IVS Newsletter

Issue 8, April 2004

A Student VLBI Project

–Wolfgang Winkler, IGG, Vienna University of Technology

Students of Harald Schuh and Robert Weber in the masters degree program (diploma course) at the Vienna University of Technology planned and executed a VLBI experiment last year. The project was meant to make the students familiar with all the steps needed in VLBI. This article, written by one of the students, describes the work of these budding VLBI practitioners. The students involved were: Wolfgang Winkler, Boris Bogensberger, Wilfried Karel, Michael Kistenich, Gerold Pacher, Andrea Pany, Andreas Roncat, and Gerhard Summer.

(top) Gerhard Summer in the operators room. (middle) Boris Bogensberger in front of the Wettzell antenna watching the beautiful sunset. (below) Students are watching the TIGO antenna via webcam in a lecture room of the Vienna University of Technology. First, Hayo Hase explained all the tests to be done at the telescope before the beginning of the session – later, he told us some funny jokes.

(above) Dorothee Fischer from Bonn University explained the principles of scheduling with a lot of enthusiasm. (below) Students in Vienna working with OCCAM. Left to right: Gerold Pacher, Gerhard Summer, Andreas Roncat and Wolfgang Winkler.

The VLBI project VIEPROJ1 was planned and executed involving university students doing the main work in every step. It was part of the lecture titled "Auswertung geodaetischer Weltraumverfahren" (Space Geodetic Techniques), within the curriculum of Vermessung und Geoinformation (Geodesy and Geoinformation) at the Vienna University of Technology. The teachers were Prof. Harald Schuh and Prof. Robert Weber.

After the date of the session had been fixed and the participating stations had been chosen, Dorothee Fischer from the University of Bonn advised the students how to make an appropriate schedule for a 3 hour VLBI session, using the SKED software. The final schedule was produced by the students.

On November 27, 2003 the radio telescopes at Wettzell, TIGO/Concepcion and O'Higgins observed about 20 different scans in 3 hours. Four students visited Wettzell while the experiment took place. So far, the tapes from Wettzell and TIGO have been correlated at Bonn. The tape from O'Higgins is still on its way. The observed delays were analyzed with the OCCAM software at the Vienna University of Technology. Estimates for DUT1 and the station coordinates of TIGOCONC were calculated.

For us as students the project was a pleasant change to our "normal" studies, as it was practical work. We had already heard many things about the VLBI technique, so it was quite good for us to see how the different steps were carried out (for example, the observations at Wettzell) or even better to work them out ourselves. Insight into how international cooperation in VLBI works and how many people are involved was particularly impressive. And, of course, it was fun to get to know researchers and professors not only in lectures but also while discussing the whole topic with a beer after the work had been done.

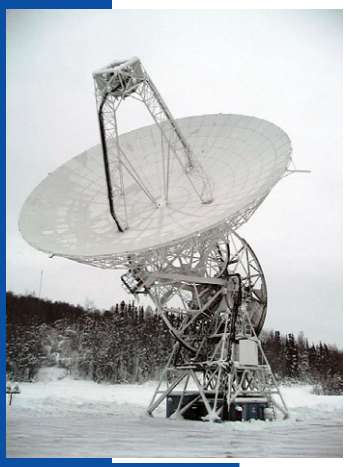
Acknowledgements

The Vienna student team wants to express our thanks for the opportunity to learn so much about geodetic VLBI under real conditions. Without the support of the following persons the project would not have been possible:

- Dorothee Fischer, University of Bonn
- Wolfgang Schlüter and his team at Wettzell (especially Mr. Kronschnabel)
- Hayo Hase and his team at Concepcion
- O'Higgins team
- Arno Mueskens and the correlator team at Bonn

Gilmore Creek Geophysical Observatory, Fairbanks, Alaska

Rich Strand retired from the Gilmore Creek Geophysical Observatory last year. Hayo Hase caught up with him recently by e-mail to review the history of the GCGO and Rich's participation at this IVS network station in Alaska.



(above) Gilmore Creek X-Y mount VLBI antenna. (below) The famous Big Red GPS pier shown in its natural habitat.

Rich, what brought you to this cold place and when?

