Pioneer Mission Support

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This article reports on activities within the Deep Space Network in support of the Pioneer Project's in-flight spacecraft during the period April through July 1977. The amount of tracking coverage provided by the Network and a summary of operational testing of the Mark III Data Subsystems at DSS 14 are presented.

I. Pioneers 6, 7, 8, and 9

Coverage of these spacecraft has increased dramatically during this reporting period. The tracking coverage times shown in Table 1 represent more than a ten-fold increase over the last reporting period (Ref. 1). However, the majority of the tracks supported were for the acquisition of radio metric data only, in order to update the spacecraft trajectory data. Adequate telemetry data and command capability were provided to the Project during this period to allow spacecraft performance assessment and scientific data monitoring.

II. Pioneers 10 and 11

A. Mission Operations and Status

Pioneer 10 continues to operate satisfactorily. The spacecraft is now more than 13 astronomical units (AU) from the Earth and the round trip light time is over 3 hours 40 minutes. Tracking coverage has increased somewhat over the last reporting period, due primarily to greater availability of the 64-meter stations. Tracking coverage for the last four months is tabulated in Table 1 and coverage during the last twelve months is shown in Figure 1.

On 7 May, the spacecraft passed through superior conjunction – its fifth since launch – at a minimum Earth-Sun-probe angle of 2.83 degrees (approximately 10.4 $R_\odot$). Telemetry data were degraded during the week surrounding conjunction, necessitating a decrease in bit rate from the normal rate of 128 bits per second to 32 bits per second. Radio metric data were also affected, as indicated by an increase in Doppler noise – although the maximum noise observed was less than expected (Fig. 2).

Pioneer 11 is also operating normally. Earth-spacecraft range is now more than 6 AU and the round trip light time is over 1 hour 50 minutes. No further problems with the spacecraft thrusters have been encountered, but the health of the entire attitude control and propulsion system continues to be closely monitored. Tracking coverage for Pioneer 11 is shown in Table 1 and Figure 3.

B. Mark III Data Subsystems Support of Pioneer

Since the previous report (Ref. 1), Mark III Data System (MDS) verification testing for Pioneers 10 and 11 has been completed at DSS 14. Configuration control for Pioneer was established on 2 August. Table 2 is a listing of representative demonstration passes performed by the station and a summary of the problems encountered. All major anomalies have been

cleared by the issuance and successful demonstration of either updated software or hardware changes. The majority of the minor anomalies encountered were related to operator training and familiarization. These problems decreased as operations personnel became more proficient and more knowledgeable of the new systems.

DSSs 42 and 43 are currently undergoing upgrading to MDS configurations. Verification testing of these stations for Pioneer support will begin in October of this year and will follow the same pattern of demonstration passes as used for DSSs 12, 14, 44, and 62. A future article will report on this testing.

Reference

1. Adamski, T. P., "Pioneer Mission Support," in *The Deep Space Network Progress Report 42-39,* pp. 9–16, Jet Propulsion Laboratory, Pasadena, California, June 15, 1977.

Table 1. Pioneer tracking coverage

Month	Spacecraft	Station Type	Tracks	Tracking time hr:min
April	Pioneer 6	26 m	3	27:52
	Pioneer 7	26 m	4	33:26
	Pioneer 9	26 m	1	12:47
	Pioneer 10	26 m	4	35:32
		64 m	31	192:59
	Pioneer 11	26 m	80	611:10
		64 m	7	38:13
May	Pioneer 6	26 m	18	112:43
	Pioneer 7	26 m	11	67:46
		64 m	6	32:10
	Pioneer 9	26 m	15	91:48
	Pioneer 10	26 m	2	7:05
		64 m	30	201:48
	Pioneer 11	26 m	84	651:11
		64 m	11	43:21
June	Pioneer 6	26 m	8	45:01
	Pioneer 7	26 m	22	154:54
	Pioneer 8	64 m	3	14:41
	Pioneer 9	26 m	7	47:20
	Pioneer 10	26 m	4	21:40
		64 m	32	331:07
	Pioneer 11	26 m	87	660:05
		64 m	6	27:28
July	Pioneer 6	26 m	11	57:42
	Pioneer 7	26 m	22	138:56
	Pioneer 8	64 m	1	1:30
	Pioneer 9	26 m	10	55:46
	Pioneer 10	26 m	4	20:34
		64 m	32	244:48
	Pioneer 11	26 m	85	654:58
		64 m	3	18:08

