IVS Newsletter

Issue 33, August 2012

RFI Data Urgently Needed from Potential VLBI2010 Sites

– Bill Petrachenko, NRCan; Chris Beaudoin and Brian Corey, MIT Haystack Observatory

As most readers are aware, the demanding technological challenges of the VLBI2010 system are now largely met. High speed antennas, efficient low-noise broadband front ends, digital back ends, extremely high rate recorders, e-VLBI, software correlation, and increased automation at the stations are all essentially a reality. However, as the period of VLBI2010 deployment approaches, important questions regarding the RFI environment at stations still need to be answered.

Deteriorating RFI (Radio Frequency Interference) conditions, especially at S-band, were one of the motivating factors for the next generation system. The VLBI2010 solution was to develop a system with a very broadband front end (2–14 GHz) and back end systems capable of flexible selection of band frequencies. These characteristics make it possible to optimize frequencies in the context of current RFI conditions and to adapt easily as the RFI environment changes.

The main weakness of the new approach is that the broadband front ends are now open to receiving RFI anywhere in the full 2–14 GHz range. If the RFI is very strong it can saturate the LNAs (Low Noise Amplifiers) and this destroys not only the region of the spectrum where the RFI occurs but the entire broadband range. So the most urgent RFI-related question to answer is how many stations will routinely experience strong enough RFI to saturate the front ends.

The good news is that the "proof-of-concept" broadband systems being used at GGAO and Westford are not experiencing saturation of the LNAs. These systems are located in, or near, metropolitan areas subject to the usual heavy communication activity. It is expected that more remote sites will typically be subject to less RFI. Although promising, the experiences at GGAO and Westford represent a very small sample. It is important at this point to receive as much information as possible regarding the RFI environment at other sites.

A request has already been sent from the VLBI2010 Project Executive Group (V2PEG) to station managers for existing RFI data. The purpose of this article is to underscore the urgency of this request. In order to reliably evaluate the saturation potential of the collected data it is necessary that it be accompanied by estimates of the antenna and receiver gain used in the measurements and, for spectrum analyzer plots, by the resolution bandwidth. However, even if this information is not available, the data will still be of interest. It should be noted that the receiving system need not be particularly sensitive since the RFI level required to saturate the LNA is very strong and easily detectable. It is also not necessary at this initial stage that the data cover the full 2–14 GHz range.

At the same time, equipment and processes are being developed for a more systematic RFI survey. The setup will first be tested at GGAO and then a second communication will be sent to station managers requesting, where possible, that a similar survey be carried out at their station. Participation in these surveys is a critical step in the preparation for deployment of VLBI2010 systems.

VLBI Cartoon

– Chopo Ma, NASA GSFC

NASA's Space Geodesy Project (SGP) aims to complete a prototype integrated station with state-of-the-art VLBI, SLR, GNSS, and DORIS systems and to be the focus of NASA's space geodesy activities. As part of its outreach to the public, two animated videos have been produced, one on geodesy and one on the VLBI technique. They are viewable on the SGP Web site and can be distributed freely:

http://space-geodesy.nasa.gov/

Board Elections on the Horizon

As every even year, IVS Directing Board elections are coming up in the latter part of the year and early 2013. The Board has determined the three-person Election Committee with Alan Whitney (chair), Shinobu Kurihara, and Dirk Behrend. Expect a call to be sent out by early fall. The new Board will elect a new chair at the Board meeting in March 2013 in Helsinki.

Dirk Behrend

Institute of Geodesy and Geophysics, TU Vienna, Austria

The Institute of Geodesy and Geophysics of the Vienna University of Technology (TU Vienna) in Austria supports an Analysis Center in the IVS. The 'Viennese school' for VLBI was created when Prof. Dr. Harald Schuh was appointed to his position some 12 years ago. His right hand is Prof. Dr. Johannes Böhm who is one of his research fellows leading several investigations with respect to VLBI analysis. For this feature Newsletter Editor Hayo Hase interviewed Harald and Johannes to be introduced in more detail to the Vienna VLBI group.

Prof. Dr. Harald Schuh (left) and Prof. Dr. Johannes Böhm (right). (below) Main building of TU Vienna.

Harald and Johannes, when and how did you get interested in VLBI?

