Haystack Observatory VLBI Correlator

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Abstract

This report presents the status of the Haystack Correlator, focusing on its activities, its current and future hardware capabilities, and its staff.

Figure 1. Haystack Mark IV Correlator

1. Introduction

The Mark IV VLBI correlator of the MIT Haystack Observatory, located in Westford, Massachusetts, is supported by the NASA Space Geodesy Program and by the National Science Foundation. The available correlator time is divided approximately equally between processing geodetic VLBI observations for IVS and processing millimeter-wave radio astronomy observations for the Coordinated Millimeter VLBI Array. In addition to its role as an operational processor, the Haystack Correlator also serves as a development system for testing new correlation modes and hardware improvements and for diagnosing correlator problems encountered at Haystack or at one of the identical correlators at the U.S. Naval Observatory and the Max Planck Institute for Radioastronomy. This flexibility is made possible by the presence on-site of the team that designed the correlator hardware and software.

2. Summary of Activities

An area of major development this past year has been integration of Mark 5 recorders into the correlator. There has been steady progress in this area, with two Mark 5 units in operation for most of the year. These recorders are routinely used to process experiments recorded at field sites which have Mark 5s, such as Westford, Kokee, and Wettzell. A related development is the e-VLBI program, in which the Mark 5 units play a part. Two successful e-VLBI experiments were processed on the Haystack correlator in the last year, one between Westford and GGAO

using Mark 5 units, and another between Westford and Kashima using CRL's PC based recording system.

Significant efforts to improve reliability of software and hardware, especially in the station units, have continued and should result in measurable improvements in efficiency at all correlators. Two major problems related to station units which have been resolved in the last year are "forks" (which cause all data from an affected station unit to be discarded) and "byte slips" (which cause artificially low amplitudes in individual channels), both of which contributed significantly to the amount of data to be reprocessed after the production pass, and which compromised correlator throughput.

Amidst all this development work, it has been a significant challenge for the Haystack operation to meet the requirement introduced this year for turnaround of the R1 experiments within 15 days. Because of our limited staffing for production correlation, we have been able to meet this challenge only through major adjustments in our processing methods.

3. Experiments Done

Since January 2002, 42 experiments have been processed at the Haystack correlator. This total subdivides into 12 R1s, 5 R&Ds, 3 CONTs, 3 GRAVs, 2 CORE-3s, 1 CORE-1 and 16 test experiments. The test experiments cover a wide variety of areas including tests of the correlator, racks, stations (both new such as TIGO and existing to check hardware changes such as Algonquin), Mark 5 integration, e-VLBI, new recording modes, and assorted other issues. In addition, 24 intensives on Mark 5 disks were processed in order to test and develop production processing on the Mark 5.

4. Current/Future Hardware and Capabilities

Current hardware installed and functional on the system are 7 tape units, 2 Mark 5 units, 7 station units, 16 operational correlator boards, 2 crates, and miscellaneous other support hardware, with the ability to process all baselines for 7 stations simultaneously in the standard geodetic modes. One significant addition this past year was a decoder for diagnosing recording problems. In the near future we hope to add one more station unit and fully enable the use of the on-board DSP chip capabilities. Over the next year there will be a major effort to integrate more Mark 5 disk based recording systems into the correlator and to further develop e-VLBI.

5. Staff

Staff who participate in aspects of Mark IV development and operations include:

5.1. Software Development Team

- John Ball - operator interface; playback; Mark 5/e-VLBI development
- Roger Cappallo - leader; system integration
- Kevin Dudevoir - correlation; maintenance/support; e-VLBI development
- Colin Lonsdale - post processing

- Alan Whitney - system architecture; Mark 5/e-VLBI development

5.2. Operations Team

- Peter Bolis - correlator maintenance
- Tom Buretta - playback drive maintenance
- Brian Corey - experiment correlation oversight; station evaluation; technique development
- Dave Fields - playback drive maintenance; Mark 5 installation/maintenance
- Ellen Lautenschlager - correlator operator
- Glenn Millson - correlator operator
- Arthur Niell - technique development
- Don Sousa - correlator operator; experiment setup; tape library and shipping
- Mike Titus - correlator operations oversight; experiment setup; computer services; software and hardware testing
- Ken Wilson - correlator maintenance; playback drive maintenance

6. Conclusion/Outlook

Full integration and expansion of Mark 5 units into the correlator will be a major effort in the next year. Other related work, such as development of e-VLBI, will also be a priority. Efforts to improve operations and efficiency will continue, and all of the above hopefully will result in improved data quality and increased data throughput for all the correlators in the coming year.