IVS Newsletter

Issue 49, December 2017

Successful Start of CONT17

– Dirk Behrend, NVI, Inc.

On November 28 the most ambitious continuous VLBI campaign (CONT) yet has successfully started its first day of observing. Two separate global legacy S/X networks started to take data at the stroke of midnight (UT) at 27 sites (see IVS Newsletter #48 for more info). Well, actually one of the networks (Legacy-1) already performed a pre-CONT17 fringe test four hours prior to the true start of the campaign. Eleven of the 14 stations of the Legacy-1 network participated in this station sanity check. They e-transferred two scans to the Bonn Correlator where Laura La Porta with support from Simone Bernhart and Helge Rottmann worked late hours to search for fringes. Fringes were found for all eleven stations, ensuring that these stations were operational at the beginning of the campaign. Thank you Laura for your dedication and giving confidence to those stations. While the remaining three stations of Legacy-1 have to wait for their first data to be correlated, the initial indication is that they are operating fine. For the Legacy-2 network (VLBA+ network) a rapid fringe test was not possible, as all data have to be sent physically on modules to the correlator at Socorro.

As a late addition, Seshan Observatory complemented the Legacy-2 network, filling in a gap in the Asian region. Thus, the non-VLBA stations in Legacy-2 are Medicina, Seshan, Wettzell North, and Yarragadee. The same network, however, suffered the loss of the VLBA station of St. Croix. Although the station itself survived the hit by Hurricane Maria mostly unharmed, the infrastructure of this island in the U.S. Virgin Islands was severely impacted and is still a far cry from being functional again. St. Croix was scheduled as a tag-along station. Hence, for the case that the station will be able to observe at a later stage of the campaign, they will be able to do so. However, the likelihood is relatively small.

In the middle of the 15-day CONT17 period, a third network consisting of six VGOS broadband stations will enter the activities. The VGOS-Demo network will observe for five consecutive days from December 4 to December 8. In order to allow stations that operate both legacy and VGOS antennas in CONT17 with sufficient transition time between schedules, it was decided to commence the VGOS CONT17 days one hour earlier, that is, to start them at 23:00 UT of the previous day. The last of the five VGOS days will be scheduled with a 25-hour period. Hence, it should be possible to re-arrange the VGOS observing time at the correlation/analysis stage to directly coincide with the legacy observing periods. This will be beneficial for comparison and combination purposes.

Initial results of CONT17 are expected to come out about two weeks after observing for the campaign days that are considered rapid turn-around equivalents. The R1 and R4 equivalents are: C1701 (R1), C1703 (R4), C1707 (R1), C1710 (R4), and C1714 (R1). The Bonn Correlator will correlate these five sessions first, using individual day clock parameters. That means that the first R1 equivalent should be available by mid-December. The final results of the Legacy-1 network with a consistent clock model for the entire campaign will come out around the end of April 2018. The results of the Legacy-2 network are expected already for mid-January 2018.

The Coordinating Center would like to thank the many people involved in the preparation and execution of CONT17 for their help and strong commitment without which a campaign of this magnitude would not be possible.

Laura La Porta (left) managing the correlation effort for the Legacy-1 network of CONT17 in Bonn.

Feature

Chopo Calls It a Day, Completes Illustrious VLBI Career

After a very long career (over 40 years) in VLBI, Chopo Ma retired from NASA Goddard Space Flight Center at the end of September 2017. Being with GSFC's VLBI Group basically from the beginning, a huge knowledge pool will be lost with his departure. Newsletter editor Hayo Hase wanted to tap into this wealth of knowledge one last time and interviewed Chopo via e-mail. This is what he learned.

Chopo, looking back to your long career in VLBI, how and when did it start?

Chopo giving a talk at the GM2014 in Shanghai.

The start of my career in VLBI can only be described as a fortuitous confluence of circumstances. My undergraduate degree was in chemistry and physics but I entered the graduate physics program at the University of Maryland with no particular research in mind. In the early 1970s it happened that a professor with funding for analysis of geodetic VLBI data needed a research assistant and I started working at the lowest level. At the time my roommate was a student of Tom Clark in the astronomy program using VLBI for astrophysics, and I was part of his social crowd. When my VLBI work came to an unforeseen end, Tom Clark took me under his wing—and I was a member of the geodetic VLBI group he established at Goddard in 1974 along with Jim Ryan. My training and interest came from interacting with Tom and Jim.

