixes to fringe rotation in zoom modes. Long baselines can now be used, and fewer artifacts are present around strong sources. Image provided by Chenoa Tremblay.

Pilot Surveys Phase I processing

Completion of data processing for Pilot Surveys Phase I remains a high priority, along with processing the SWAG-X observatory project. Most of the survey science teams have access to the majority of their Phase I data, with some FLASH and DINGO fields still to be processed. All science teams are encouraged to validate their observations in CASDA so they can be released and a DOI issued. This process must be completed before Pilot Surveys Phase II observations commence.

Before the next issue of this newsletter is published, we expect to release a major ASKAPsoft update. This will significantly increase the efficiency of several key processing steps and should reduce processing times for SWAG-X and Pilot Surveys Phase II. Our goal is to begin quality gate observations in April, provided sufficient disk space is available and Phase I data have been released.

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