I arrived in Fairbanks in the summer of 1971. I had been transferred from GSFC's Radio Astronomy Explorer-A mission in Greenbelt, MD to the station in Alaska for the upcoming RAE-B satellite launch. NASA had located the station in a valley north of Fairbanks where the surrounding hills protected it from radio interference.

How did the station get the name Gilmore Creek?

A gold miner named Tom Gilmore worked this area in the early 1900s and the creek that runs beside the facility was named for him. The creek originally ran down the center of the valley but NASA diverted it to make room for the antennas and station buildings. There are still operating gold mines on one end of the valley and a very large mine is slowly making its way towards the observatory.

When did NASA add the VLBI radio observatory to the site?

During the fall of 1984 NASA decided to terminate Gilmore Creek satellite tracking operations. The old NOAA 85 foot tracking antenna then became available for other projects. During this time Tom Clark from the NASA Crustal Dynamics program did some VLBI observing using this antenna to verify if it would be suitable for geodesy and astrometry. In April of 1985 they decided it would and construction of the Gilmore Creek Geophysical Observatory began.

How did you get involved with GCGO?

I accepted the lead position of a team to disassemble a perfectly good tracking station. Surprisingly it took only 90 days to undo what had taken decades to build. In April came the good news that the VLBI test data was okay and funding available. I arrived back on site to start clearing out the old NOAA tracking equipment. Tom soon arrived as did the VLBI equipment. Along with teams from the other NASA contractors we built the GCGO.

That must have been an interesting time for you?

It sure was. It's really fun to build an observatory. I had just spent three months dismantling one. Working with all the different experts was terrific. Until that time I had never actually worked with the folks that designed the electronics. Now I was working with people with all the necessary skills to build a working observatory. You remember things like being on your hands and knees pulling electronic cables under a floor and everyone that's helping having a PhD.

So when was first light?

Actually very soon. Some of the necessary equipment was in place from the previous testing phase and the Bendix VLBI team of maser and receiver experts did an excellent job during the install. We were able to resolve most of the startup quirks and problems quickly. Ed Himwich worked day and night to interface the Field System to our unique telescope controls. The station needed to be ready for the upcoming Alaska mobile campaign called "Great Alaska & Pacific Experiment". Nancy Vandenberg was very busy organizing GAPE back at GSFC and would soon arrive in Fairbanks as would Arthur Niell and others to manage the mobile campaign from the GCGO.

The GAPE must have been successful, GCGO is still in operation.

It sure was. The observing started to require too many hours for one person so Steve Caskey left NOAA ops to become a GCGO team member. Later we started to observe in other programs and added more team members. The station finally settled down to the day by day routine of a normal radio observatory. What kept it fun was adding different instruments. We had a super conducting gravimeter for a while that required a lot of attention. NASA sent me to a GPS school and then instructed GCGO to build a GPS instrument pier. Being an Alaskan I doubled all the measurements and we built the "best" pier in the whole world much to the chagrin of those that had to pay for it.

GCGO support team (left to right) Andre Sanders, Harold Grotsema, Zeek Padilla, Mark Meindl, Frank Holan.

Now that you have retired from GCGO what was the best part of the IVS program?

By far it's the people you meet and work with. Ed Himwich effectively became a GCGO team member. We had a dorm room on site and he could work nonstop

and uninterrupted on the Field System with ready access to the telescope and DAT rack. Many of the FS features you use today were coded during those long days and nights. I was able to help, somewhat, by a steady stream of suggestions and a never ending "wish" list from the operator point of view.

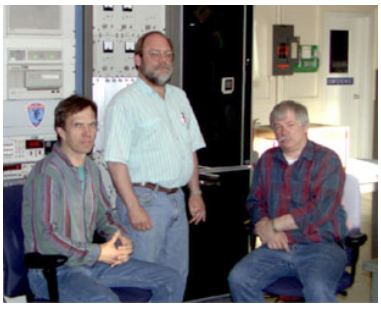
I had the good fortune of going to other observatories and working with Dave Shaffer, Chopo Ma, Chuck Kodak and Mike Poirier to name just a few. I'm sure I was Brian Corey's worst pest. We could spend an hour on the phone troubleshooting a problem with me looking and him thinking. Tom's visits always brought new gizmos. John Bosworth's then Bill Wildes' visits brought solutions to local problems. Many IVS members from Italy, Japan and other countries have visited and we made sure they had a good time here in Alaska, okay sometimes too good a time. A big surprise was Sylvain Brazeau from Algonquin who showed up on a motorcycle he rode all the way from Ottawa. I will miss the visitors to the GCGO station the most.

