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Houston, Texas 77058

IN REPLY REFER TO: 70-PM-113

MAY 25 1970

MEMORANDUM TO: See attached list

FROM : FMS/Chief, Lunar Mission Analysis Branch

SUBJECT : Corrections to the flyby options of the RTCC Midcourse Correction Processor as specified in Internal Note No. 70-PM-11

The three flyby options use similar logic for the first five steps of each option. Option B, the EPS lunar flyby, will be used as an example; but the changes indicated apply to each option. These changes have been coordinated with Flight Software Branch and IBM.

Ronald L. Berry

APPROVED BY:

John A. Mayer  
Chief, Mission Planning  
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

  
James C. Stokes, Jr., Chief  
Flight Software Branch

Enclosure

Addressee:  
(See attached list)

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1. Type of Document  
Change sheet to Internal Note2. Identification YO-PM-11 dated  
February 6, 1970Page 1 of 1 Pages

TO:

3. FROM:  
Division Mission Planning and Analysis  
Branch Lunar Mission Analysis  
Section4. Title or Subject MSC REQUIREMENTS FOR APOLLO 14: LUNAR  
FLYBY MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCEDUREDate of Paper  
May 25, 1970

5. Author(s)

Kenneth T. Eiler and Quentin A. Holmes

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## CHANGE HISTORY FOR 70-PM-11

Change no.	Date	Description
1	5/25/70	<p>Page 7: pen-and-ink change to correct typographical error.</p> <p>Pages 8 and 9, 14 and 15, 21 and 22: changed steps because of misordering.</p> <ol style="list-style-type: none"> <li>a. Delete the call to integrated TIME immediately preceding step 3.</li> <li>b. Step 3 should be a conic instead of an integrated flyby.</li> <li>c. First-guess values come from step 1 instead of TIME in step 3.</li> <li>d. Delete integrated maneuver storage immediately after step 3.</li> <li>e. Insert a call to integrated TIME immediately before step 4.</li> <li>f. Step 4 should be an integrated instead of a conic flyby.</li> <li>g. First-guess values in step 4 come from TIME instead of step 2.</li> <li>h. Store the integrated maneuver (deleted on pages 8, 14, and 21) immediately after step 4.</li> <li>i. Step 5 executes a conic flyby to the same inclination of free return and height as step 4.</li> <li>j. First guess values for step 5 come from step 3 not step 4.</li> <li>k. Converged value of INCL OF FREE RETURN should read "CONV. VALUE FROM STEP 4 ± .01°".</li> </ol> <p>Page 17: pen-and-ink change to correct error in step 6.</p> <p>Page 18: pen-and-ink change to show program modification to step 8.</p> <p>Pages 13 and 20: HEIGHT of PERILUNE in block that reads SCALE WEIGHT OF PERILUNE FOR TIME.</p>

CHANGE SHEET


FOR


MSC INTERNAL NOTE 70-PM-11 DATED FEBRUARY 6, 1970  
HTCC REQUIREMENTS FOR APOLLO 14: LUNAR FLYBY MODES  
OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

By Kenneth T. Zeiler and Quentin A. Holmes

Change 1

May 25, 1970

  
\_\_\_\_\_  
Ronald L. Berry, Chief  
Lunar Mission Analysis Branch

  
\_\_\_\_\_  
for John P. Mayer, Chief  
Mission Planning and Analysis Division

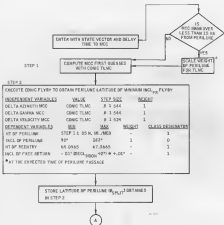
Page 1 of 13  
(with enclosures)

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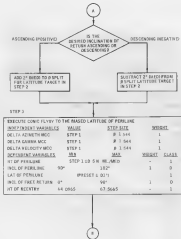
NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacement pages, have been inserted and after the following pen-and-ink changes have been made, insert this CHANGE SHEET between the cover and the title page and write on the cover, "CHANGE 1 inserted".

1. Page 7: change WEIGHT to HEIGHT in the block that reads "SCALE WEIGHT OF PERILUNE FOR TIME".
2. Page 17: Step 6 - The dependent variable HT OF PERILUNE has no weight and is class 1.
3. Page 18: Step 8 - The dependent variable INCL OF FREE RETURN should have a MIN of  $-1^\circ$  and a MAX of  $+1^\circ$  instead of  $\pm 01^\circ$ .



<sup>1</sup>To determine minimum glide height from perilune when 15 ft or greater lower, the total height of perilune in TLMC and the last three steps of each flyby pattern are scaled according to the time of the maneuver. Between TLJ and subline minus 15 ft, the height of the nearest TLJ perilune is entered as TLMC. From perilune minus 15 ft to subline arrival, the total height decreases linearly from the TLJ target value to 80 ft, in