[H] When I studied at Bonn University in the 1970s we had a young Associate Professor named James Campbell. I liked his quiet attitude and his special kind of humor and decided to choose him as supervisor of my diploma thesis ('master thesis'). James reported about a modern space geodetic technique called VLBI that had been developed by scientists in the USA and Canada. They were using large radio antennas and measured geodetic parameters with a fantastic accuracy. James had already done some studies on this technique and had worked with real VLBI data. In 1980, his research proposal on 'VLBI data analysis' got approved by the German Research Foundation and he offered me a position as a research assistant in this project; that's how I entered into VLBI and started to work on a PhD thesis on VLBI.

[J] I got interested in VLBI when Harald came to Vienna in 2000. Before that time, VLBI was only a minor part of the studies at TU Vienna. I have always been fascinated by the fact that we can determine positions on Earth to a few millimeters by observing extragalactic radio sources which are billions of light years away.

Currently geodetic and astrometric VLBI is taught only at a few universities. TU Vienna is one of the few places, where one may obtain a master's degree in VLBI. What are the actual research subjects in Vienna after more than three decades of global scientific exploration of VLBI?

[H] At TU Vienna we do not offer a master's degree in VLBI, but within the curriculum of our current Master of Geodesy program a thorough knowledge in modern space geodetic techniques plays a big role with a particular focus on VLBI. Thus, the students in our master's program get a good basic education in the principles of geodetic VLBI. Many of them even get trained in data analysis to gain some first experience by analyzing VLBI data. In our VLBI group we are working on various research topics, starting from effects of the troposphere on VLBI signals, via geodynamical phenomena and Earth rotation, to space applications of VLBI such as navigation of spacecrafts by differential VLBI methods.

[J] Many research topics are related to VLBI2010. For example, we work on improved observing strategies for VLBI2010, and of course tropospheric delay modeling is an ongoing task. On the other hand, long time series of VLBI observations allow a better determination of geodynamical and astronomical parameters, such as the period of the free core nutation.

How many student theses have been made related to VLBI?

[H] In my professional life at Bonn University, DLR (German Space Agency), DGFI Munich, and TU Vienna, I have been supervisor or co-supervisor of more than a twenty PhD theses dealing with VLBI and related topics and – in the last few years together with Johannes – I supervised approximately about 40 bachelor and master theses. It is nice to observe that many of my former students are still active in research and science. There are also still plenty of new topics for future students.

The TU Vienna supports the IVS as an Analysis Center. Please introduce us to your VLBI group. Who is doing what and contributing to IVS subjects?

[J] Presently, ten members of the research group Advanced Geodesy are contributing to VLBI: Tobias Nilsson is involved in many VLBI activities; one of which is maintaining the master version of the Vienna VLBI Software VieVS. Lucia Plank and Matthias Madzak are working on the ties between kinematic and dynamical reference frames, and Jing Sun is taking care of scheduling and simulating VLBI observations. Global VLBI solutions can be used for the determination of geodynamical and astronomical parameters. For example, Hana Krasna (née Spicakova) is estimating

Love and Shida numbers, Sigrid Böhm (née Englich) is determining parameters of empirical Earth rotation models, and Virginia Raposo is investigating reference frames. Claudia Tierno Ros has started to work on the implementation of the Kalman filter solution in VieVS, and we will be glad to have Kamil Teke back for a nine-month visit. He will support Claudia and improve the least-squares adjustment. Last

Members of the Vienna VLBI Group at the IVS General Meeting in Madrid (left to right): Matthias Madzak, Lucia Plank, Hana Krasna, Harald Schuh, Johannes Böhm, Claudia Tierno Ros, Jing Sun, and Tobias Nilsson (missing from the picture: Virginia Raposo, Sigrid Böhm).

but not least, Harald Schuh is Chair of the IVS, and together with him, I am coordinating the VLBI activities at our group. Moreover, there are many master students who are contributing to our team.

[H] In fact, after ten years as Associate Analysis Center and Special Analysis Center for Specific Observing Sessions (SAC-SOS) we plan to become an Operational Analysis Center soon.

Your activities have been awarded. What was the most outstanding award and why was it given?

[J] One of the highlights for our VLBI group was in 2003 when the Descartes Prize was awarded to a team of European researchers that included Harald. The project that got awarded with this highest science prize of the European Union (often called the 'Nobel Prize for Research Groups') was dealing with a significantly improved nutation model and VLBI was contributing with high precision measurements of the nutation parameters, an essential part of the whole work. The prize money of 300.000 Euro was spent for funding travel and research grants of 13 young scientists and I was happy to see several of them working again on VLBI. Another award for Harald was the Vening Meinesz Medal 2011 of the European Geosciences Union (EGU) for "his work in the field of Very Long Baseline Interferometry (VLBI) and his important contribution to space geodetic research."