> ***What is a Gizmo....***
>
> A device that is very useful for a particular job.
>
> alternative words... doodad, doohickey, gimmick, gadget, gubbins, thingamabob, thingamajig, whatchamacallit, whatsis, stuff.

I was able to meet your replacement Kyle Eberhart at TOW 2003. It seems the GCGO has a good observing team.

Yes, we are very fortunate to get Kyle. The NOAA facility has some very good folks trained in data acquisition. Kyle was working there fresh out of the Air Force when the opportunity came up to replace me at the GCGO. He decided to make the switch from NOAA to NASA which was good for Steve and me. Kyle has been an asset to the site for his work with Linux. He was able to attend the TOW 2003 which is obviously good for the training aspect, and he now knows many of his IVS colleagues that will depend on his good work.

Gilmore Creek operators can be contacted by e-mail at oper@blizzard.gcgo.nasa.gov. Rich Strand's e-mail is kl7ra@ptialaska.net.



(above) GCGO operations crew Tony Knuutila, Steve Caskey, Rich Strand. (above right) Kyle Eberhart participating in the TOW 2003.

Spring Cleaning!

–Michael Poirier, MIT Haystack Observatory

It is approaching spring time in the northern hemisphere. This time of year brings with it a fresh look at all of our facilities. It is a good time to go through all of our equipment to insure that it will operate at its best.

Examine the Data Acquisition Rack

- Check that all cooling fans are clean and spinning properly. Check the back of the rack below the fans for excessive dirt/dust buildup. Check and clean all intake air filters.
- Measure all the power supplies for the correct voltages and check that there is minimal AC ripple and noise on the lines.
- Check the phase-cal on each video converter to see if it is stable. Also check to see that the image rejection between upper and lower side bands is greater than 20 db on each VC or BBC.
- Check that the LO in each VC or BBC locks over the full frequency range.

Inspect all IF Distributor patch cabling on the back of the Mk III/IV rack for loose or worn connectors. I have found that shields on the SMA connectors can fail and the center conductor can be pulled completely out from the patch cable connector. Repeat these checks on all the RF cables connecting the many inputs on the rack. If you find bad cables replace them. Visually inspect the female SMA connectors on the patch panel. In the past we have found broken center conductors which will cause loss of signal.

Inspect the back side of all of the multi-pin connectors on the rack. Check to see if any pins have been pushed out of their connectors.

Check Timing Device Cables

Inspect all cables and connectors within your timing systems. Connections between counters, GPS, formatter, and masers are critical to station operations.

Examine Receiver

Confirm that all connections are good. If any problems are found, please repair them.

Measure all the power supply voltages and check for AC ripple and noise on each supply line.

Inspect all semi-rigid cables and connectors. Cracks can develop in time due to vibration and stress. Repair or replace these bad cables. Clean or replace any cooling fans that are not operating properly.

These checks and repairs along with all the standard checks that we complete every session will help us continue to provide the quality data needed by the IVS.

Third IVS General Meeting Report

–Calvin Klatt, Mario Berube, Anthony Searle
Geodetic Survey Division, Natural Resources, Canada

Bright sunlight and the Winterlude mid-winter festival greeted the fearless IVS members as they arrived in Ottawa on February 8 for the General Meeting. 110 guests from 20 nations and 6 continents dared to come to Ottawa, the coldest national capital in the world after Ulan Bator, Mongolia. Fortunately the Weather Gods cooperated after threatening the anxious hosts with arctic blasts just the week before.

On Sunday evening the Lord Elgin Hotel was the scene of our IVS ice breaking – situated across the street from the scene of Winterlude ice sculpture making. A good time was had by all!

Toni Searle, Jacques Lafrance, Calvin Klatt and Steve Farley at the Ice Breaker Reception.