Table 2. Pioneer MDS demonstration pass summary

Date	Duration (hr:min)	Space-craft	Anomalies
6/24/77	5:33	10	(1) Unable to access CPA for data transfer test. CMF had been initialized for 22-bit GCF error polynomial instead of 33-bit code. Reinitialized CMF. (2) Continuous time errors observed by Project in telemetry data at acquisition. TPA had been initialized for default bit rate (2048 bits/second) instead of actual rate (16 bits/second). TPA reinitialized. (3) Antenna went to brake due to erroneous indication of low film height at pad 3 (4) Lost MDA/DIS interface at the DIS. MDA/DST interface remained active. Reestablished interface by DIS type-in. (5) Unsuccessful timed frame length change due to erroneous procedures.
6/24/77	4:00	11	(1) Lost high speed data line from station due to failure of carrier selector amplifier at GCF 10. (2) TPA changed telemetry frame length consequent with a bit rate change.
6/26/77	9:09	10	(1) Unable to access either CPA for command data transfer. Program reloaded. (2) Unable to maintain DIS high speed output. Program reload decreased frequency of problem, but the condition persisted throughout the pass. Data output restarted at the DIS each time. (3) Received series of command alarms (bit verify, symbol period abort limit, missing symbol interrupt, symbol period warnings). (4) Excessive angle residuals displayed by the tracking RTM. Residuals of over four degrees in each angle were displayed.
6/26/77	7:07	11	(1) Unable to enter commands into the manual buffer. Illegal type-in format used by station personnel. (2) SSA dropped lock immediately upon entry of a timed frame size change scheduled for the following radio day. (Program characteristic, corrected by software update.) (3) Observed three bit verify errors from prime CPA during the pass. (4) TPA changed telemetry frame size consequent with a bit rate change. (5) Unable to perform telemetry replays post-pass. Suspected procedural errors.
7/15/77	5:42	10	(1) CMF ODR stopped logging. Reloaded program. (2) SPD maser failed. Reconfigured to Mod III maser.