What was the technical status of VLBI at that time?

Chopo in a conversation with Mr. Cho at the conference dinner of the GM2008 in St. Petersburg.

My first exposure to VLBI observing in the 1970s was with the Mark I system, which used 7-track, half-inch reels on computer tape drives writing at 72 kbits/sec. 2400 feet of tape lasted three minutes. Bandwidth synthesis was used, but simultaneous dual frequency was in the future. An extreme example of Mark I use was observation of the occultation of 3C279 in 1972 to measure gravitational deflection. 3C273B and 3C279 were observed simultaneously and continuously by two pairs of antennas on an 845-km baseline for an extended time. Students from the University of Maryland including my roommate and me were recruited to go to Green Bank to mount and pack the thousands of tapes needed. Sometimes in the rush the tape reel was not properly locked and would fly off when the tape started spinning.

What were the challenges and your duties in the early years of VLBI?

From the founding of the Goddard VLBI Group in 1974 it was understood that there would be a lot to do when the Mark III systems and dual-frequency receivers became available. The first such observations were in 1979 at the beginning of the Crustal Dynamics Project (CDP), so there was time to prepare software for data analysis and data handling. I worked with Jim Ryan on the first versions of *Calc* for analysis and the data base handler for archiving. It was difficult to work with the small computers we had, which were acquired as instrument controllers to simplify the purchasing. The operating system was loaded from paper tape and there was only 32k memory including the operating system.

You are one of the founding members of the IVS in 1999. What do you remember from that time?

VLBI intrinsically requires a high degree of cooperation and coordination. In the beginning of geodetic VLBI this was accomplished under the umbrella of NASA's Crustal Dynamics Project and continued in practice at Goddard. The establishment of the IGS and ILRS provided a different, formalized model for organizing space geodesy techniques, and the IVS community was strongly encouraged to do likewise. The CSTG and IERS set up a steering committee with James Campbell as chair and issued the call for proposals for IVS components. I was the IERS representative on the steering committee. Because the committee people had worked together before and many components had already proposed to the IERS, the process was very smooth. My main contribution may have been to include astrometry explicitly in the IVS name.

You were involved in the process of the IAU to replace the celestial reference frame from optical observations to VLBI observations, resulting in the ICRF replacing the FK catalogs of fundamental stars. What do you remember of this process and the scientific debate?

Although I had the privilege of leading the sub-working group that generated the ICRF, its adoption by the IAU General Assembly in 1997 was the culmination of extended scientific preparation and outreach. An early list of quasars and other radio sources to potentially define an extragalactic reference frame was compiled by the IAU Working Group for the Identification of Radio/Optical Astrometric Sources formed at IAU Colloquium 48 "Modern Astrometry" in 1978. At that point VLBI had only shown its potential with single frequency observations on a small number of sources. The situation rapidly improved in the 1980s as Mark III came on line. My interest in astrometry was probably solidified by IAU Symposium 109 "Astrometric Techniques" in 1984. Starting in 1985 the IAU had a continuous sequence

of working groups on reference systems/frames addressing four key areas: nutation, astronomical constants, time, and reference frames. I was a member of the reference frame subgroup in 1988 as well as of the subsequent subgroups to identify and to measure the radio sources needed for the ICRF. Significant conceptual and modeling advances were needed in all four areas to support the change from an optical, stellar, galactic, Earth-dependent definition to a radio, quasar, extragalactic, quasi-inertial frame. The discussions and outcomes from IAU Colloquium 127 "Reference Systems" in 1990 were important in focusing later work. Presentations, papers, and reports informed the astronomical community. A set of related resolutions was prepared for the 1997 IAU General Assembly. The improved accuracy and simplicity of the ICRF more than balanced the significant reduction in the number of objects.

The Goddard VLBI Group in spring of 2012 on the day of the space shuttle Discovery fly-over (April 17, 2012).

