INITIAL ACQUISITION PROCEDURE FOR KOMPSAT2 WITH K13 ANTENNA

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ABSTRACT:

In general, most incomplete communication link setup between satellite and ground station right after separation from launcher come from less accurate orbital vector ground station uses to track the satellite because only predicted orbital state vector is available during first few orbits. This paper describes the developed procedure for successful initial acquisition for KOMPSAT-2 using scanning functions of K13 antenna system with predicted orbital information.

Azimuth scan, raster scan, spiral scan functions were tested with KOMPSAT1 under intentionally degraded orbital information for antenna operation. Through tests, spiral scan function was decided to be best search scan among 3 scans. Developed procedure can assure the successful acquisition only if azimuth offset and time offset value are within +/- 2deg and +/-30sec, respectively.

KEY WORDS: KOMPSAT1, Scan Modes. Orbit data

1. INTRODUCTION

The data acquisition facility is designed to provide imagery data and telemetry data from KOMPSAT satellites. The system is able to acquire and maintain automatic tracking of any satellite in the S-Band and X-Band frequency range at any elevation angle equal to or greater than 3 degrees above the local horizon. The modes of operation consist of STANDBY, AUTO ACQUISITION, PROGRAM, SCAN, AUTOTRACK and STOW mode. There are three scanning modes in K13M antenna system of KGS. These are very useful function to track the satellite in case of inaccurate orbit information or right after separation from launcher which supplies less accurate orbital vector to ground station. Scan modes consist of azimuth, raster and spiral also have their parameter on the EPROM of single board computer and the value can be adjusted to extend scan range by operator if necessary. This function keeps going on until find a signal and mode automatically change to auto track from scanning mode to loss of signal.

2. MODES OF OPERATION

2.1 STANDBY

This initial power-on condition inhibits servo power amplifier signals to the drive motors and sets axes brakes. This mode automatically actuates when a pedestal interlock is opened.

2.2 AUTO ACQUSITION

This allows the system to automatically track a target with no real time operator or computer inputs(other than the initial mode selection). By comparing actual position of antenna with the location of RF signal to be pointed to correct antenna pointing angles to coincide with the RF location in close-loop. AUTOTRACK MODE is automatically entered when target signal strength exceeds pre-selected threshold value.

2.3 PROGRAM

This allows the antenna position to be controlled by look angles, calculated from ephemeris data or from manual point commands from the GSC(Ground Station Controller) virtual front panel.

2.4 SCAN

This is an Auto acquisition aid, a sub-mode of the PROGRAM mode. A scan pattern is superimposed on the current position mode. Antenna commands are generated based on a raster scan pattern around the primary mode position. The system automatically enters AUTOTRACK mode when target signal strength exceeds preset threshold value.

2.5 AUTOTRACK

The DEU(Digital Electronic Unit) automatically tracks the target based on signal source strength.

2.6 STOW

In this mode, the antenna is driven to stow position, servo amplifier power is removed, and brakes are set in both axes.

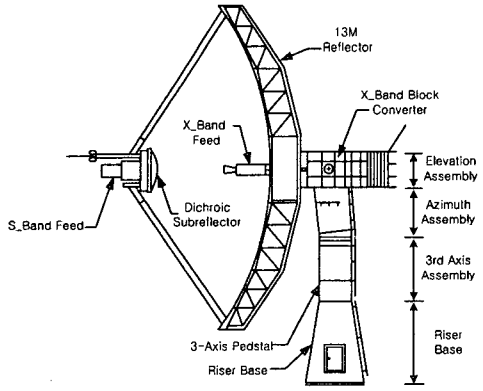

Figure 1. K13 Antenna system of KGS

3. MODES OF SCAN

3.1 Azimuth Scan

Azimuth scan makes antenna to sweep left to right from the center without elevation movement. This mode can be used in case of very low elevation and Table1 & Figure 2 are described their parameter and moving antenna tracks.

Table 1. Azimuth scan parameter

Angle	1.0	deg
Width	1.0	deg
Rate	1.0	deg/sec

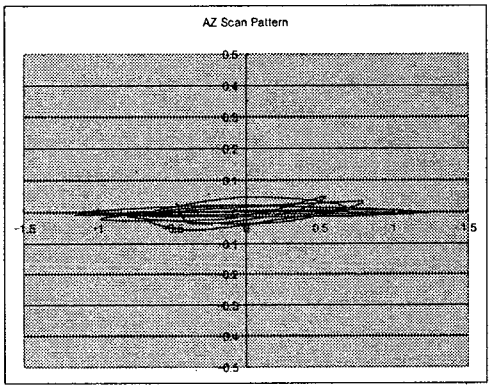

Figure 2. Azimuth scan pattern

3.2 Raster Scan

In this mode antenna is looking for a signal from upper right to bottom of left. But while operation with this mode antenna makes a serious vibration and it can cause a problem or damage to antenna system. Also like this vibration affect moving of the antenna therefore antenna system should be carefully used. Table 2 and Figure 2 describe the raster scan parameter and graph of real tracks.