[H] Besides several national prizes, best paper and best presentation awards that people of the Vienna VLBI group received in the last years, I would like to mention the Guy Bomford Prize of the IAG that Johannes received in 2011. It is the highest award in international geodesy for scientists under 40 bestowed only once every four years.

Johannes, we also know the Vienna Mapping Function (VMF) based on data of the European Centre for Medium-Range Weather Forecasts (ECMWF). What is this and why is it used as a reference among scientists around the world?

[J] VMF is a mapping function that "maps" the path delay from zenith direction down to the elevation angle of the observation. Its accuracy is important for the accuracy that can be achieved for station coordinates. Unlike other mapping functions (e.g., NMF or GMF), the Vienna Mapping Function is calculated from real weather information with a time resolution of six hours. It has proven to be more accurate than other mapping functions presently available.

With your students you developed a VLBI analysis program based on a commercial calculation program MATLAB. Why is this program so popular among students? How can somebody obtain access to it?

[J] We decided to go for MATLAB about four years ago, and we are very happy that we made this change. All our students are experts in MATLAB so it is very easy for us to attract students to write their bachelor or master theses about VLBI. Moreover, MATLAB has a lot of built-in functions which can be used to write the source code very concisely, and also the plotting utilities are very useful. In the new version (2.0) we connect the scheduling, simulation, and estimation parts of the software. Now it is easy to test new (VLBI2010) networks with realistic simulation parameters. If you are interested in VieVS, please go to http://vievs.hg.tuwien.ac.at/ to get further information.

Do you offer training schools on VLBI data processing? If so, when will be the next school?

[J] Yes, we do. The third VieVS User Workshop will take place in Vienna from 11 to 13 September 2012. Everybody is welcome to attend. Please, register at the webpage mentioned above. My impression is that this workshop is not only useful to learn VieVS but also to better understand VLBI analysis in general.

What are the past, present, and future challenges in VLBI analysis?

[H] What makes VLBI so attractive for scientists and researchers are the multiple applications in geodesy and astronomy – in other words it never gets boring as there are always new topics and new challenges. A main research topic – and still the limiting factor – is the troposphere that requires special attention. Other promising research areas could be the determination of rheological parameters of the Earth as well as of astronomical/cosmological parameters such as the rotation of our galaxy. Also space applications of VLBI and its combination with other space geodetic techniques open a lot of new interesting research fields.

[J] We want to get the 1 mm! With VLBI2010 we have the chance to achieve this goal. Of course, we still face problems with tropospheric turbulences, but I am optimistic that with new observing strategies we can get a better handle on that. Another interesting challenge is the tie between kinematical (realized by quasars) and dynamical (realized by satellite orbits) reference frames.

Harald, as IVS chair and member of the VLBI2010 Project Executive Group (V2PEG) you are a strong promoter of introducing the VLBI2010 ideas to the IVS components and creating the VLBI2010 Global Observing System (VGOS) as part of the Global Geodetic Observing System (GGOS). How do you evaluate the progress on modernizing the global VLBI infrastructure?

[H] The development of VLBI2010 (the next generation VLBI system) and the implementation of VGOS (the VLBI2010 Global Geodetic Observing System launched at the last IVS General Meeting in Madrid) are indeed the main achievements of the IVS in the past few years and I am extremely happy to observe the rapid progress made. In particular, I am enthusiastic about the high number of new VLBI2010-type radio telescopes that have already been constructed or are in the planning phase all over the world.

We have heard about upcoming changes in your professional career. Would you like to share your plans with us? Will the TU Vienna continue to be a strong partner in the IVS? Will VLBI be part of your professional future?

[H] It is right that a new phase in my professional career will start on November 1st, 2012, as I'll become Head of Department 1 "Geodesy and Remote Sensing" at GFZ in Potsdam, the German Research Center for Geosciences. This position will be connected with a professor position at Technical University Berlin and thus will allow me to keep direct contact with master and PhD students. That's what is essential when thinking about the next generation of VLBI specialists. One of my conditions before accepting the job offer was that I can continue to work on VLBI, and my plan is to establish a research group at GFZ working on space applications of VLBI, e.g. applying differential VLBI methods for navigation in space but also developing new space missions that allow co-location of different techniques in space.

