Remote Operation and Performance of the Auscope VLBI Array

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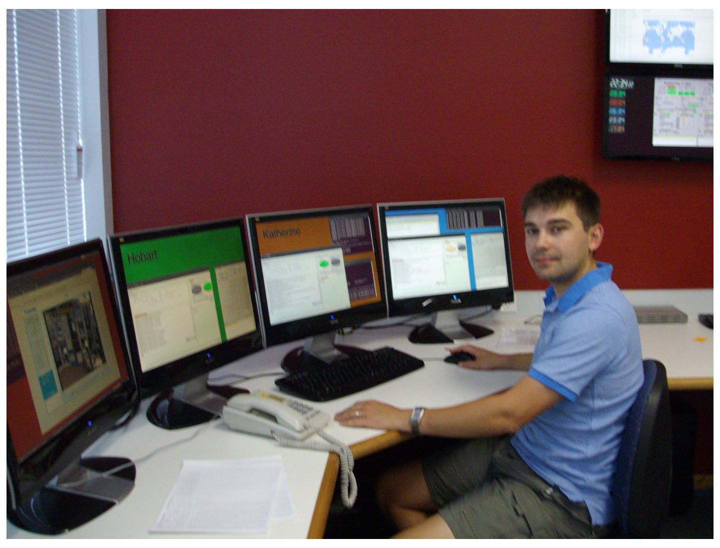
Introduction:

Th Auscope VLBI array consists of three Australia 12m telescopes located in Hobart (Hb), Katherine (Ke) and Yarragadee (Yg). The full array commenced operations with the IVS in June 2011. The telescopes are operated by the University of Tasmania, and are all controlled from an operations centre at the University's main campus. With two telescopes located in distant remote sites with limited local support, it has been vital to have a reliable and comprehensive remote observing system. A short outline of the system, and the current performance of the telescopes is given below.

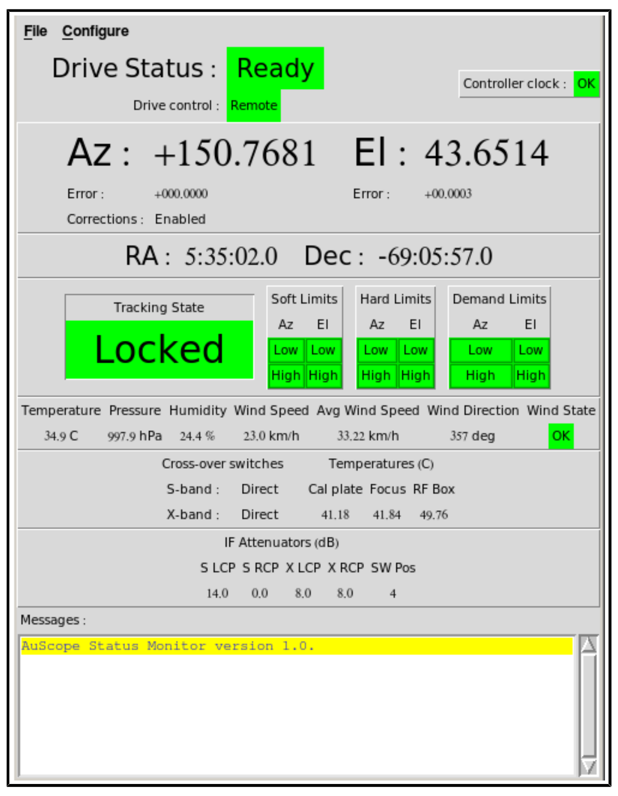
Control & Monitoring systems for remote operations:



The operations centre for the Auscope array is located in the University of Tasmania campus and is shown in the picture opposite. The main displays provide the control interface for the operators while a number of secondary displays provide additional information.

The Auscope antennas use a standard PCFS configuration (using the current 9.10.04 version) with customised modules for antenna control and system monitoring. The PCFS host machines are server-class machines using RAID file systems for reliability.

Control and monitoring of the experiments is carried out using the eControl interface for the field system, together with the Open-MoniCA system. eControl was developed by Neidhardt et al (2010) and offers significant benefits in bandwidth usage and connection reliability for the remote sites, compared to alternatives such as VNC. The MoniCA system was originally designed for the Australia telescope Compact Array (ATCA), and collects information on the observing system from a number of monitoring points. For the Auscope array, this encompasses supply voltages for the receiver electronics, temperature and humidity in the antenna structure, wind conditions, drive parameters, generator battery voltages, and so on. Most of the analogue interfaces are provided by PICAXE-based devices which are interfaced to MoniCA via simple TCP servers.