Today, the data quality and quantity obtained from geodetic VLBI observations for Earth monitoring form the base of the ICRF. What has been your contribution to it?

While it remains a fact that the IVS data set is predominantly from geodetic sessions, this is not as important now as its effect in the first ICRF in 1998. Then there were few sessions observing most of the sources in the catalog. With ICRF2 the largest number of sources came from the 24 sessions of the VLBA Calibrator Survey, albeit with much larger errors requiring somewhat different handling. For ICRF3 the recent set of astrometric S/X sessions with the VLBA most likely provides better positions than the geodetic sessions for sources observed infrequently as well as for the sources not observed since ICRF2. As chair of the working groups for ICRF and ICRF2 I supported IVS CRF sessions and monitoring of defining sources. As representative between the IVS and IERS and as lead of the Goddard VLBI Group I tried to ensure that astrometric work was carried on with sufficient priority.

How do you see the further evolution of the ICRF (to ICRF-x)? What will be the upcoming tasks in the celestial reference frame subject?

The definition of ICRF3 is up to the IAU working group and the 2018 IAU General Assembly. Because of the improved quality and time span of the applicable VLBI data, there are effects that did not need to be addressed in ICRF and ICRF2. Beyond ICRF3, the *Gaia* catalog will certainly be a candidate for the next realization, but a radio CRF will still be required for VLBI applications. The VLBI CRF will improve with future observing but the *Gaia* data set will be finite.

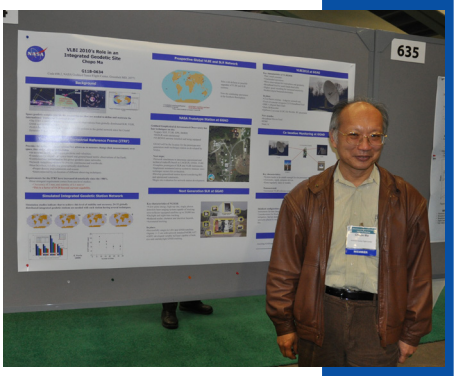
The upcoming IVS tasks for the celestial reference frame are to make full and efficient use of the various capabilities available. IVS has advanced to the new VGOS systems with the goal of continuous observing. When operational the VGOS network will generate astrometric data with unprecedented temporal resolution and accuracy, although for a smaller set of sources than ICRF3 because of sensitivity. Interested parties are needed to develop and use the source structure information. In the meantime the VLBA has become the premier astrometric instrument because of its sensitivity and the support of USNO, which has an institutional responsibility for the celestial reference frame. The IVS could coordinate with USNO and the VLBA on a permanent astrometric observing program. The VLBA network could be supplemented by distant S/X stations with fully compatible backends to improve the geometry. The VLBA+ network could also be the basis for K-band or X/KA-band astrometry. The deficiency in the southern hemisphere still needs to be addressed.

Speaking of VGOS, in retrospect how do you see this step to a new infrastructure and its implications for the ICRF?

The change to the new VGOS infrastructure was a necessary and essential step to improve the IVS products for EOP and ITRF. It is still in process, but 2018 should see a number of stations come on line. The VGOS network will not have the sensitivity or observing time to observe the full set of ICRF3 sources, but it should provide exceptional accuracy and temporal mapping resolution for the geodetic sources, which will be the anchor for the radio CRF.

Based on your long experience, do you see any developments which might make VLBI superfluous in the future? In which scientific and technical areas do we depend on VLBI as a unique technique?

I do not see anything that will completely replace VLBI, which provides a unique connection between celestial and terrestrial frames. In this regard, VLBI probably has more potential for improvement than other space-geodetic techniques. It will be important to have compatibility between the various systems to enhance reliability and operational simplicity.



At a poster presentation of the 2010 AGU Fall Meeting.

Continued from page 3

Chopo explaining items during a tour of GGAO as part of the TLS Workshop held at GSFC in 2008.

With your retirement you have reached a point in your life, where you can free your mind and tackle projects you didn't get to before. What are you doing now and what do you have still lined up?

I do not have any particular plans, although I would like to do some traveling while I still have the stamina. I do intend to look after my physical and mental well-being by proper exercise and stimulation.