[J] For sure, TU Vienna will continue to be a strong partner in the IVS. There will be an intensive collaboration with GFZ as well as with other IVS Analysis Centers around the globe.

Thank you very much for your openness. We wish you success with all the changes. At the end of my interview I would like to know, what you like to do at the end of day when you are not busy with VLBI. What do you like to do at the end of the day as leisure activities?

[H&J] Indeed it is also important to relax and enjoy doing activities other than VLBI. In this respect we have a lot in common as both of us like to do some sports, in particular running, and when we return to the institute we like to watch our favorite team Bayern Munich playing in a high level football (soccer) match.

Harald, Younghee Kwak, and Johannes cheering on their favorite team.

The IVS Newsletter is published three times annually, in April, August, and December. Contributed articles, pictures, cartoons, and feedback are welcome at any time.

Please send contributions to
ivs-news@ivscc.gsfc.nasa.gov.
The editors reserve the right to edit contributions. The deadline for contributions is one month before the publication date.

Editors:
Dirk Behrend, General Editor Dirk.Behrend@nasa.gov
Hayo Hase, Feature Editor hayo.hase@bkg.bund.de
Heidi Johnson, Layout Editor hjohnson@haystack.mit.edu

The newsletter is published in color with live links on the IVS web site at

http://ivscc.gsfc.nasa.gov/.

Upcoming Meetings...

XXVIII IAU General Assembly
Beijing, China
August 20-31, 2012

6th Annual DiFX Users and Developers Meeting
Sydney, Australia
September 24-28, 2012

11th EVN Symposium
Bordeaux, France
October 9-12, 2012

1st International VLBI Technology Workshop
Haystack Observatory
Westford, MA, USA
October 22-24, 2012

AGU Fall Meeting,
San Francisco, CA, USA
December 3-7, 2012

EVGA Working Meeting
Helsinki, Finland
March 6-8, 2013

EGU GA 2013
Vienna Austria
April 7-12, 2013

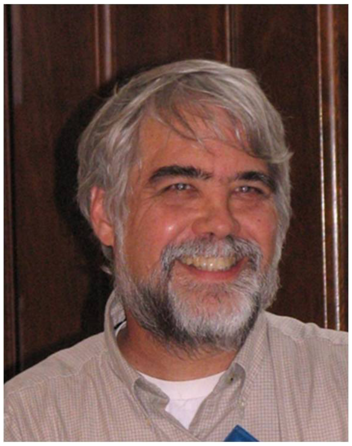
7th IVS TOW Meeting
Haystack Observatory
Westford, MA, USA
May 6-9, 2013

http://ivscc.gsfc.nasa.gov/meetings

NEWS...

Kingham Retires from WACO

– *Brian Luzum, USNO*



On 2 June 2012, Kerry Kingham retired from the U.S. Naval Observatory (USNO) after more than thirty years of outstanding service. For the last twenty-five years, Kerry used his extensive technical and computer expertise setting up the Washington Correlator (WACO) facility and later serving as its head. Kerry's service to the VLBI community spanned a critical period. When Kerry started, VLBI observations were called experiments because the results of the observations were not guaranteed. By the time he retired, anything less than a successful VLBI session is unexpected. Kerry's efforts helped to usher in this era of operational success.

Kerry's experience with radio astronomy began in graduate school at the University of Virginia. However, USNO was not able to take advantage of this expertise until the 1980s when the U.S. National Earth Orientation Service (NEOS) partnership was created with the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA). NEOS was initiated to pool resources among the three agencies in order to meet common goals. Setting up an operational geodetic VLBI observing and correlating capability was high on that list and Kerry was tapped to lead the WACO facility.

Over the years, Kerry was at the forefront of many aspects of VLBI correlator improvements. He was involved in building and debugging first the Mark III VLBI correlator in the 1980s, followed by the Mark IV correlator in the late '90s. He also worked extensively in the transition of recording media from wide-track tape, to narrow track tape, and finally to electronic transfer of VLBI data.

Kerry has been a valuable resource to the international scientific community. His willingness to share his knowledge and experience made him one of the people that scientists turned to with challenging questions. His multiple terms on the IVS Directing Board show the regard with which he was held in the international scientific community. Kerry's presence and expertise will be missed.

