Antenna Pointing Subsystem Drive Tape Generator — Another New Interface

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The Antenna Pointing Subsystem (APS) program was changed to meet new needs. To continue service to radio science targets, a new interface between the ephemerides of these targets and the APS program was required. This report describes briefly the program, called APSTAPE, written for this purpose. An important feature of the program is that it performs a read-after-punch operation, which ensures that the drive tapes generated will be error free. The program described has been successfully used in the field.

I. Introduction

Antenna pointing at a Deep Space Station (DSS) is performed by the Antenna Pointing Subsystem (APS). The APS consists of hardware, an XDS 910 computer and special peripherals, and software, the APS Program. Input to the APS Program is delivered by the Tracking Predicts System for most project requirements. For all scheduled tracking, the APS is operated by the station staff.

The tracking of both planetary and spacecraft targets for radio science activities requires an interface between the ephemeris and the APS Program. For radio science work, the ephemeris is delivered as a Chebychev polynomial while the APS Program requires a point-by-point type of ephemeris.

The APS Program was changed to meet new needs. One of the side effects of this change was that the drive tape interface (paper tape) was altered. A program for the conversion to the new format was needed. APSTAPE was written to perform the conversion using the XDS 930 computer, which supports radio science activities. The following is a description of that program.

II. Interface Program Requirements

The requirements of the interface program can be broken into four sections: (1) input, (2) output, (3) operations, and (4) verification.

The input polynomial coefficients may be delivered to the station on cards, in the RADAR 11 format, or on magnetic tape, in the Ephemeris Delivery System (EDS) format. Since more than one pass or target may be delivered in such a file, parameters input by the station operators are required for the selection of the proper set. Additional entries are passed to the drive tape to be used by the APS Program operator. This data is used to verify that the correct drive tape is being used.

The primary output of APSTAPE is a valid drive tape for the APS XDS 910. While not necessary, it has been shown

desirable to provide the APSTAPE operator with listings of pertinent data. These listings permit the operator to monitor the APSTAPE operation and performance, and thereby provide the "warm feeling" necessary for effective operation.

Since the station staff for radio science is limited and is therefore highly "cross-trained", it is extremely important that the APSTAPE Program operation be straightforward and self-explanatory. Program-generated messages covering all normal and contingency operations are required. To the degree possible, the operating instructions for the program should be contained within the program itself. Satisfying this requirement leads to smooth operations even when the use of the program is occasional.

While paper tape itself is a reliable medium, its generation suffers from occasional failures. To eliminate the propagation of this type of error into the antenna pointing process, the output tape must be verified.

III. APSTAPE Program Description

The APSTAPE Program as written satisfies the above requirements. It is a "self-loading" program that guides an operator through the process by typed messages and requests. Verification of the output is done by reading the punched paper tape and comparing against the desired output. Since the paper tape punch does not have read after write, enough records are punched so that the tape reaches the paper tape reader. The operator is then requested to load the tape into the reader for the verification process. Should the tape fail verification, the operator is directed in a recovery procedure by the program. When a completed and verified tape has been produced, the operator is provided with a label to attach to the tape.

The program description is presented in three sections: (1) initialization, (2) processing, and (3) termination.

A. Initialization

At the start of the program execution, the variables are initialized and control and data information is accepted. Because of the separation of the punch and reader, a delay in the verification process must be set. A circular buffer, which contains the delayed data until verification, is cleared and its pointers are reset. At the completion of these actions, the operator is requested to enter the date, target, station, pass and predict set identifications, the step size, and the coefficient input medium.

With this information available, the program will scan the coefficient file for the proper data. The input data is checked for consistency as it is entered. Errors result in requests for specific corrective action. A monitor output of the data to be used is listed. When this is complete, the execution automatically enters the processing phase.

B. Processing

In the processing part of the program, the drive tape points are computed, formatted into records, and punched into paper tape. The punched records are read and verified against a stored image.

The APS drive tape starts at the rise time of the polynomial and continues to the set time. Points are computed at intervals of the input step size. These values are formatted into records containing two sets of day, time, hour angle, and declination. It is not necessary that the step size divide the pass period evenly. If an odd number of points results, the last set is identically zero (day, time, and angles). This preserves the record format. After formatting, the record is punched. It is also saved in the circular buffer and listed for monitoring.

If verification is permitted (i.e., there is enough tape punched to reach from the punch to the reader), a record is read from the tape. Should it not match the contents of the circular buffer, the operator is directed to discard the offending record and all the tape between the reader and the punch. A new section is punched and the operator is directed to splice it to the verified tape. The splice is done by simply overlapping blank sections of tape and taping together. The program waits for each operator action.

This process continues until set time is encountered.

C. Termination

At the end of a pass, the drive tape must have an End-of-File record and some leader punched. Then the remaining records must be verified. As an aid to operations, a label is printed containing the necessary information about the drive tape generated. This label is attached to the tape by the operator.

Following a successful run, the program is reentered for a second one.

IV. Conclusions

The program has been successfully used to provide drive tapes for both the moon and a synchronous satellite. It is available from the DSN Program library under number DXI-5490-SP.