MARK III REAL-TIME FRINGE-DETECTION SYSTEM

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ABSTRACT

A RAM memory built into the Mark III decoder module allows the capture of 1 Megabit of data. Data may be collected either in real time or from a pre-recorded tape. Once collected, the data may be retrieved using a standard EIA serial data link. The data may be transmitted to a remote computer for cross-correlation processing with similar data from other stations to verify fringes in "real time." The data may also be analyzed by a local computer to verify phase-calibration, bandpass, format, etc., during a Mark III observing session.

INTRODUCTION

A well-known difficulty in conducting very long baseline interferometry (VLBI) experiments is real-time verification of proper data taking. Much money and effort has been spent in rushing newly recorded tapes back to a processing center to verify that everything is in order. With the recent development of high-density, low-cost semi-conductor memories, it has become practical and economical to capture a small segment of VLBI data in local memory and transmit that data over ordinary telephone lines to a remote processing facility where it may be cross-correlated with similar data from other sites for fringe verification. The Mark III Data Buffer has been designed for this purpose.

HARDWARE IMPLEMENTATION

The Data Buffer system is a 1-Megabit memory which is physically mounted within the Mark III Dual-Decoder module and accepts data from the "A" section of the decoder for storage. Data may be collected in real time in either "bypass" mode or read-after-write, or after-the-fact by playing back a pre-recorded tape.

Operation of the Data Buffer typically is as follows: Once armed by the host computer, the buffer waits for a sync signal from the decoder (normally on the 10-sec mark). When this sync signal is detected, all following data is stored to the capacity of the memory. Data is acquired in a single, continuous 1-Megabit window but is blocked into 4-kilobit segments for transmission to the host.

The data stored is exactly that which would have been written onto a Mark III tape and includes all header, synchronization, and parity bits. The data buffer contents, therefore, represent a "slice" of Mark III tape, 1 track wide and 1 Megabit long.

All functions of the data buffer may be controlled through a host computer. The data source and operating modes are reported to the host computer in a status byte sent with each transmission. Identification codes, segment number, and a binary checksum are also reported to the host on each transmission. Re-transmission of any segment can be requested by the host in case of difficulty.

An auxiliary data source may be selected by a rear-panel toggle switch and a set of 3 BNC jacks. This might be used, for example, to capture Mark II data in a similar manner.

A set of 13 memory test patterns can be loaded and verified by the host in order to detect malfunctioning circuits. The expected positions of the Mark III header information from frame to frame may also be exploited for error detection purposes.

While each data buffer is wired for a full megabit of memory, capacity may be reduced in 0.25-Megabit increments for economy. Also, the design will directly accommodate 64-kbit memory chips when they become economical, expanding the memory capacity to 4 Megabits.

SOFTWARE SUPPORT

A full set of software-support programs has been developed to retrieve and process the data collected by the Mark III Data Buffer. The data stored within the data buffer may be accessed by either a local or remote computer. Transmission to a local computer may be done at 9600 baud, requiring only a few minutes to transmit a full buffer. The local computer can examine the data for proper format and process it for phase-cal signals and bandpass. Data transmission to a remote computer is normally done using ordinary dial-up telephone lines at 1200 baud. At these data rates, approximately 15 to 20 minutes is needed to transmit a full 1-Megabit buffer. Data rates up to approximately 4800 baud can be supported through the use of more sophisticated modem equipment. Cross-correlation and phase-calibration processing is done in software in a manner exactly analogous to the Mark III Processor and is displayed in real-time as data is received from the data buffer. Software integration periods may be shortened to any desired value to search for the possible presence of phase-modulation of local oscillators at power-line frequencies, a problem that has occasionally plagued VLBI experiments.

Figure 1 displays the results of "real-time" Mark III fringes on 3C84 at X-band obtained between Haystack and Green Bank during an experiment on August 4, 1979. Figure 1a displays the fringe-rate spectrum; note that there is no evidence of local-oscillator phase-modulation at power-line frequencies. Figure 1b displays the correlation amplitude and residual-fringe-phase versus time, one point for each 5-msec frame. Also displayed in figure 1b is the phase-calibrator phase for each station.