However, Kerry's retirement doesn't mean that USNO will have a diminished role in geodetic VLBI. USNO is in the process of a lifecycle replacement of its existing hardware correlator. The new software correlator is expected to be delivered soon and become operational by September 2012.

The process of transitioning from shipping Mark5 disk packs to sending VLBI data electronically, initiated at USNO under the leadership of Kerry, continues to evolve. Currently, all Intensive observations sent to WACO are transmitted by high-speed Internet. This capability has reduced the latency of the Intensives from 2–3 days a couple of years ago to less than a day in most cases. This reduced latency has had, in turn, a direct impact in the downstream EOP products: during this time UT1–UTC errors in recent combination and short-term predictions have been reduced by roughly 50%.

Another ongoing project that Kerry led is the creation of additional scripting to facilitate the automation of the pre-correlation process. With the expectation that USNO will be involved in 24-hour/day VLBI2010 correlation, efforts are already underway to setup software to relieve the manual intervention required in setting up the correlator for processing sessions. The hope is that over the next several years, VLBI data can be automatically retrieved from the stations, correlator files setup, correlation completed, and results analyzed with minimal intervention.

So, while we are sorry to see Kerry leave, USNO is excited at the VLBI prospects that Kerry worked so hard to advance.

Kerry Kingham while explaining the VLBI technique at an IVS Technical Operations Workshop.

1969: The Birth of Modern Geodetic VLBI

– *Alan Whitney, MIT Haystack Observatory*

The first VLBI experiments of the modern era were conducted independently in mid-1967 by Canadian and U.S. researchers. These early experiments were primarily targeted at developing high-resolution maps of radio sources and/or placing upper bounds on their angular sizes for sources which appeared to contain structures too small to be resolved with traditional connected-element radio interferometers that had been in use since the late 1950s and early 1960s.

Mark I VLBI data recording system.

Exactly when the use of VLBI for high-precision geodetic measurements was recognized is somewhat cloudy. In 1968, Irwin Shapiro suggested the use of VLBI for high-precision geodetic measurements. Also in 1968, Canadian researcher H. E. Jones analyzed data from the 2100 km baseline from Algonquin Park, Ontario to Prince Albert, Saskatchewan for geodetic content, though the results were inconclusive due to large ionospheric corruption at the 448 MHz observing frequency (Jones recommended observations at higher frequencies).

Early VLBI measurements were hindered for geodetic accuracy by several factors. Firstly, they were generally conducted using Rb oscillators, which did not have the necessary stability for good geodetic measurements. Secondly, recorded bandwidths were too small to obtain good group-delay measurements (360 kHz for the U.S. Mark I digital system; 4 MHz for the Canadian analog system, but difficult time-base control).

In 1967, Alan Rogers of MIT Haystack Observatory proposed two possible methods of effectively extending the effective recording bandwidth for a fixed recording bit-rate capability to obtain a high-precision group-delay measurement: (1) simultaneous recording of many widely separated frequency channels, and (2) rapid sequential recording of different frequency channels. Though Dr. Rogers' paper was not published until 1970, a major development effort to support "frequency-switched" VLBI system utilizing the Mark I recording system was begun at Haystack Observatory in late 1967. The first frequency-switched VLBI experiment was conducted in April 1968 between the 120-ft Haystack antenna in Massachusetts and the 84-ft antenna at Onsala, Sweden at an observing frequency of 1660 MHz. The results from this first experiment, however, were very few and poor due mainly to the problems involved in shaking down all of the new equipment.

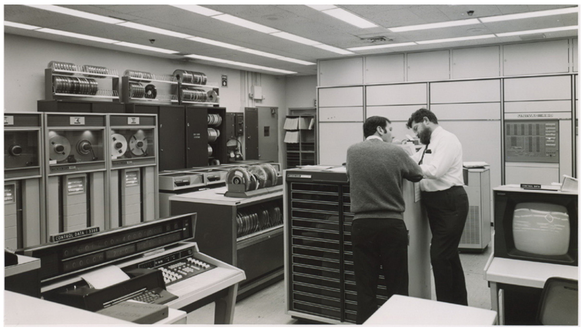
In October 1968, a second switched-frequency experiment was attempted between Haystack and the NRAO 140-ft antenna at Green Bank, West Virginia; though the primary purpose was to attempt to measure the differential relativistic bending of radio sources 3C273 and 3C279 as they passed near the sun. Observations were at two widely separated, but simultaneously observed, frequencies (X-band and L-band). My recollection is that this experiment also marked the first time of simultaneous phase and group-delay calibration through the use of phase-calibration tones, suggested by Alan Rogers. The data were correlated on the CDC 3300 computer at Haystack (a software correlator!); see Figure 2. Though many fringes were obtained, the results of the experiment were disappointing for two reasons: (1) continued problems in clean switching of local oscillator frequencies, and (2) much more corruption of the data by the sun's corona than expected.