Table 2. Raster scan parameter

Angle	1.0	deg
Width	1.0	deg
Height	1.0	deg
Step size	0.4	deg
Rate	3.0	deg /sec

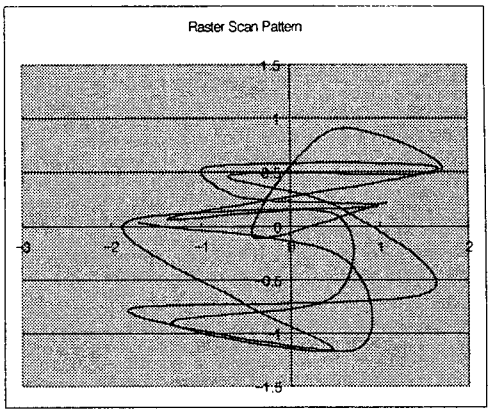

Figure 3. Raster scan pattern

3.3 Spiral Scan

Spiral scan is moving like a helical curve and try to find a satellite signal while is operation and the system automatically enters AUTOTRACK mode when target signal strength exceeds preset threshold value.

Table 3. Spiral scan parameter

Size	2.0	deg
Step Size	0.5	deg
Rate	1.0	deg/sec

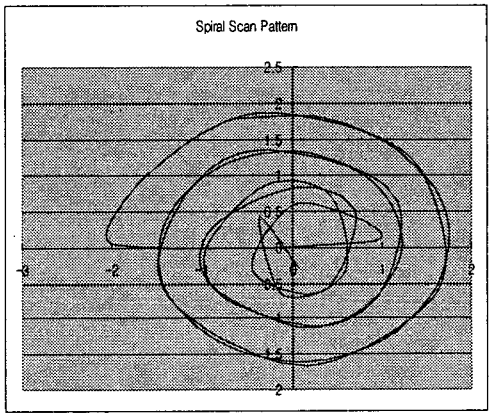

Figure 4. Spiral scan pattern

4. SPIRAL SCAN OPERATION

4.1 Set Frequency

The frequency of target signal must be set to 700MR track receivers prior to antenna move. If target frequency does not be set to track receivers then the AUTOTRACK might be failed even if target signal strength exceeds preset threshold value.

4.2 Add time offset and scan selection

Time off set has been added by +30seconds on the GSC to sufficiently cope with worst case separation from launcher. If antenna starts to track the satellite then select to spiral scan and add time off set by -1 or -2seconds and repeat it until to find a signal. If antenna receives a target signal then operation mode will be changed into

AUOTRACK and keep going on until to loss of signal and GSC writes a track result with an angles. This log file will be used to orbit determine for the next passes.

4.3 Procedures Summary

1) Set the target frequency to track receivers
2) Add time offset by a few seconds (ex. +30secs)
3) Wait until the antenna moves to track the satellite
4) Select spiral scan or any wanted scan modes
5) Add back off time offset by -1 or -2 seconds
6) Repeat step 5 until to receive a target signal
7) If antenna receives a target signal then track mode will be automatically changed to AUTOTRACK from scan mode.
8) GSC writes a log file with angles after pass.

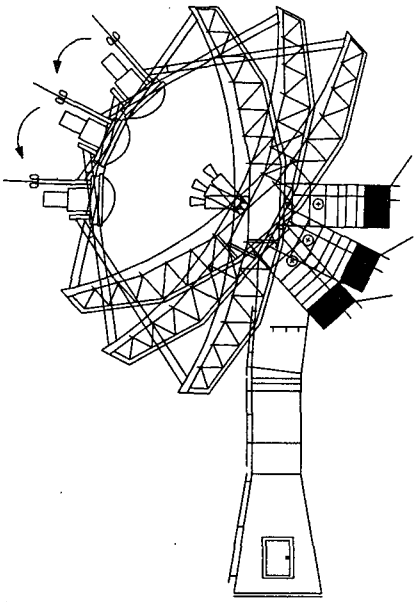

Figure 5. Back off time offset

4.4 Result of test pass with spiral scan

Table 4 came from a part of log file after pass with spiral scan and describes well about the result. +30 seconds time offset was added as soon as the antenna went to set up position and spiral scan was selected as soon as the antenna moved to track the satellite. And add back off the time offset by -1 second at every second and repeat it. The antenna system got a target signal less then 1min 12seconds and tracked the satellite automatically. Figure 6 and 7 are trace graph while antenna is scanning the target signal and Table 5 is parameter of scan status.