On Monday morning it was back to work, with an opening address from Dr. Susan Till of Natural Resources Canada. Wolfgang Schlüter followed with a welcome from the IVS and presented his report as the IVS Chair. Nancy Vandenberg then gave the report of the IVS Coordinating Center. The morning's keynote presentations followed the conference's theme of "Today's Results and Tomorrow's Vision". Martine Feissel-Vernier (l'Observatoire de Paris) and Ben Chao (NASA) provided overviews of the current scientific state and challenges facing the community related to Earth rotation. Hermann Drewes (DGFI) gave an overview of the IGGOS mission within the IAG and Patrick Charlot (Univ. of Bordeax) provided a vision for the ICRF in 2010 and beyond.

Six technical sessions were held over the three-day General Meeting. Following the keynote speeches, Alan Whitney and Arthur Niell chaired sessions related to the VLBI2010 initiative. Presentations examined current and future requirements for VLBI geodetic systems, including all components from antenna to analysis and considered opportunities for a new generation of systems.

On Monday evening the place to be in Ottawa was the IVS poster room, where the General Meeting activities kept going into the night.

Session 3, chaired by Hayo Hase and Kerry Kingham, provided a review of Network Stations, Operation Centers and Correlators. The session focused on recent activities and future plans at VLBI Networks Stations and Correlators. Session 4 turned back to the consideration of New Technology Developments in VLBI, with Shigeru Matsuzaka and Alan Whitney acting as chairs. Presentations included reviews of the Mark 5 and K5 systems, Gbit data rate systems, e-VLBI, digital data processing and a number of papers on software correlators.

On Tuesday night the conference attendees enjoyed the IVS banquet at the historic Chateau Laurier Hotel. It appears that Ed Himwich enjoyed himself a little too well, leaving his table with a crash.

Session 5 began bright and early the next morning with discussions of Analysis Strategies and Software, with Harald Schuh and Calvin Klatt chairing. Discussions on improvements to the fundamental scheduling and analysis tools were followed by summaries of analysis center activities and new modeling approaches.

The final session reviewed VLBI results and Geodetic/Geophysical/Astrometric Interpretation. This session,

All sessions were well attended, even Wednesday morning after the Banquet.

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.

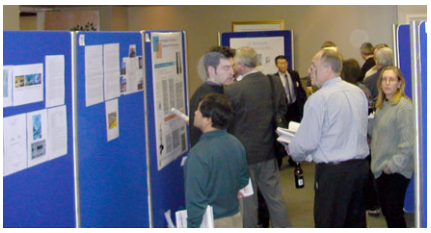
Editors:
Nancy Vandenberg, General Editor
nrv@gemini.gsfc.nasa.gov
Hayo Hase, Feature Editor
hase@wettzell.ifag.de
Heidi Johnson, Layout Editor
hnj@haystack.mit.edu

The newsletter is published in color with live links on the IVS web site at http://ivscc.gsfc.nasa.gov/.

chaired by Rüdiger Haas and Zinovy Malkin, had several interesting reports on the ICRF, EOPs and their geophysical significance, as well as the troposphere and ionosphere. The contributions of both the new K4 intensive series and the CONT02 were presented.

While the General Meeting officially ended on Wednesday, most of the attendees remained in Ottawa and worked diligently right into the weekend. Thursday's Analysis Workshop was very well attended. On Friday the VLBI2010 Working Group held a meeting at Natural Resources Canada, with 32 participants. It would be difficult to make a list of all the side meetings that took place over the week.

Oleg Titov and Mamoru Sekido enjoy the Ice Breaker Reception (above); John Romney, Wayne Cannon (back to us) and Alan Whitney enjoy themselves at the IVS Banquet (left).



While a great deal of VLBI work was completed during the week, a number of adventures were had in Ottawa nevertheless. Almost everyone had a chance to tour central Ottawa and see the Canadian Parliament Buildings and the Winterlude ice sculptures. A trip to Algonquin proceeded with only minor mishap (see text box), and several VLBI'ers went outdoor skating on the Rideau Canal/Skating-Rink, the world's largest and longest skating rink, with only minor injuries and soreness reported!

On Monday evening the place to be in Ottawa was the IVS poster room (above). Wine tasting at the banquet, with Heidi Johnson, David Gordon, Kerry Kingham and Clyde

Pictures taken at the meeting by various people are all posted on the meeting web site at http://ivscc.gsfc.nasa.gov/meetings/gm2004/pictures.