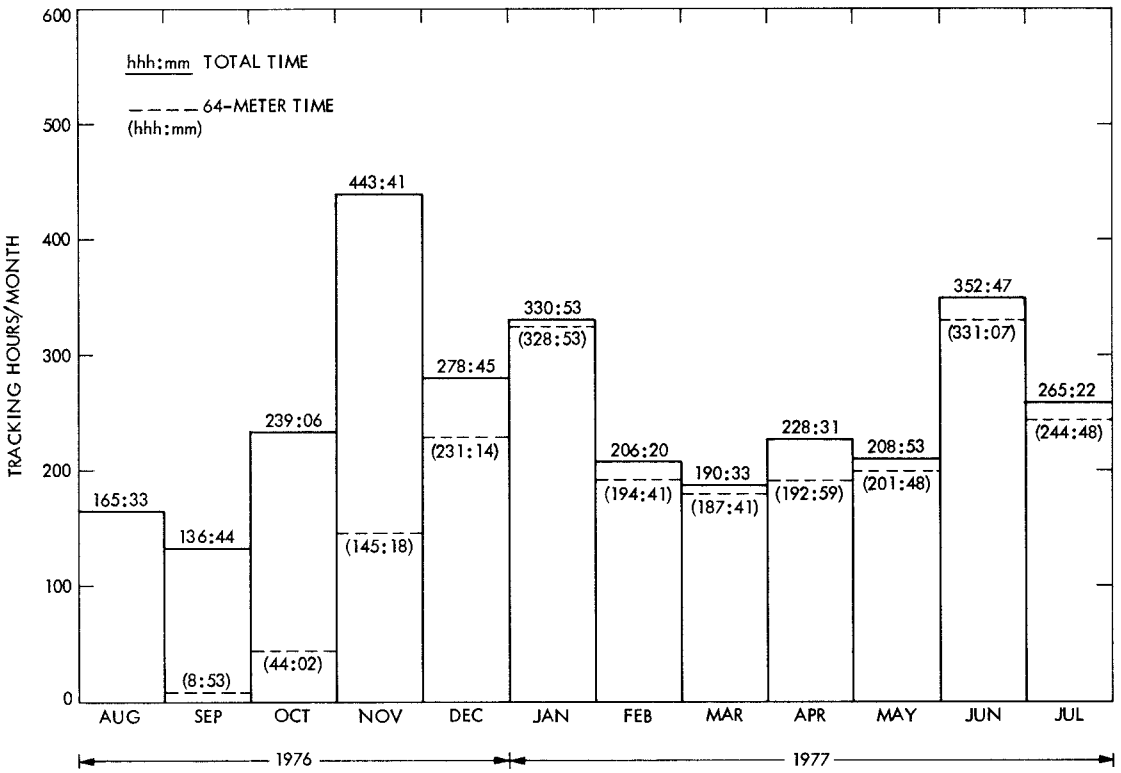

Fig. 1. Pioneer 10 tracking times

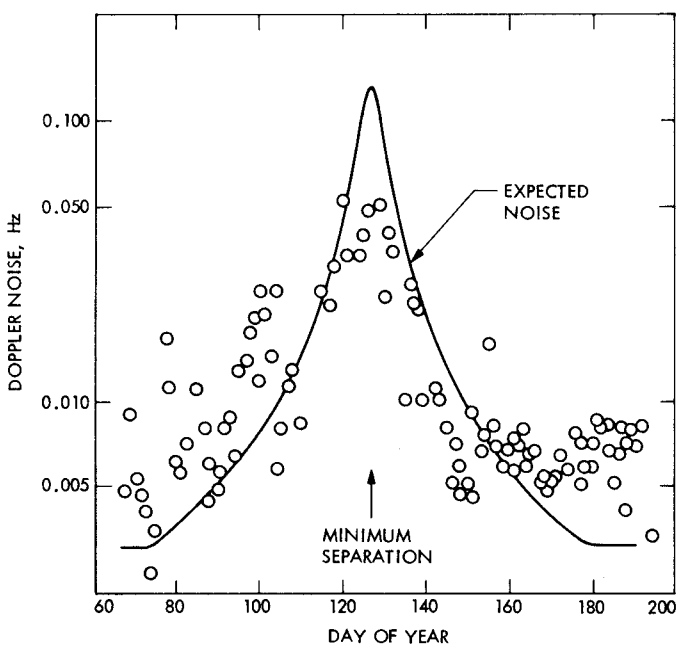

Fig. 2. Doppler noise during Pioneer 10 superior conjunction

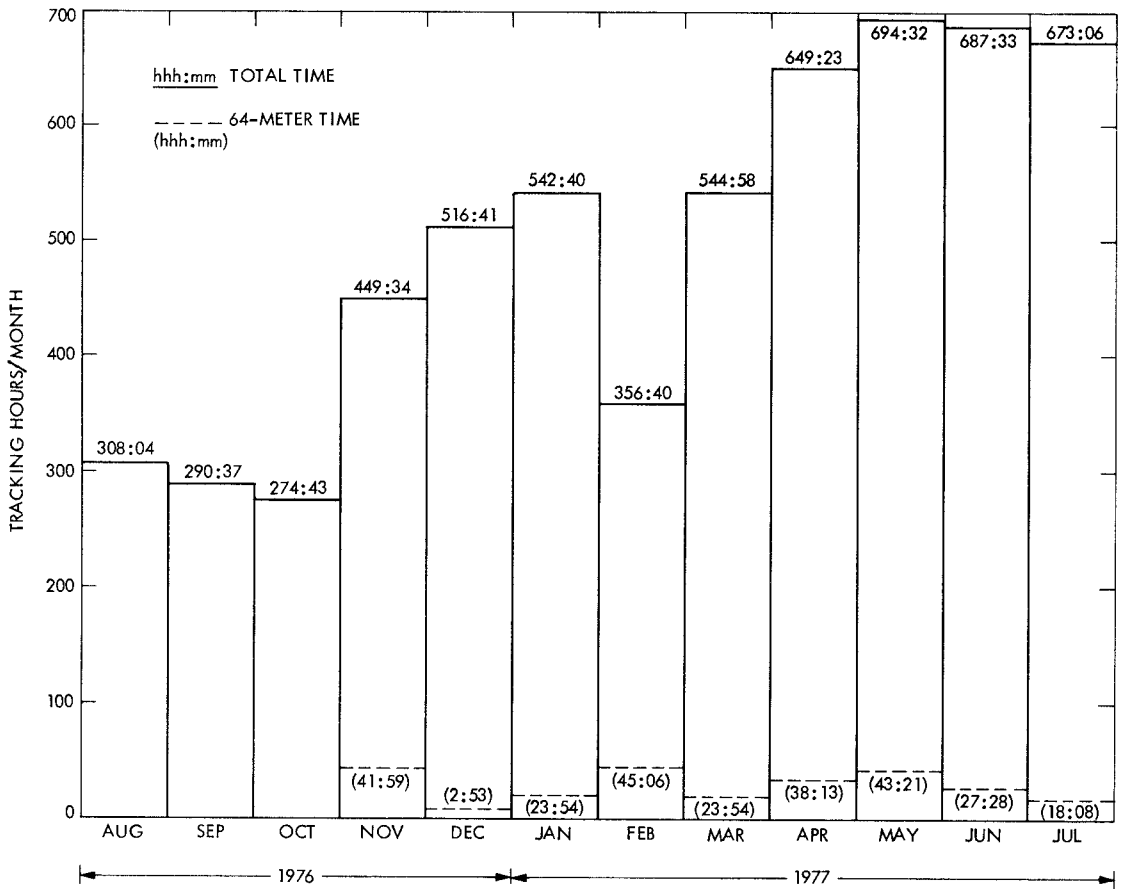

Fig. 3. Pioneer 11 tracking times