B

COMPLETE MCC FIRST GUESSES WITH  
INTEGRATED TLRC USING RAISED  
LATITUDE OF PERILUNE

STEP 4

EXECUTE INTEGRATED FLYBY TO THE SAME LATITUDE OF PERILUNE AS STEP 3

INDEPENDENT VARIABLES	VALUE	STEP SIZE	HEIGHT
DELTA ADMITT MCC	TLRC	$\theta$ 1.544	1
DELTA GAMMA MCC	TLRC	$\theta$ 1.544	1
DELTA VELOCITY MCC	TLRC	$\theta$ 1.524	1
DEPENDENT VARIABLES	MIN	MAX	WEIGHT CLASS
HT OF PERILUNE	STEP 1.00 5 W. W. MED		- 1
INCL OF PERILUNE	90°	180°	1 0
LAT OF PERILUNE	SAME AS STEP 31		- 1
INCL OF FREE RETURN	0°	90°	1 0
HT OF REENTRY	64.2965	67.3460	- 1

STORE INTEGRATED STATE VECTOR  
( $\Delta \dot{L}_1, \Delta \dot{L}_2, \Delta \dot{L}_3$ )

STEP 5

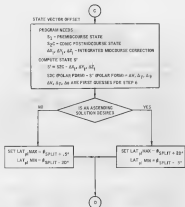
EXECUTE SONIC FLYBY TO SAME INCL OF FREE RETURN AND HEIGHT AS STEP 4

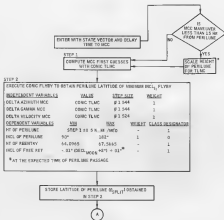
INDEPENDENT VARIABLES	VALUE	STEP SIZE	HEIGHT
DELTA ADMITT MCC	STEP 5	$\theta$ 1.544	1
DELTA GAMMA MCC	STEP 5	$\theta$ 1.544	1
DELTA VELOCITY MCC	STEP 5	$\theta$ 1.524	1
DEPENDENT VARIABLES	MIN	MAX	WEIGHT CLASS
HT OF PERILUNE	STEP 1.00 5 N. M. MED		- 1
INCL OF PERILUNE	90°	180°	1 0
INCL OF FREE RETURN	SCW VALUE FROM STEP 4 1.00°		- 1
HT OF REENTRY	64.2965	67.3465	- 1

STORE PREMANOEUVRE STATE (S1) AND POSTMANOEUVRE  
STATE (S2)

C







The minimum measured between perline and 1.5 hr to perline arrival, the total height of perline for TLMC and the time three days of each flyby are scaled according to the size of the maneuver. Between TLJ and perline about 1.5 hr, the height of the arrival TLJ perline is related to TLMC. From perline about 1.5 hr to perline arrival, the total height drops linearly from the TLJ target value to 63 hr. hr.

4

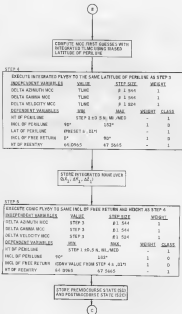
ADD 2" GPP TO  $\phi$  TRIT  
FOR LATITUDE TARGET  
IN STEP 2

## STEP 2

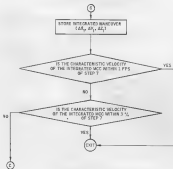
EXECUTE CONC PLAN TO THE BASED LATITUDE OF PERLUNG

<u>INDEPENDENT VARIABLES</u>	<u>VALUE</u>	<u>STEP SIZE</u>	<u>MIN</u>	<u>MAX</u>
DELTA ALPHA MCC	STEP 2	0 1.544		1
DELTA GAMMA MCC	STEP 1	0 1.544		1
DELTA VELOCITY MCC	STEP 1	0 1.944		1
<u>DEPENDENT VARIABLES</u>	<u>MIN</u>	<u>MAX</u>	<u>HEIGHT</u>	<u>CLASS</u>
HT OF PERLUNG	STEP 1 OR 2 IN. ME/WTS		-	3
INCL OF PERLUNG	90°	180°	1	0
LAT OF PERLUNG	PHISET ± 60°		-	3
INCL OF FREE RETURN	0°	90°	1	0
HT OF REENTRY	40 0000	67,5645	-	1

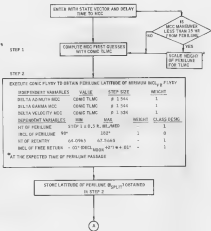
5





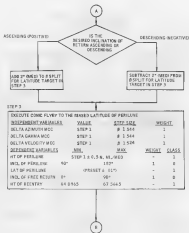


Flow chart 2 - Optimal Line Ratio - Continued.



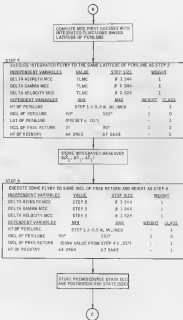
<sup>1</sup>For maximum clearance performed from perilene status 1.5 ft to perilene level, the step height of sections for TLRC and the first three steps of each flight path are scaled according to the line of the maximum. Between TLRC and perilene minus 1.5 ft, the height of the normal TLRC sections is added to TLRC. From perilene minus 1.5 ft to perilene level, the total height drops linearly from the TLRC step value to 0 ft. 0 ft.

Flow chart 3.- Optimal ACS flight to a required inclination of free return.



Flow chart 3.- Optimized RCS Flyby to a desired inclination  
of the return - Continuum.





Flow chart 2. - Determine RCS flyby to a desired collection  
of free return - Continued.

Change 1, May 20, 1970  
1044-000