Haystack Observatory VLBI Correlator

Mike Titus, Roger Cappallo, Brian Corey, Arthur Niell, Alan Whitney

Abstract

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

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

1. Introduction

The Mark IV VLBI correlator of the MIT Haystack Observatory, located in Westford, Massachusetts, is supported by the NASA Space Geodesy Program. Production correlator time is dedicated to processing geodetic VLBI observations for the IVS. In addition to its role as an operational processor, the Haystack Correlator also serves as a development system for testing new correlation modes, e-VLBI, 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

There has been a diverse array of activities over the last year. Some of the highlights of our activities follow.

A major focus continues to be improving and expanding the e-VLBI technique. Many experiments and tests have been performed, including the correlation of data in real time at rates up to 512 Mb/sec, as well as a demonstration for a major supercomputing conference. Tangentially related to operations is the continuing effort to transfer station data via e-VLBI for regular sessions, thus circumventing the process of shipping physical media. For more detailed information

on correlator related e-VLBI development activities at Haystack, please refer to the "Haystack Observatory Technology Development Center" report.

Integration of Mark 5 into operations continues. Four Mark 5 units were installed in a single rack, and a tape drive was removed from the correlator line of equipment to make room for it. New Mark 5A software releases are frequently tested on the Haystack system before general release.

Increased efficiency due to Mark 5 and other improvements has allowed the use of production time to examine parameter space not previously explored in order to investigate whether any errors - systematic or otherwise - are being inadvertently introduced into results. Several tests have been run in order to examine issues such as effects near search range edges, consistency of results in repeat processings, and the like. Many of these studies are in their early stages, and we hope to report the results later in 2005.

New observing modes, apart from e-VLBI, such as Gb/sec recording, have been tested and used extensively in the year's production sessions. The geo_export package has been upgraded in order to accommodate these new observing modes.

3. Experiments done

Since January 2004, 47 geodetic VLBI experiments have been processed at the Haystack correlator. This total subdivides into 13 R1s, 9 R&Ds, 1 APSG, and 24 test experiments. The test experiments cover an assortment of e-VLBI, new observing modes, Mark 5, correlator software, and station/equipment tests.

4. Current/Future Hardware and Capabilities

Currently, functional hardware installed on the system includes 6 tape units, 5 Mark 5A units, 7 station units, 16 operational correlator boards, 2 crates, and miscellaneous other support hardware. We have the capacity to process all baselines for 7 stations simultaneously in the standard geodetic modes. By mid 2005, implementation of the Mark 5B may allow the correlation of more than 7 stations, due to the Mark 5B's independence of an accompanying station unit. We expect to remove tape drives from the system as more stations move to recording exclusively on a Mark 5.

5. Staff

There have been a number of staff changes in the last year. Due to increased efficiency and the ending of the CMVA project, we have reduced the number of hours of production. One of our long-time operators, Ellen Cellini, has moved on to a new career, and we decided not to fill her position. This leaves us with 30 hours per week of production time. The last few months of operation in this mode has proven adequate to meet our production deadlines. Another change is that Brian Corey is now working remotely from Florida, supplemented by bi-monthly local visits. Thanks to high speed internet access, this arrangement manages to work almost as well as locally-based operations. Further changes are that David Lapsley has left for industry—with Jason SooHoo taking up part of the e-VLBI effort in his place—and the retirement of our long-time maintenance person, Tom Buretta.

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; post processing
- Kevin Dudevoir - correlation; maintenance/support; e-VLBI development
- Jason SooHoo - e-VLBI development
- Alan Whitney - system architecture; Mark 5/e-VLBI development

5.2. Operations Team

- Peter Bolis - correlator maintenance
- Brian Corey - experiment correlation oversight; station evaluation; technique development
- Dave Fields - playback drive maintenance; Mark 5 installation/maintenance
- 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

We hope to begin operational testing of Mark 5B in the next year. Each Mark 5B that is integrated will allow either the retirement of a station unit, or an increase in the number of stations that can be simultaneously correlated. The station units have been a major source of reduced efficiency due to frequent need for reprocessing and to the length of time they take to set up each scan. This upgrade, and the greater use of Mark 5 and e-VLBI in operations, should continue to increase the efficiency and reliability of operations. We will also concentrate on moving operational correlator production tasks to more modern Linux-based systems over the next year, possibly including the correlator run time software. All the above should speed up and streamline the data production process and provide greater capability to the IVS community.