JPL VLBI Group Report for 1998-1999

Chris Jacobs, Ojars Sovers

Abstract

This report describes the transitional activities of the JPL Analysis Center.

1. Introduction

For JPL the year from March 1998 to March 1999 has been one of many transitions. We are currently making changes in just about every aspect of our VLBI program.

2. Field Operations

In the field, the transition from Mark III to Mark IV has stabilized and we are striving to improve the operability of the Deep Space Network (DSN) antennas for VLBI. We continue to use both 34m and 70m antennas in Goldstone California, Tidbinbilla, Australia, and Madrid, Spain. These sites are transitioning to the new triple-cap heads thus allowing recording of either the old-style thick tapes or the newer, higher capacity thin tapes.

We also began to collect K-band (19 to 26 GHz) VLBI data on a semi-regular basis. We hope to eventually observe at even higher frequencies. The DSN wants to raise its deep space telemetry carriers from X-band (8.4 Ghz) to Ka-band (32 GHz) in order to support higher telemetry rates. Thus we may have an opportunity in the coming years to extend our celestial reference frame work to a new region of the spectrum.

In an effort to tame that long time nemesis of VLBI, water vapor fluctuations, we have been developing an advanced Water Vapor Radiometer (WVR). This instrument measures the brightness temperature of the 22 GHz rotational line and supplements that data with measurements of the temperature vs. altitude. By improving gain stability and narrowing the instrument beam to allow co-pointing at low elevations, we hope to achieve mm level calibrations of water vapor induced path delay variations.

3. Data Processing

Turning to data processing, the JPL Block II Correlator is now reliably correlating Mark IV data recorded at 135 ips. Our next generation correlator, the Block III, is under development and will support a wide range of Mark IV modes while greatly reducing maintenance costs. This upgrade is inheriting technology developed for arraying Deep Space Network antennas for reception of Galileo spacecraft transmissions. This should reduce development time and maintenance costs.

Over the last year we began a fruitful collaboration with a new industry partner, Remote Sensing and Analysis (RSA) of Altadena, California. Many of you have had the good fortune of working with Ojars Sovers and Jack Fanselow–both of whom are now with RSA.

Our MODEST VLBI modelling and parameter estimation software saw two major milestones over the last year. First, the MODEST software was ported from Compaq/DEC VMS to Compaq/DEC Unix as well as HP-UX, Sun Solaris and Linux. The other milestone was the publication

of a comprehensive review article in Reviews of Modern Physics (Sovers, Fanselow, and Jacobs, vol 70, no. 4, Oct 98) covering our modelling efforts over the last two decades and reviewing the scientific results produced by the larger VLBI community over a similar period.

4. Publications

Several reports relevant to VLBI analysis were published in JPL's online technical journal, the TMO Progress Reports, which is available at `http://tmo.jpl.nasa.gov/tmo/progress_report`

1. Jacobs et al., The JPL Extragalactic Radio Reference Frame
   `http://tmo.jpl.nasa.gov/tmo/progress_report/42-133/133E.pdf`
   describes in detail our celestial frame work including a lengthy discussion of the current VLBI error budget.
2. Gorham, Designing Optimal Bandwidth Synthesis Arrays for VLBI
   `http://tmo.jpl.nasa.gov/tmo/progress_report/42-133/133D.pdf`
   discusses the design of the frequency sequences we use in astrometric/geodetic S/X observing.
3. Jacobs, Phase Calibration Tone Processing with the BlockII VLBI Correlator
   `http://tmo.jpl.nasa.gov/tmo/progress_report/42-134/134A.pdf`
   describes in detail the phase calibration tone processing done by the JPL BlockII Correlator.
4. Lanyi, Determination of the Tropospheric Fluctuation Coefficients in VLBI Parameter Estimates
   `http://tmo.jpl.nasa.gov/tmo/progress_report/42-133/133I.pdf`
   discusses our use of a combined temporal-spatial observation covariance in the analysis of VLBI data. This is an alternative approach to the more common technique of stochastic estimation of temporal variations.

Finally, our multi-year collaboration with colleagues from several institutes has been documented in Ma et al., The International Celestial Reference Frame based on VLBI Observations of Extragalactic Radio Sources
`http://www.journals.uchicago.edu/AJ/journal/issues/v116n1/970504/970504.html`
This paper describes the new IAU celestial reference frame which since 1 Jan 1998 has been the official definition of coordinates on the sky.

5. Outlook

So considering all the above developments, one can see that it has been a fruitful year for our group. The many ongoing transitions will be taking us into a number of new areas in the coming years. We look forward to these opportunities and to continued collaboration with our colleagues in the IVS.