Thank you very much Chopo for this interview. We wish you all the best for your future life.

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 the General Editors (see below).

The editors reserve the right to edit contributions. The deadline for contributions is one month before the publication date.

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

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

https://ivscc.gsfc.nasa.gov/.

Dancing at the inauguration of the Onsala Twin Telescopes during this year's EVGA meeting (from the left): Alessandra, Chris Jacobs, Jim Lovell, Alet de Witt, and Jamie McCallum.

Arrivederci, Alessandra! A presto!

At the end of September, Alessandra Bertarini of the geodetic correlator group in Bonn left the VLBI world and took on a management position with the German Aerospace Center (DLR). Alessandra was active in IVS matters and was the Correlators and Operation Centers Representative on the IVS Directing Board since 2011. Newsletter editor Hayo Hase met with Alessandra in an e-mail chat. Here's an excerpt of this exchange.

Last day in office at MPIfR (from the left): Laura La Porta, Alessandra, and Simone Bernhart.

Alessandra, a couple of months ago you decided to leave the Bonn Correlator at MPIfR for a management position at DLR. You had worked at the Bonn Correlator for quite a long time. How did you end up in Bonn and got involved with correlation?

By chance! After getting my diploma in astronomy, I went to Bonn for a two-year contract in the millimeter group of MPIfR. The idea was to gain experience abroad and then go back to Italy— but then I met my husband, stayed on, and was in need of a job. I got to hear that there was a vacant position at the correlator and applied for it. It was a great choice, although at the time I did not know. I deeply enjoyed the past 15 years working with you guys!

Many of us who got a chance to know you admired your expertise in almost any subject related to geodetic and astronomical VLBI. In your view, what was important to acquire so much expertise?

Thank you Hayo! I became a "blue belt" in VLBI mostly thanks to three black-belted VLBIers who have mentored me throughout these years: Brian Corey, Dave Graham, and Alan Roy. But the beauty of working for the IVS is that whenever you need help, you always find someone who gives you a hand. So the list is indeed much longer.

There is not much literature available about VLBI. Which advice would you give to a newbie in VLBI who wants to "learn" the various aspects of VLBI?

I need to smile now. I remember a good idea developed at the EVGA in Ponta Delgada to write a book on geodetic VLBI. A lot of people were involved. I hope that the ones still around will continue pursuing this idea. But the book

does not exist yet, so a newbie should maybe read Thompson, Moran, and Swenson (a.k.a. the VLBI Bible) and take part in schools, like the tri-annual IVS schools and/or the TOWs.

As the correlation has changed from hardware to software, what is the impact of this change on the daily processing of VLBI?

Cool! I always have liked to learn new things. I felt a bit sad to switch off the Mark IV correlator. But the DiFX correlator is very good and it has the advantage that it can be easily upgraded (as opposed to the Mark IV correlator). A property that sometimes gets a bit abused though...

In view of VGOS with 24/7 operation (including correlation), what do you consider to be the key issues to be resolved?

In my opinion, the IVS definitively needs more correlator centers and qualified people to use them!

Do you think that it is feasible to fully automate the correlation process?

No, definitively not. The VLBI correlation is quite an involved process. Sometimes I had the impression that people tend to compare the VLBI correlator with the GPS correlator. Well, apart from the fact that behind the GPS correlator there is a huge amount of expertise too, one difference is the SNR. The VLBI signals are about four orders of magnitude smaller than the noise created by the atmosphere/telescopes/frontends. The GPS SNRs on the other hand are booming! Another big difference is the flexibility and complexity of the VLBI system in comparison to the one mode of the GPS. The more complex the system, the bigger the space of errors that only expert eyes can disentangle. Last but not least, the reliability of the GPS is probably much bigger than what we have in VLBI. It is, however, difficult trying to quantify the number of people required to have a reliable system. This is reliability engineering. I have no experience in that, but from what I heard it is a damn big task due to the number of states/interactions in which the system can get into.

Drawing on the experience of 15 years, could you share an anecdote or two from the correlator business?