Mario Berube explains how things work.

Markus Vennebusch is one of the "hardcore" VLBI fans.

A Long Drive, A big Antenna and A Minor Mishap

The tour of Algonquin Radio Observatory was recommended only for "hardcore" VLBI fans – those who wouldn't mind sitting in a vehicle careening over icy roads for six hours just to spend one hour at an antenna.

It turned out that one of the vehicles used for the trip had a shock absorber fail on the way to the park, and had to turn back. A second vehicle carried the guests in reasonable comfort to the antenna and returned them to Ottawa safely.

Upcoming Meetings...

1st General Asembly,
EGU
Nice, France
April 25-30, 2004

Joint Assembly:
AGU, CGU & SEG
Montreal, Canada
May 17-21, 2004

Journees 2004, Fundamental Astronomy: New concepts and models for high accuracy observations,
Paris, France
September 20-22, 2004

3rd e-VLBI Workshop
Kashima, Japan
October 6-7, 2004

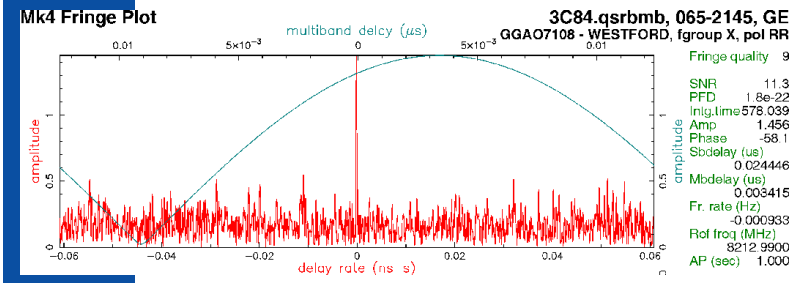
Pan Ocean Remote Sensing Conference 2004 (PORSEC)
Concepcion, Chile
Nov 29-Dec 3, 2004

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

Real-time fringes with Mark 5A and Mark 4 correlator

–Alan Whitney, MIT Haystack Observatory

Real-time fringes with no disk buffering were obtained on the Mark 4 correlator at Haystack Observatory on Friday, 5 March 2004, with data transmitted directly from GGAO in Maryland and Westford in Massachusetts. Because Haystack's Gbps network connection is temporarily down due to a major re-configuration, GGAO data were transmitted over Haystack's commodity 100 Mbps Internet connection. Two X-band channels of 8 MHz BW, sampled at 1

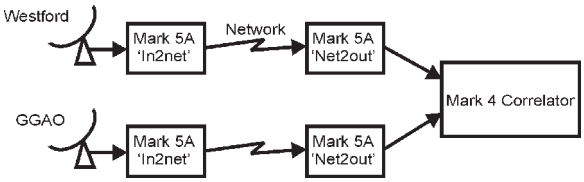


Real-time fringes on 3C84 on Westford-to-GGAO baseline

bit/sample, were used in the experiment, for a total data rate of 32 Mbps from each station.

Fringes from one of several scans on 3C84 are shown in the figure above. Several scans over a period of one hour showed similar results, all with consistent residual delays and rates.

The figure to the right shows the block diagram of the experiment setup. A Mark 5A system was set to the 'in2net' mode at the station so that antenna data were transmitted directly onto the network. At the correlator, a Mark 5A in 'net2out' mode was used to feed the data directly to the correlator. The 'ROT' (Reconstructed Observing Time) clock of the correlator was set to lag UT by about 3 seconds. For the data arriving from each station, coarse synchronization to ROT was done by managing the read pointer in the 0.5 GB buffer of the each receiving Mark 5A's,



Real-time experiment setup

and the fine synchronization was then accomplished within the Station Unit. Correlation and fringe-finding then proceeded in the normal manner.

When our Gbps network connection is restored, we plan to extend these experiments to much higher data rates.

The team to which credit for this work is due includes John Ball, Roger Cappallo, Brian Corey, Kevin Dudevoir, Dave Fields, Chuck Kodak, Mike Poirier, Jay Redmond, Dan Smythe and Mike Titus. In addition, Cindy Thomas and Nancy Vandenberg provided scheduling support.

News Flash!

