RESULTS OF TARGET ACQUISITION TESTS; FEBRUARY, 1987

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ABSTRACT

FOS Binary Search and Firmware Target Acquisition was tested under the newest (3.9) version of flight software at LMSC. All corrections of the previous version of flight software TA were verified, and no new bugs were discovered.

The target acquisitions were simulated by illuminating the science apertures with the blue LEDs in the same way that aperture acquisitions will be done in flight. The largest errors were 16% of the aperture size in the Y direction, and about 30% of the aperture size in X. These errors are due to the non-uniformity of the illumination from the LEDs, and the large size of the science apertures, and are satisfactory.

INTRODUCTION

The Mode 2 target acquisition tests at Lockheed Missile and Space Company were run under the new flight software, version 3.9. Binary Search and Firmware acquisitions were interwoven in the test without any problems. Except for one pause due to an incorrect wait-time when loading a new version of RTCS 87, the test ran without interruption. The problems encountered were minor; cases 6 and 18 were incorrect because too few lines per frame were alloted; cases 8 and 9 were incorrect due to the starting YBASE values used in the Firmware map. The results of the acquisitions are discussed below and summarized in Table 1.

DISCUSSION

The positions found by Binary Search or by Firmware TA are compared here to positions found by mapping the aperture in a fine map. A discussion of accuracy is limited by the accuracy of that map. Two factors make the positions difficult to determine; the apertures are large compared to a point source and; they are illuminated non-uniformly by the LEDs.

The most important results are for the acquisitions done on the 0.″1-pair aperture. Acquisitions of the 0.″1 aperture illuminated by the LEDs will be done regularly in flight because of the floppiness of the grating wheel. We are aiming for accuracies of several microns, because the 0.″1 aperture is 14 microns large.

The X positions for Binary Search are more negative than for Firmware, or for the aperture maps. That is because Binary Search finds X positions by doing a weighted mean over many points (13 in this case, where the number depends on the value of XSTEP). Since the LED apertures are all brighter at low XBASE values, as demonstrated in Figure

1, this affects the weighted mean for Binary Search. In this case the resulting X value is more negative. Firmware fits the center 3 values of the peak to an isosceles triangle, so the extended region of a target does not have as much influence. To rephrase this, Binary Search does a weighted average over many data elements when finding an X position, while Firmware fits only the central data elements without reference to the extended elements.

The Y positions for the 0".1 TAs agree very well with the Y position for the aperture map, with most δ's less than 2.5 microns. There were several exceptions to this; cases 6, 9, 11, and 18. Cases 6 and 18 were incorrect because too few lines per frame were alloted for the data. This error is easy to make since the calculation for number of lines per frame needed must include 1 line for the engineering header. That line was left out here so that when the data were transmitted, it included one line of engineering header, and two lines of data instead of three lines of data. The third line of data as viewed in the plots was old data, not related to the TA. There is some concern that this error will crop up easily in the SOGS/PASS generated command loads unless there is an automatic check of lines per frame.

Cases 9 and 11 were incorrect because of the start value of YBASE for the Firmware map. Firmware identifies a targets position by looking for the edge as the target is mapped onto the diode. For cases 9 and 11 the target was already partially or fully in the diode at the beginning of the map. Case 9 is just a little off, but case 11 failed altogether because the aperture was fully in the diode at the beginning of the map. This error came about because we were varying the YBASE values for the test cases, and used some wrong values. In an actual Firmware acquisition, this error would not occur because the whole large aperture would be mapped.

The Y positions do not show a systematic difference between Binary Search and

Firmware.

SUMMARY

Tests of binary search target acquisition with version 3.9 of the flight software were done at LMSC in February of 1987. The test was run straight through without any procedural errors, and a re-run was not necessary. Also, Binary Search and Firmware acquisitions were interwoven during the test without any problems. The resulting X and Y positions reflect the different algorithms used in Binary Search and Firmware for centroiding on a peak.

The positions for the acquisitions of the 0.″1 aperture show errors of several microns. The errors are caused at least in part by the non-uniform illumination of the aperture by the LEDs. The 0.″1 aperture is about 14 microns across so we want to know its position to within several microns to center targets in it. These tests show that we can expect to achieve that accuracy. For point sources, acquisition is expected to be even more accurate.

Table 1

Positions of Apertures as found by FOS TA

Case	Test	Aperture	X Position XBASE units	δ X microns	Y Position YBASE units	δ Y microns
1	BS TA	0.″1-PAIR	-599.8	5.2	-771	2.3
2	FW TA	0.″1-PAIR	-597	0.8	-766	1.6
3	**Map**	0.″3	**-600**		**-499**	
4	FW TA	0.″3	-596	6.2	-497	1.6
5	BS TA	0.″3	-596.8	5.0	-504	-3.1
6	FW AA	1.″0	-600	0.0	-513	-11.7
7	BS AA	1.″0	-603.5	-5.5	-500	-0.8
8	**Map**	**0.″1-PAIR**	**-596.5**		**-768**	
9	FW TA	0.″1-PAIR	-599	-3.9	-761	5.5
10	FW TA	0.″1-PAIR	-597	-0.4	-771	-2.3
11	FW TA	0.″1-PAIR	*	*	*	*
12	FW TA	0.″1-PAIR	-597	-0.4	-771	-2.3
13	BS TA	0.″1-PAIR	-598.9	-3.9	-770	-1.6
14	BS TA	0.″1-PAIR	-598.7	-3.4	-770	-1.6
15	BS TA	0.″1-PAIR	-599.3	-4.2	-770	-1.6
16	BS TA	0.″1-PAIR	-598.7	-3.4	-769	-0.8
17	**Map**	**0.″1-PAIR**	**-596.5**		**-768**	
18	FW TA	1.″0-PAIR	-604	-11.7	-777	-7.0
19	BS TA	1.″0-PAIR	-608.5	-18.8	-761	-5.5