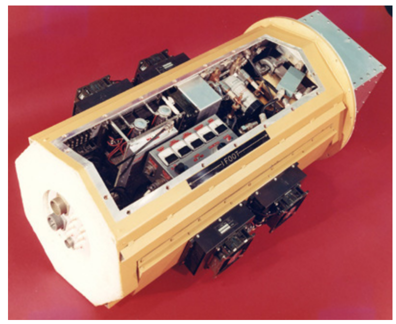
The first truly successful switched-frequency VLBI experiment was conducted in January 1969, again between the Haystack 120-ft and NRAO 140-ft antennas. All observations were made at L-band near 1660 MHz, spanning a synthesized bandwidth of 110 MHz over six frequency windows. The agreement of the 3-dimensional vector baseline using group-delay measurements was to within ~2 meters in length and about ~5 meters in orientation. Additionally, the positions of six radio sources were simultaneously determined to accuracies varying from ~0.2 to 1.0 arcseconds. The results still were not up to initial expectations, but did represent a significant improvement in the state-of-the-art.

In the spring of 1969 planning began (along with NASA/GSFC as a participant for the first time, the beginning of a 40+ year relationship!) for another switched-frequency experiment to be conducted in October 1969, the goals being to make high-accuracy geodetic and astrometric measurements as well as another attempt to measure the gravitational bending of radio waves. This time three antennas were involved, the Haystack 120-ft, the NRAO 140-ft, and one of the 90-ft antennas at the Owens Valley Radio Observatory (OVRO) near Big Pine, California. Simultaneous observations were again made at L-band and X-band. This was the first switched-frequency VLBI experiment to use three antennas and offered a unique opportunity to collect simultaneous data on three baselines, allowing, for the first time, internal consistency checks to be made around three baselines. Goals for the measurement accuracies were set at about 1 meter in baseline vector components and ~0.1 arcseconds for source positions. Approximately 3000 observations were scheduled, requiring the recording of ~4000 Mark I 12-inch-diameter 800 bpi 9-track open-reel computer tapes, each able to collect just 3 minutes of data.

When the correlation processing (on the IBM 360/91 computer at NASA/GSFC, one of the largest and fastest computers then available anywhere) of the October 1969 experiment was completed and the data were edited, approximately 500 observations remained, of which approximately 70% were from X-Band. A correction for the ionosphere was also applied to both the delay and delay rates. Although the initial goals of the October 1969 experiment proved to be somewhat optimistic, the results were significantly improved over previous results (~0.7 meter consistency on the ~850 km Haystack-to-NRAO baseline and, ~2.5 meters on the ~5000 km baselines to OVRO). Source position errors were mostly in the range ~0.1-0.9 arcseconds with a recognition that source structure of some of the observed sources was likely a significant contributor to both baseline-vector and source-position errors.

The geodetic VLBI developments and observation of 1969 laid the groundwork for the modern multi-band and broadband geodetic VLBI techniques that are used today and that are many times more accurate. The author would like to acknowledge the large contributions to this work by Tom Clark, Hans Hinteregger, Curt Knight, Doug Robertson, Alan Rogers, Irwin Shapiro, and Nancy Vandenberg.





(left) CDC 3300 computer at Haystack Observatory; correlated and processed VLBI experiments 1967-1969; (right) VLBI front end for OVRO 90' antenna for October 1969 experiment; nested L-band/X-band feeds.

Example of an IVS Operational Wiki

– Stuart Weston, AUT University; Jim Lovell, University of Tasmania

Raised at the TOW last year by some operating stations was the requirement for easier access to available documentation and information. Although much information is contained within the Haystack memo series, it is a very formal and controlled source.

In the IVS Newsletter Issue 30, it was commented on the difficulty with the documentation for new hardware such as the DBBC. The question was asked, can we as operators help improve this situation for ourselves?