Successful real-time fringes were obtained between Westford and Onsala on 25 March 2004. This is believed to be the first intercontinental real-time VLBI ever accomplished! The setup was similar to the Westford/GGAO experiment described above. More details will be forthcoming.

Mark 5B Update

–Alan Whitney, MIT Haystack Observatory

The Mark 5B VLBI data system is now being developed at MIT Haystack Observatory. It is based on the same physical platform, uses the same disk modules as the Mark 5A, and supports the same maximum data rate of 1024 Mbps. However, the Mark 5B will adhere to the VLBI Standard Interface (VSI) hardware and software specifications (see http://web.haystack.edu/vsi/index.html). Because the Mark 5B accepts sampled data directly and formats the data internally, the use of external formatters will be unnecessary. Adapters will be available for existing Mark 4 and VLBA systems to provide a VSI interface to the Mark 5B system.

In addition, the Mark 5B is being designed to support all critical functionality of the Mark 4 Station Unit. This will allow the Mark 5B to be played back directly to the Mark 4 correlator through a simple interface without the use of Mark 4 Station Units.

Mark 5A and Mark 5B disk recordings will not be interchangeable. However, an upgrade to the Mark 5A system is planned so that Mark 5A systems can read recordings written on a Mark 5B to create VLBA track-format output that can be correlated on existing Mark 4 correlators. This backwards-compatible path for Mark 5B data will be used during the transition period to Mark 5B.

Prototype Mark 5B systems are expected to be available in late 2004. Existing Mark 5A systems will be upgradeable by replacing the current Mark 5A I/O Interface Board with the Mark 5B I/O Interface Board and upgrading the control software. The cost of a Mark 5B system is expected to be approximately the same as Mark 5A.

11th Directing Board Meeting held in Ottawa

–Wolfgang Schlüter, BKG-Fundamental Station Wettzell

The Directing Board held its 11th Meeting in Ottawa, on Sunday, February 8, 2004, the day before the IVS General Meeting started. It was organized by the local organizing committee. Franco Mantovani was welcomed as a new board member. He replaced Zinovy Malkin as an at large member; Zinovy became the representative of the Analysis and Data Centers. Congratulations were expresses to the Working Group "Non Rigid Earth Nutation Theory", led by Veronique Dehant, which has won the Decartes Prize – the highest award in Europe for science. IVS/VLBI contributed strongly with the EOP time series.

Considering the advantage of being locally close together in Europe the chairs of IGS, ILRS and IVS met earlier this year. The author reported to the board about the discussions with Werner Gurtner , Bern/Switzerland (ILRS) and John Dow, Darmstadt/Germany (IGS). The responsibility of the services with respect to the support of contributing agencies was discussed. As result a joint document will be prepared explaining the importance of the service products and the need for contributions by the agencies. Such a document might help to provide arguments for supporting the services. The overall visibility of our services should be increased collaboratively, e.g. by making use of a booth at meetings, as IGS already has done. Harmonization of the contents e.g. of the site or station information files, which contain comparable information, should enforced to avoid misinterpretation. A joint IAG web page with the links to the service pages is proposed. The INDIGO proposal is regarded as an important development for all the services. The chairs will meet again for continuing the exchange of information.

The director of the Coordinating Center, Nancy Vandenberg informed us that the observing program for 2004 is nearly the same as for the two years before. The totals are about 175 session days (3.5 days per week) and 1100 station days. Usage of Mark 5 is increasing gradually. By the end of the summer it appears that most stations will be Mark 5 or K5.

The Analysis Coordinator, Axel Nothnagel, described the call for participation in the IERS combination pilot project which requests combined products from each service. IERS will combine the files to get a fully consistent set of ITRF, EOP and ICRF products. To get started, IVS will submit one SINEX solution to IERS until our combined product in SINEX is available.

The Network Coordinator, Ed Himwich, reported the station performance analysis for 2003. It covers 188 sessions and 1040 session days. The data loss was 14.2% compared to 12.2% in 2002. Major subsystems that caused the data loss: 25% receiver problems, 18% antenna problems.

Alan Whitney, Technology Coordinator, reported that the VSI-E draft is being reviewed by the committee. The protocol is based on RTP, making many pre-existing tools and utilities available for use. Haystack has implemented an experimental version of VSI-E. He mentioned that about 75 Mark 5 systems and 500 disk packs are deployed; 85 systems are expected by the end of 2004.