The X positions are measured from the center of diode 256, which is the convention for Firmware. The Y positions are measured from the start YBASE position. The deltas (δ) give the offset from the central position of the 0.″3 map for the 0.″3 and 1.″0 TAs, and from the 0.″1-pair maps for the 0.″1-pair and the 1.″0-pair TAs. BS = Binary Search. FW = Firmware. AA = aperture acquisition. TA = target acquisition. *: Firmware failed because of start YBASE; see text.

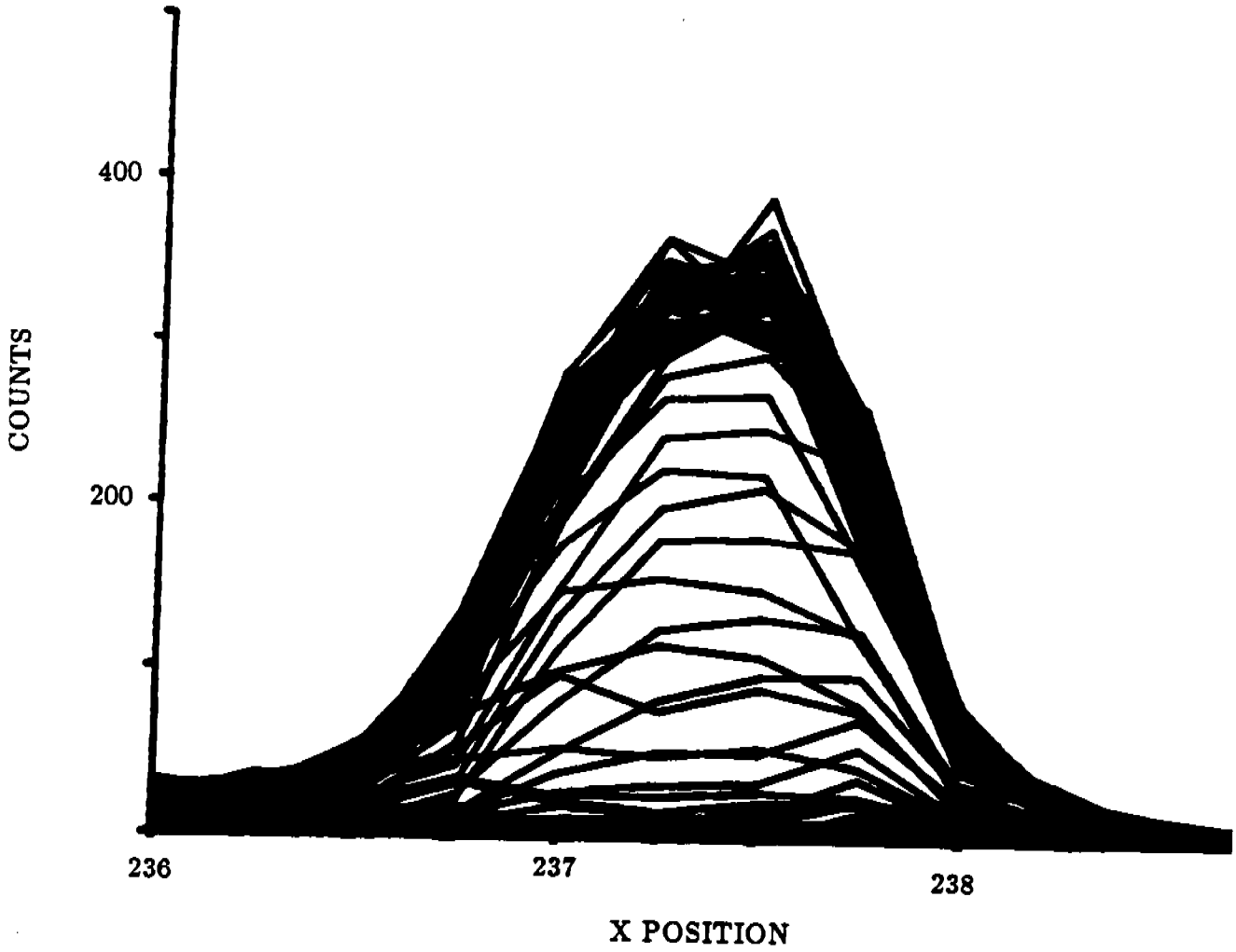

Figure 1: Counts versus X position in XBASE units for a map of A4L aperture. The 64 Y steps are all plotted on the same scale. Note that there is extended emission from the low side, and that the emission in the center is not symmetrical.