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Brief 68-10033

NASA TECH BRIEF

Computer Program for Interplanetary Conic Patching

A computer program has been designed that makes possible the study of one-way transfers, single planet flybys, double planet flybys, single planet stopovers, double planet stopovers, or mixed flyby and stopover trajectories.

This program is capable of the rapid calculation of interplanetary trajectories applicable to parametric studies. One such trajectory is the one-way transfer whose parameters are useful either as approximations for inputting to high accuracy trajectory programs which use numerical integration schemes or as figures of merit for one-way transfers of the Mariner type. The program can also use the gravitational influence of a planet during planetary passage to alter the probe's trajectory about the sun to insure interception with a selected target. Missions of this latter type are referred to in this program as "flybys". It is possible through judicious use of such maneuvers to obtain significant reductions in the incremental velocity requirements compared to those associated with direct transfers. The program can also calculate the velocity change needed to put the vehicle into a specified orbit about a planet for a preselected time, with such orbital stops referred to as "stopovers". An option also exists allowing broken leg maneuvers to be performed whenever a transfer plane becomes excessively inclined to a planetary ecliptic. For all trajectories the program uses the relevant velocity increments to calculate the weight needed in orbit at the start of each leg. Trajectories whose incremental velocities exceed the associated input limits will be rejected by the program. It can also calculate the weights associated with these missions.

In all modes of operation this program first computes the heliocentric conic which connects the centers of the launch and target planets and requires a given trip time. This calculation is performed by making use of an extension of Lambert's theorem. That theorem, first formulated in 1761, states: "The transfer time between any two points on an ellipse is a function of the sum of the distances of each point from the focus, the distance between the points, and the semimajor axis of the ellipse." Functionally, this is expressed as $t = t(r_L + r_t, c, a)$, where r_L is the radius to the launch planet from the focus measured at the time of launch, r_t is the radius to the target planet measured at the time of arrival, c is the distance between the two planets, and a is the semimajor axis of an ellipse connecting the two points and requiring trip time t.

Notes:

1. This program is written in Fortran IV and MAP for use on the IBM 7094 computer.
2. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10033

Patent status:

No patent action is contemplated by NASA.

Source: D. A. Davis and D. G. Gussow
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