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. Partial view of Haystack Mark IV correlator, showing correlator rack, 3 tape units, 1 rack containing 4 SUs, and 1 rack containing 2 Mark 5A units and a decoder.

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

Integration and testing of Mark 5 on the correlator has continued throughout the year. The two initial Mark 5P units have been replaced with Mark 5As, and two more have been added. Production use of Mark 5 has steadily increased, resulting in frequent upgrades with enhanced software on the Mark 5s and correlator in order to improve the smoothness of operation. The increased use of Mark 5 recordings and the effects of other improvements in software, such as the elimination of "forks" and byte slips, have resulted in improved efficiency. For R1 experiments the efficiency factors are now routinely below 2.0 - typically 1.8 or so - whereas previously they were typically between 2 and 2.5. This is reflected in the improved efficiency of all the Mark IV correlators, which have significantly reduced or completely eliminated their backlogs over the last year.

Another area of continued focus has been e-VLBI. Several e-VLBI test experiments, and the use of e-VLBI for quick feedback fringe tests, have demonstrated the value of e-VLBI in an operational sense. One particular accomplishment worthy of note is the turnaround of a Kashima-Westford Intensive session within 24 hours (27 June 03). More recently, the focus has been on automating the transfer process and the transfer of entire 24-hour sessions (particularly Kashima data from the CRF series).

In addition to these developments, other improvements and fixes continue to be implemented on a time available or as needed basis. These are intended to improve operations or data quality, or to correct problems. It should be noted that some fixes and improvements come as a byproduct of Mark 5 or e-VLBI related development, showing that new technology development and improvements of a more general nature are often coupled.

3. Experiments Done

Since January 2003, 40 experiments have been processed at the Haystack correlator. This total subdivides into 19 R1s, 8 R&Ds, 3 CONTs and 10 test experiments. The test experiments cover an assortment of e-VLBI, Mark 5, correlator software, and station/equipment tests. The increase in 24-hour production experiments over last year (+4), reflects the better throughput due to improved efficiency.

4. Current/Future Hardware and Capabilities

Currently functional hardware installed on the system consists of 7 tape units, 4 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. By late 2004, development of the Mark 5B might allow the correlation of more than 7 stations, due to the ability to add Mark 5 units without the need for an accompanying station unit. We expect to remove tape drives from the system as more stations move to exclusively recording on Mark 5.

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
- David Lapsley - 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 Cellini - 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 & hardware testing
- Ken Wilson - correlator maintenance; playback drive maintenance

6. Conclusion/Outlook

Continued integration and expansion of Mark 5 units into the correlator will be a major effort in the next year. Mark 5B development might make possible an increase in the number of stations that can be processed simultaneously. Another major priority will be development of e-VLBI. Efforts to improve operations and efficiency will continue, and all of the above tasks should result in further improved data quality and increased data throughput for the Mark 4 correlators in the coming year.