Ed Himwich, IVS Network Coordinator, explains data loss to board members. (left-right) Axel Nothnagel, Chopo Ma, Alan Whitney, Bill Petrachenko, Arthur Niell, and Yasuhiro Koyama.

Due dates for completion of reports have been agreed for the VLBI2010 Working Group. A draft report should be completed by April, the final report by July 2004.

A status report was given on the Pilot Project "Baselines" by Axel Nothnagel. A web page is being set up to access the test products.

Kerry Kingham reported about the Mark 5 experiences at the Washington Correlator. The gains from Mark 5 are: increased efficiency with processing factors decreasing to about 1.5 times record time, potential for unattended correlation and interoperability between K5 and Mark 5. The transition to Mark 5 has gone very smoothly and is having a positive effect on the IVS observing program.

With respect to IAG, the services have three representatives recently elected to IAG Commission 1: Chopo Ma (IVS), Werner Gurtner (ILRS) and John Ries (IGS).

Chopo Ma reported from the IERS Matera workshop about local ties. The workshop recommends: local ties should be at the 1 mm level, VLBI sites with GPS should be included in the main IGS analysis. Standards were proposed for surveys, analysis, and documentation. He also mentioned the three new IERS working groups that are most important with respect to IVS, namely WG1 "Datum Definition of Global TRF", WG2 "Site Survey and Co-location" and WG3 "Combination".

Franco Mantovani explained the EVN consortium which consists of 14 institutions operating 16 telescopes. EVN plans to use Mark 5 only in 2004. Funds were received from the EC for 5 years to support users of the EVN and to run the EVN itself.

The one-day Directing Board Meeting was again a very busy but informative meeting. A complete summary of the meeting is at http://ivscc.gsfc.nasa.gov/org/board.html.

Height Corrections for IVS Network Stations

–Axel Nothnagel, Geodetic Institute of the University of Bonn

During the Fifth IVS Analysis Workshop held in Ottawa, Canada on February 12, a number of topics important to VLBI data analysis were discussed. One of the crucial topics in VLBI data analysis is the application of height corrections due to local effects. Two phenomena should be emphasized at this time, particularly asking the staff at IVS Network Stations for support: antenna thermal deformation and local hydrology. With ever increasing observing and analysis accuracy these effects have to be taken into account rigorously to correct the height positions of VLBI antenna reference points.

For antenna thermal deformation a database of antenna dimensions has been compiled at the IVS Analysis Coordinator's Web page (http://giub.geod.uni-bonn.de/vlbi/IVS-AC). So far, the parameters of a few telescopes are still missing. We would be glad to receive further antenna dimensions from anyone who can provide this information for the purpose of modeling thermal expansion effects.

Some stations like Onsala and Wettzell regularly carry out in situ height measurements of the VLBI reference point. Onsala has an invar rod and Wettzell an invar wire to measure the height variations continuously. Other stations are encouraged to follow these examples for a better calibration of VLBI data.

Concerning local hydrology a talk presented by Shigeru Matsuzaka at the General Meeting about height changes at Tsukuba emphasized the importance of monitoring ground water table heights. At Tsukuba heavy pumping every year for the rice fields in the area causes a severe drop in the ground water table and consequently a short-duration subsidence of the telescope. Since it is not unthinkable that similar effects exist at other sites as well, the staff at IVS Network Stations are asked and encouraged to find out about regular ground water table measurements in the vicinity of their sites and to make this data available to the IVS Analysis Coordinator.

Both types of auxiliary data, thermal effects and local hydrology, have been gathered, sometimes occasionally and, in the case of thermal expansion at Onsala and Wettzell, for a long time. However, no standardized path of including this data in the VLBI data analysis process has been developed yet. Therefore, all this data should be tabulated in a specified form for easy integration in the VLBI analysis chains. In order to prepare the respective procedures and file formats, an Analysis Working Group has been established.

http://ivscc.gsfc.nasa.gov
ivscc@ivscc.gsfc.nasa.gov
phone: 301-614-5939
fax: 301-614-6099

IVS Coordinating Center
NASA GSFC
Code 926
Greenbelt, MD 20771