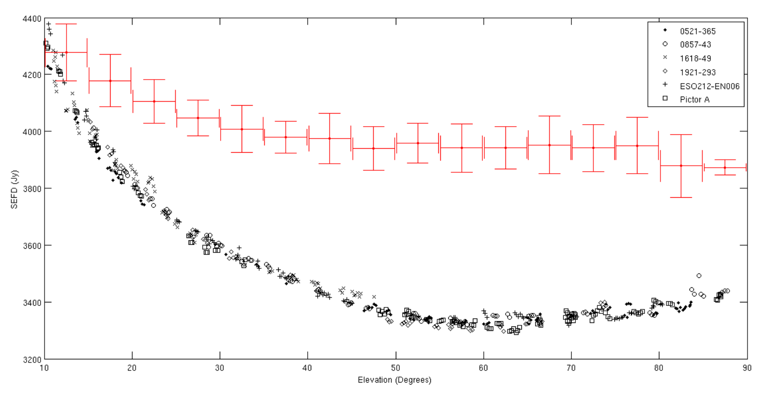
All of the information collected by MoniCA is permanently logged to assist in post-facto fault finding. A real-time monitoring system is also present to detect any faults when they occur, and to warn the operator. Informational displays (like the one opposite) are used to provide operators with a summary of important information. The open-MoniCA system in currently under active development to improve its performance and to offer a number of new features such as a web-interface system and finer control of the alarm system.

All the systems in the Auscope array have been standardised as much as possible, in order to make troubleshooting and replacement of units easier. The basic operation of the array consists of a number of modular units. The IF signal first passes through the IF unit, and then into the DBBC for sampling. The sampled data is then recorded to disk using a mark5B+ unit. All of the IF and recording systems are controlled by the PCFS machine.

The IF unit consists of 4 IF chains (RCP and LCP of S- and X-band), each with tuned cable compensators, IF amplifiers and independent controllable attenuator array. The output of each IF are split with two outputs going to the inputs of the DBBC conditioning modules, together with one other output as an analogue monitor point. In usual operation, these monitoring points are connected to a remotely controlled selector device which determines the input to the Agilent power sensor. A network-accessible spectrum analyser is also connected to this analogue monitor point. This is particularly useful for detecting the presence of RFI.

Performance:

During the commissioning of the antennas and after any work on the receiver system, the system temperature is measured using a warm load. Using the nominal LNA temperatures, the inferred system temperature is generally in the range of 85-90 Kelvin for a system in good order. The SEFD of the telescope was estimated using sources from the Ott et al. (1994) catalogue as flux calibrators, primarily Virgo A and Hydra. The zenith SEFD of the Auscope antennas is estimated at ~3500 Jy for both S- and X-band. A plot of the current performance of the Hobart 12m telescope is included to the right.

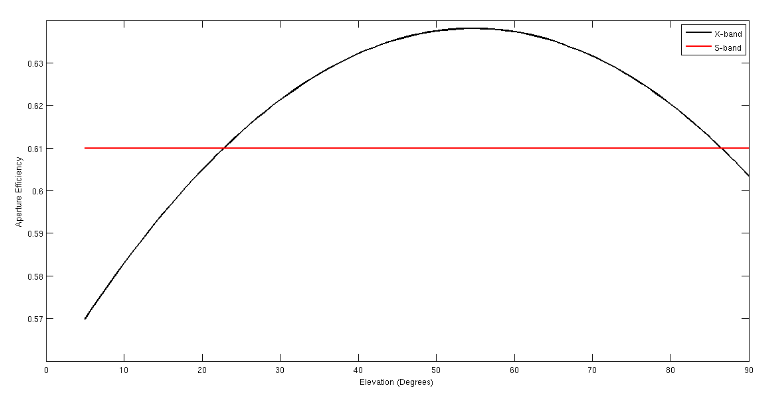


System Equivalent Flux Density performance of the Hobart 12m telescope. The S-band system was suffering from a slightly elevated system temperature when these measurements were made. The S-band observations have been averaged by bin, as they are somewhat noisier due to terrestrial interference.

The gain of the telescope was measured using observations of sources that transit near to the zenith. The amplitude of the sources relative to the noise diode was measured at elevations between 10 and 85 degrees. At S-band, there is no evidence for any change with respect to elevation with an estimated aperture efficiency of 60%. At X-band, the optimal gain is seen at an elevation of 55 degrees and a slight decrease is apparent toward the zenith and horizon. The peak aperture efficiency is 63.8\%, decreasing to 60% at the zenith. The gain curve was estimated via a polynomial fit which is included here

Aperture Efficiency = $-2.77\times10^{-5}\ El^{2} + 3.03\times10^{-3}\ El + 0.555$

The pointing model is currently implemented through the drive controller itself, which accounts for structural offsets such as tilts and encoder offsets. The RMS pointing accuracy across the sky is estimated at 45 arcseconds. The effect of these pointing errors should be a loss of < 1% at X-band. The pointing model and error estimates were obtained using grid-like observations. Further improvements



Estimated aperture efficiency for the Hobart 12m telescope