There are lots, but not all can be told. Let me tell a couple. I remember my first TOW in 2003. At the time I had not met anybody beyond the Bonn group, but, of course, I interacted with many through a lot of email exchanges. I was taking Mike Poirier and Rich Strand's class at the Westford antenna, when Rich pointed the finger at me saying to the other attendees: "Watch out what you do, she is checking and you do not want to be caught! She is bad!" Lol. So, I think I scared a generation of telescope personnel. Another nice one is from the IVS General Meeting in Madrid (2012). We met Chris Jacobs wearing a tuxedo, and Alexander Neidhardt immediately thought of James Bond and, of course, the Bonn Girls.

But let's look forward—you have found a new job as project manager. What are you doing now?

My "baby" now is a 150-ton Boeing 747SP, her name is SOFIA. But she is not my only task. I am also involved in the ESA projects Euclid and *Gaia*. Yes, you heard it right, *Gaia*. My new colleagues welcomed me immediately and I am happy with the new job. But you did not ask me what my hobby is! I will assume you did, and proceed to answer the question: I am continuing to correlate K-band data within the collaboration toward a K-band CRF. So I am still in touch with the IVS.

If you could change the world, what would you do first? Any correlation work?

That's a hard one! The first thing that comes to my mind is improving the schools from kindergarten onward. The more educated the people we have, the better the world would be. But, of course, cross-correlating VGOS bits forever is definitively tempting.

It was great to have had the opportunity to work within the IVS world. And, whenever you guys happen to pass through Bonn, let me know!

Thank you Alessandra. We'll surely pay you a visit when we have a chance. All the best for your new endeavors.

The special performance Boing 747SP, going by the name of SOFIA, while landing in Hamburg (Copyright LHT – Jan Brandes).

Enjoying my first TOW in 2003 (from the left): Arno Müskens, Alessandra, and Mike Titus.

ICRF3 Meeting in Bologna

– David Gordon, NVI, Inc.

Members of the ICRF3 Working Group in Bologna, Italy (left-to-right): Geraldine Bourda, Chris Jacobs, Sébastien Lambert, Oleg Titov, Patrick Charlot, David Gordon, Aletha de Witt, Johannes Böhm, and Elena Skurikhina.

The IAU ICRF3 Working Group was formed in 2012 with the goal of generating the third realization of the International Celestial Reference Frame at radio frequencies in 2018. A particular emphasis is put on providing a frame tie and accuracy comparisons with the future *Gaia* optical reference frame. The Working Group is mostly made up of IVS members with a few other astrometry experts. The group recently held a two-day meeting at the Istituto di Radioastronomia in Bologna, Italy on October 13–14.

Numerous topics were covered at the meeting, such as the status of several prototype ICRF3 catalogs, comparisons with *Gaia* data releases, handling of galactic aberration, selection of defining sources, the generation of the final catalogs, and publication of the ICRF3. Unlike the first two ICRFs, ICRF3 will be a multi-frequency realization, with catalogs at X/S band, K band (24 GHz), and Ka/X band (32/8 GHz). The X/S catalog is expected to contain positions of more than 4,300 sources, compared to 3,414 for ICRF2, and it will be much more precise and uniform than ICRF2. Some 28 VLBA sessions at 2 Gbps and extensive observing with new antennas in Australia, South Africa, and New Zealand have significantly increased the number of sources and greatly improved the precision of thousands of sources at X/S band.

A K-band reference frame catalog has also been greatly improved and expanded by a group led by Alet de Witt using the VLBA and the HARTRAO–HOBART26 antennas. The K-band catalog now has over 800 sources. And, finally, a Ka/X campaign has been led by Chris Jacobs over the past few years using DSN antennas and now has accumulated a catalog of nearly 700 sources. At the higher frequencies, the sources show less structure and are generally more stable but also weaker.

The final ICRF3 catalogs will be generated early in 2018 and several publications are planned. ICRF3 will then be presented to the International Astronomical Union for approval at the IAU General Assembly in Vienna in August 2018.