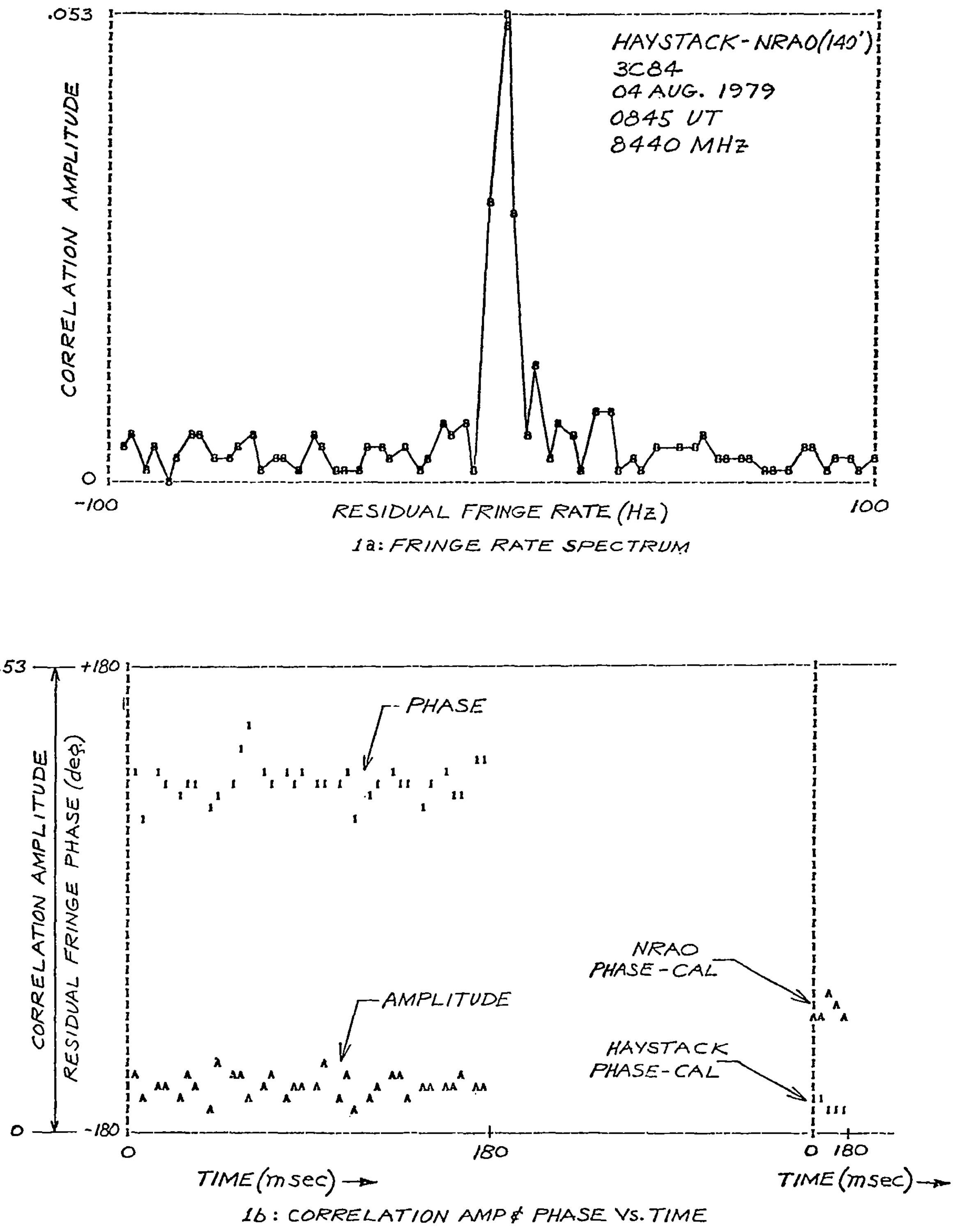

Figure 1. "Real-time" Mark III fringes.