

TO: J. Scott (6) June 21, 1962

FROM: V. Clarke

SUBJECT: Interplanetary Round-Trip Program

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I. INTRODUCTION

This RFP is to request two basic actions by Section 372.

- (1) Make Mike Minovich Round-Trip Interplanetary Trajectory Program operational on the JPL 7090 with minimum modification.
  - (2) Follow up action (1) by modifying the program as necessary to meet Section 372 standards and systems requirements.
- Also, modify output as specified below.

II. OUTPUT FORMAT

EARTH-VENUS-MARS-EARTH

LAUNCH DATE

ARRIVAL DATE

TFT	ECA	C3	VEL	DLA	RAL
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FIRST LEG

INTERCEPT DATE

HELIOCENTRIC

TF	RL	RP	ECA	SMA	ECC
RC	TAL	TAP	IVC	LAL	LAP
LOL	LOP	VL	GAL	VP	GAP
V1	V2	RCA	APO	GL	ZAL

PLANETOCENTRIC

VPL	DPA	RAP	RCA	GPI	ZAI
C3	BT	BR	B	ECC	INC
TRN	VCA	GPO	ZAO		

SECOND LEG

INTERCEPT DATE

HELIOCENTRIC

TF	RP	HCA	SMA	ECC	RC
TAP	INC	LAP	LOP	VP	GAP
V2	RCA	APG			

PLANETOCENTRIC

VPL	DPA	RAP	RCA	GPI	ZAI
C3	BT	BR	B	ECC	INC
TRN	VCA	GPO	ZAO		

FINAL LEG

ARRIVAL DATE

TF	RP	HCA	SMA	ECC	RC
TAP	INC	LAP	LOP	VP	GAP
V2	RCA	APG			

PLANETOCENTRIC

VE	DA	RA	C3	GPI	ZAI
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III. EXPLANATION OF PRINTOUT FORMAT

1. On the first line print a header giving first the launch planet, then the intercept planets, and finally the arrival planet.

2. Print the launch date and the arrival date at the final planet.

3. On the third line print

TFT - the total trip time in days

HCA - the total heliocentric central angle in degrees

C3 - the vis viva energy of the launch planet conic  
in km/sec.

VHL - the hyperbolic-excess speed of the launch planet  
conic in km/sec.

DLA - the declination of the outgoing asymptote of the  
launch planet conic

RAL - the right ascension of the outgoing asymptote of  
the launch planet conic

Next is a two-group print giving first the heliocentric quantities of the first leg of flight from launch planet to the first intercept planet. Print the words **FIRST LEG** followed by the date of intercepting the first planet.

In the **HELIOCENTRIC** group print

Line 1

TF - the launch to first intercept time in days

RL - the heliocentric radius of the launch planet  
on the launch date in millions of km

RF - the heliocentric radius of the first intercept  
planet on the intercept date in millions of km

HCA - the heliocentric angle between the launch planet  
on the launch date and the first intercept planet  
on the intercept date in degrees

SMA - the semi-major axis of the first leg heliocentric  
transfer ellipse in millions of km

ECC - the eccentricity of the first leg heliocentric  
transfer ellipse

Line 2

- RC - the Earth-first intercept planet distance in millions of km
- TAL - the true anomaly at launch in the first leg heliocentric transfer ellipse
- INC - the inclination to the ecliptic of the first leg heliocentric transfer ellipse
- LAL - the celestial latitude of the launch planet at launch time
- LAP - the celestial latitude of the first intercept planet at intercept time in degrees

Line 3

- LOL - the celestial longitude of the launch planet at launch time in degrees
- LOP - the celestial longitude of the first intercept planet at intercept time in degrees
- VL - the heliocentric speed of the probe at launch time in km/sec.
- GAL - the path angle of  $\bar{V}_L$
- VP - the heliocentric speed of the probe at intercept time in km/sec.
- GAP - the path angle of  $\bar{V}_P$

Line 4

- V1 - the heliocentric speed of the launch planet at launch time in km/sec.
- V2 - the heliocentric speed of the first intercept planet at intercept time in km/sec.

- RCA - the perihelion distance of the first leg transfer ellipse in millions of km
- APO - the aphelion distance of the first leg transfer ellipse in millions of km
- GL - the angle between the launch hyperbolic-excess velocity vector and the launch planet's orbital plane at launch time
- ZAL - the angle between the outgoing launch asymptote and the Sun-launch planet line

In the ~~PLANETOCENTRIC~~ group print

Line 1

- VPL - the hyperbolic-excess relative to the first intercept planet in km/sec.
- DPA - the declination of the incoming asymptote of the first intercept planet conic
- RAP - the right ascension of the incoming asymptote of the first intercept planet conic
- RCA - the distance of closest approach to the first intercept planet's center in km
- GPI - the angle between the incoming asymptote of the first intercept planet conic and the first intercept planet's orbital plane
- ZAI - the angle between the incoming asymptote of the first intercept planet conic and the Sun-first intercept planet line

Line 2

- C<sub>3</sub> - the vis viva energy of the first intercept planet conic in km<sup>2</sup>/sec<sup>2</sup>

- BT - the  $\bar{T}$  component of the impact parameter  $\bar{B}$ , or  $\bar{B} \cdot \bar{T}$   
where  $\bar{T}$  lies in the ecliptic plane, of the first  
intercept planet conic
- BR -  $\bar{B} \cdot \bar{R}$  where  $\bar{R} = \bar{S} \times \bar{T}$ , and  $\bar{S}$  is the incoming asymptote  
of the first intercept planet conic
- B -  $\bar{B}$ , the magnitude of the impact parameter of the  
first intercept planet conic
- ECC - the eccentricity of the first intercept planet conic
- INC - the inclination to the ecliptic of the first inter-  
cept planet conic

Line 3

- TRN - the turn or deflection angle or angle between the  
incoming and outgoing asymptotes of the first inter-  
cept planet conic
- VCA - the speed at closest approach to the first intercept  
planet
- GPO - the angle between the outgoing asymptote of the first  
intercept planet conic and the first intercept planet's  
orbital plane
- ZAO - the angle between the outgoing asymptote of the first  
intercept planet conic and the Sun-first intercept  
planet line

Next print the HELIOCENTRIC quantities of the conic leg from  
the first to the second intercept and the PLANETOCENTRIC quantities of the  
second intercept conic. They are defined the same as above. Note that  
quantities relative to the first intercept have been deleted from the  
SECOND LEG groups.

Next print the HELIOCENTRIC and PLANETOCENTRIC quantities of all other intermediate legs using the same format as SECOND LEG.

Next print the FINAL LEG groups. Note the deletion of certain quantities caused by the fact that the final leg is a direct hit.

Print in fixed point on 8 1/2 x 11 paper using the same practice as the heliocentric conic program.

VCC:blv