Board Makeup Changed

As evidenced in the two feature interviews of this Newsletter issue, there were recent events that also altered the composition of the leadership of the IVS. With Chopo Ma going into retirement, he also stepped down from his position as IERS representative on the IVS Directing Board. At the same time, Alessandra Bertarini vacated her position as Correlators and Operation Centers representative—an elected position which she served about half way through her second four-year term. In less than two months after these makeup changing events, both Board positions have been refilled.

In a recent meeting of its governing body, the IERS appointed Rüdiger Haas from Onsala Space Observatory as the new IERS representative on the IVS Board. His appointment stands as long as the IERS adheres to it. Prior to its last meeting, the IVS Directing Board discussed on who should replace Alessandra for the remainder of her term (until the next official elections in the winter of 2018/2019). We are glad that David Hall from the U.S. Naval Observatory agreed and got full support for serving as the Correlator representative. This partial term will not be counted to the limit of two consecutive full terms on the Board; so David will be fully eligible for "re-election" in the next two Board elections.

With Rüdiger and David included as "new" members, the IVS Board is back to its full strength of sixteen people. The Board will have its next official meeting on June 9, 2018 at the end of the General Meeting week in Longyearbyen, Norway.

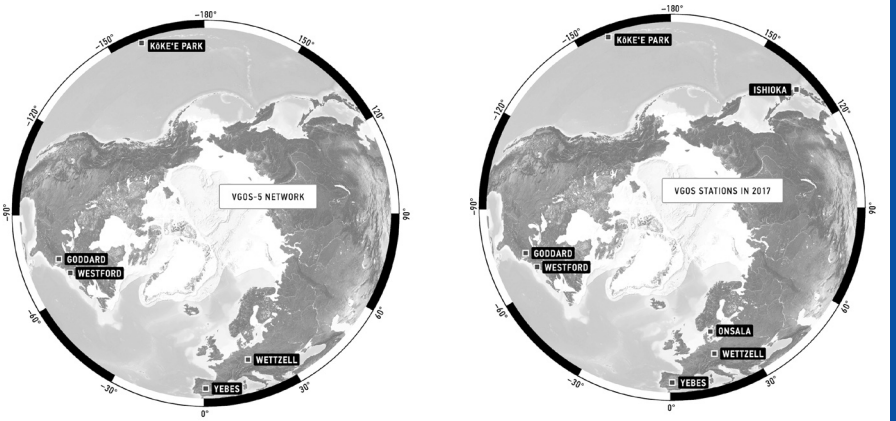
Dirk Behrend

From the VGOS World...

A Short Summary of VGOS Observing in 2017

– Chester Ruszczyk, MIT Haystack Observatory

In the August 2016 issue of the IVS Newsletter (Issue #45), the progress and successes of the roll-out of the VGOS (VLBI Global Observing System) network were presented in the front page article "First Transatlantic VGOS Fringes." The participating stations at the time were the Kōke`e Park Geophysical Observatory (KPGO, K2) in Hawaii, the Goddard Geophysical and Astronomical Observatory (GGAO, Gs) in Maryland, Westford (Wf) in Massachusetts, Yebes (Yj) in Spain, and Wettzell (Ws) in Germany—collectively dubbed the VGOS-5 (see Figure). Since that time, the goals for the emerging VGOS network have been to demonstrate the stability of the various systems and to obtain consistent end-to-end operations. "End-to-end operation" covers the wide scope of operational procedures from writing schedules to taking data to generating databases of the 24-hour sessions. As we conclude the observing year 2017, we present a summary of the VGOS network operations over the last twelve months and take a brief look at where we are headed in 2018.



The five stations of the initial VGOS-5 network (left) and the seven stations that participated in VGOS Test (VT) sessions in 2017 (right).

For 2017, VGOS Test (VT) sessions were executed for 24 hours about every two weeks for most of the year. This program was interrupted only for a mini-CONT observation in preparation of the VGOS CONT17 campaign and for the five days of the VGOS CONT17 itself. The goals of the VT sessions were twofold: (1) to prove the stability of the station network and the good quality of its data; (2) to provide a mechanism for new stations coming online to start the process of integration into the network.