One of us (SW) has recently moved from a commercial software company where wikis were extensively used internally but were also made available to some external customers. Software developers and operation/support staff were far more receptive to adding knowledge into a wiki than the more formal documentation process that existed. Of note was that the support desk noticed a significant drop in support calls from those customers with access to the wiki.

At the Warkworth station we use a wiki internally for documentation, logging, and procedures. In collaboration with the AuScope VLBI Project we have attempted to merge our respective knowledge of using the 12-m Patriot antenna with a DBBC and Mark 5 into an operations wiki hosted by the University of Tasmania which is viewable externally.

I would encourage you to have a look at the AuScope VLBI Operations Wiki which can be found at the following URL: *http://auscope.phys.utas.edu.au/opswiki/*

Currently the documentation with respect to the DBBC and 12-m antennas is very sparse in a geodetic VLBI context (although the 12-m controller documentation from MP GODWIN LIMITED is very complete). With The AuScope VLBI Project we have started to build up a wiki with respect to these devices. At the miniTOW recently held at Hobart the operations staff were very complimentary of the information stored within the wiki and see it as their first go-to source of help and information.

For those stations interested in obtaining DBBCs you might want to review our experience and knowledge gained by operating these for over 18 months now. The wiki page for the DBBC is:

http://auscope.phys.utas.edu.au/opswiki/doku.hp?id=hardware:dbbc

Within the wiki we have also started to catalog sources visible in the southern hemisphere detectable with the 12-m dishes and which can be used for pointing. Integration of the 12-m antenna and DBBC control in the PC Field System has permitted us to achieve good pointing models.

We would appreciate any feedback. If you would like to contribute to the wiki, contact Jim to obtain a User ID and Password. We leave with the idea whether this model can be applied to the greater IVS community such as a section for new stations.

What Can We Learn from High Performance Stations?

– Rich Strand, NVI, Inc.; Mike Poirier, MIT Haystack Observatory

These past few months I have been documenting station performance during all sessions for all observatories. It becomes quickly apparent a number of stations are consistently producing high quality VLBI data that allows our analysis team to provide the IVS with high confidence results. This column investigates what they are doing correctly.

Ed Himwich training the AuScope team at the Hobart mini-TOW.

Obviously pre-checks have to be first on the list. Stations that follow the basic guidelines of a pre-check list have an advantage as the operator can quickly detect any problems before the session begins. One of the best checks is to verify that pointing is correct and usually one of the first tests most station conduct.

Although the pointing model is seldom changed this check actually verifies that the telescope can "see" a radio source. This verifies, among other things, the station time at the tracking computer, that the telescope can indeed slew to a radio source and stay on that source with low tracking offsets, and that the receiver and data rack are functional. It is almost an end-to-end check from the radio source's photons focused onto the microwave feed to the total power integrators at the end of the data stream. The PCFS software provides the station operator with the proper tools to check pointing quickly and accurately allowing them to gain confidence as they continue down the check-off list.

To verify the sensitivity of the instrument the PCFS also provides the tool to measure SEFD. This and other station ready information can then be sent to the IVS network by e-mail using yet another tool called "MSG." It provides the operator a handy form to fill out with all of his pre-checks list results. Verifying phasecal in each channel, doing the cable cal checks, and confirming the frequencies are other items usually found on a pre-checks list at these stations.

The Mark 5 system now provides reliable VLBI recording without the past problems we have experienced with tape recorders, but they still require operator attention. Conditioned modules are an advantage as they have been pre-tested, reducing the chance of a module failure due to shipping. Running a short recording test before the session confirms that the Mark 5 is setup correctly for this session.

Another advantage high-yield stations use is well trained observers. The photo shows Ed Himwich training the AusScope team in June. Attention to the Field System error reports as it detects them and then quickly correcting problems as they occur obviously produces better data for the IVS then unattended observing. But this, of course, also requires an operator present for the entire session. Skilled operators and their attention to detail is the key to a VLBI station's success and probably always will be.

In summary, the top performing stations use trained observers that complete pre-checks and have been provided the necessary tools to recognize and then repair problems as they occur during a session. Some day this may not be necessary, but unfortunatley we are not there yet.

http://ivscc.gsfc.nasa.gov
ivscc@ivscc.gsfc.nasa.gov
phone: 301-614-5939
fax: 301-614-6522

IVS Coordinating Center
NASA GSFC
Code 698.2
Greenbelt, MD 20771