Table 4. Log file after LOS

Time	EL Angle	AZ Angle	Time Offset	Scan Mode
13:13:43	1.28	35.273	30	0
13:13:43	1.324	35.36	30	0
13:13:44	1.361	35.439	30	0
13:13:46	1.414	35.546	30	0
...	...	...	...	...
13:14:14	2.709	38.203	30	0
13:14:14	2.748	38.283	30	0
13:14:16	2.806	38.403	30	0
13:14:16	2.845	38.485	30	0
13:14:18	2.903	38.606	30	0
13:14:18	2.943	38.687	30	0
13:14:20	3.002	38.81	30	3
13:14:20	3.041	38.89	30	3
13:14:22	3.1	39.014	30	3
13:14:22	3.091	38.995	29	3
13:14:24	3.1	39.015	29	3
13:14:24	3.14	39.098	29	3
13:14:26	3.15	39.119	29	3
13:14:26	3.14	39.098	29	3
13:14:28	3.15	39.118	25	3
...	...	...	...	...
13:15:19	3.994	40.916	-9	3
13:15:20	4.056	41.05	-9	3
13:15:21	4.097	41.139	-9	3
13:15:22	4.158	41.272	-9	3
13:15:23	4.148	41.25	-9	3
13:15:24	4.209	41.384	-10	3
13:15:25	4.25	41.473	-10	3
13:15:26	4.312	41.61	-10	3
13:15:27	4.353	41.7	-10	3
13:15:28	4.415	41.835	-10	3
13:15:29	4.456	41.927	-10	3
13:15:30	4.518	42.065	-10	3
13:15:31	4.467	41.95	-10	3
13:15:32	4.456	41.927	-10	3
13:15:33	4.416	41.837	-10	0
13:15:34	4.457	41.928	-10	0
13:15:35	4.467	41.951	-16	0
13:15:36	4.509	42.043	-16	0
13:15:37	4.519	42.066	-16	0
13:15:38	4.56	42.158	-16	0
13:15:39	4.622	42.296	-17	0
...	...	...	...	...

Table 5. Parameter of scan status

SCAN STATUS	5	
SELECTED SCAN	0-4	NONE / RASTER / AZ / SPIRAL
SCAN GO/HALT	0,1	GO / HALT
AZ SCAN OFFSET	deg	
EL SCAN OFFSET	deg	

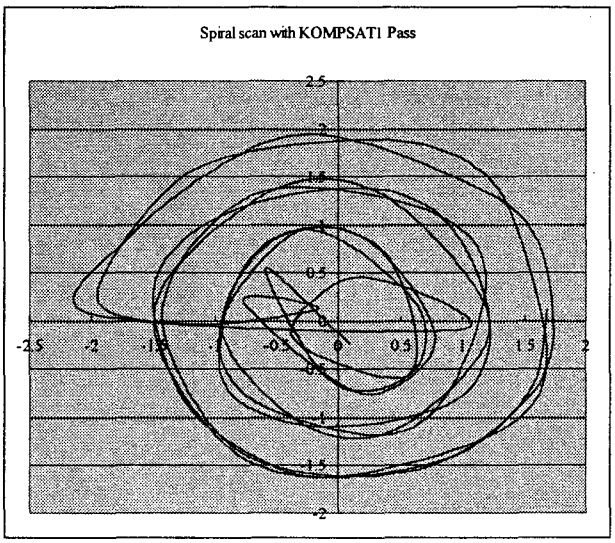

Figure 6. Spiral Scan with KOMPSAT1

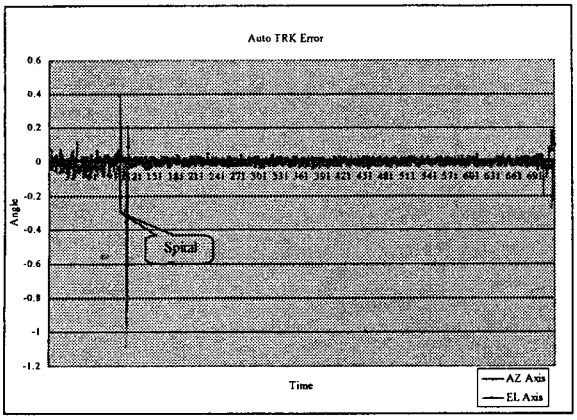

Figure 7. Auto Track Error in AZ & EL axes

5. CONCULSTION

Azimuth scan, raster scan and spiral scan functions were tested with KOMPSAT1 under intentionally severely degraded orbital information for antenna operation. Through tests, spiral scan function was decided to be best search scan among 3 scans. Developed procedure can assure the successful acquisition only if azimuth offset and time offset value are within +/-2deg and +/-30sec, respectively.

During this test the target signal can be detected by spiral scan less then 1 minute under orbital information that was intentionally added with additional time offset. And we'll expect that detect time can be reduce by repeating practice to use this function.