Valuable lessons were learned from the VT sessions. These pertained to, for instance, the improvement of the equipment and its operational stability, the data transport to the MIT Haystack Correlator, and the correlation and post-processing of the data. The findings were summarized and published as SGP documents (SGP-VLBI-ANYS-0030 and SGP-VLBI-ANYS-0031), serving as reference material for further improvement. The VGOS network has greatly improved since the start of 2017, making possible the first VGOS broadband CONT campaign.

In preparation for CONT17, a two-day mini-CONT was executed in October 2017 with the specific goal of mimicking the network usage during continuous observations. The positive results indicated that execution of the CONT17 for five continuous 24-hour sessions was possible and scientifically feasible. Thus, the 2017 VGOS observing plan culminated in the observation of the CONT17 campaign for five consecutive days in December using a network consisting of the VGOS-5 plus Ishioka (Is) in Japan. At the time of writing, the data transport (shipment of modules and/or electronic transfer of data) to MIT Haystack Observatory was ongoing; there is more to come once the data is processed.

Lastly, 2017 saw the inauguration of the Onsala Twin Telescopes and their participation in several VT sessions; fringes were detected in all four VGOS observing bands. However, their operations had not reached a stable state yet to be part of CONT17. For 2018 we anticipate a continued refinement of their new signal chain and the inclusion in the VGOS network. In addition, we expect the AuScope stations at Hobart, Katherine, and Yarragadee to convert to VGOS broadband in the first half of the year and to start the process to participate in VGOS sessions.

Upcoming Meetings...

EGU General Assembly
Vienna, Austria
April 8-13, 2018

Tenth IVS General Meeting
Longyearbyen, Norway
June 3-9, 2018

AOGS 15th Annual Meeting
Honolulu, HI
June 3-8, 2018

42nd COSPAR Scientific Assembly
Pasadena, CA, USA
July 14-22, 2018

IAU General Assembly
Vienna, Austria
August 20-31, 2018

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

The credit of advancing science has always been due to individuals and never to the age.

- Johann Wolfgang von Goethe

The Future of the Mark 5 Media Pool

– Dirk Behrend, NVI, Inc.

It is a decade ago by now that the IVS discontinued the use of tapes and tape drives. At the end of 2006, the IVS transitioned to using the Mark 5 recording system only in its operational work. The disk-based Mark 5 system has served us well and it is still continuing to do so. We saw a few changes over the years such as the move from PATA to SATA disks and the increase of the disk capacity used, which entailed the repopulation of existing Mark 5 frames with larger sized disks. With the advent of the VGOS broadband system, Mark 5 will have to be replaced by the next-generation system. This is largely the Mark 6 recording system; however, as VGOS will aim for 24/7/365 observing and a faster turnaround, e-transfer will be an important aspect. For that systems such as FlexBuff will enter into the fray as well. A disadvantage of FlexBuff for a transition period will be that modules cannot be shipped physically.

While VGOS is making strides, it will not become the operational system of the IVS before 2020 (and likely not before the early 2020ies). That means that over the next several years legacy S/X will continue to be the production system for the IVS. Hence, at least for that period the Mark 5 recording system and media will have to support IVS observing. There is a small attrition rate of a few percent per year. Thus, the Mark 5 media pool will likely shrink over the years, unless new hardware is added.

For CONT17, a few groups purchased additional Mark 5 modules to complement the media pool (e.g., Matera and NASA). The manufacturer of the units, Conduant Corp, stated that the purchase of Mark 5 modules for CONT17 would likely be the last that they could support. Conduant is running out of essential parts (which are not available on the market anymore). The implication is that the Mark 5 media pool at the time of CONT17 will be the pool that will have to be used until the end of the legacy S/X system usage. Of course, existing frames can be repopulated with new disks if need be. But broken frames will have to be removed from the pool. In today's fast-paced IT world, the deployment of a system for 1.5 decades and possibly longer has to be considered a feat in itself. We hope that Mark 6 will provide similar stability for the VGOS system.

https://ivscc.gsfc.nasa.gov
ivscc@ivscc.gsfc.nasa.gov
phone: 301-614-5939
fax: 301-286-0239

IVS Coordinating Center
NASA GSFC
Code 61A.1
Greenbelt, MD 20771