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NASA TECH BRIEF
Goddard Space Flight Center

Interplanetary Trajectories, Encke Method (ITEM)

The problem:

To compute with maximum accuracy and efficiency a variety of interplanetary trajectory problems.

The solution:

The Encke method has been shown to require minimum time in trajectory computation with minimum loss of accuracy. The ITEM program has been developed using an improved variation of the Encke method which avoids accumulation of round-off errors and avoids numerical ambiguities arising from near-circular orbits of low inclination.

How it's done:

ITEM trajectory computation consists of two parts, the exact solution to the Kepler two-body problem, and integrated additions to this solution which account for perturbation effects.

Since perturbations only are integrated, the allowable integration interval is fairly large over most of the path. Even in the vicinity of the Earth, or another planet, a relatively large interval (compared to other schemes) may be used without limiting stability or accuracy of the solution.

Round-off errors are controlled by keeping perturbation displacement small. The two-body orbit is rectified whenever the perturbations exceed a specified maximum value established by comparison with the corresponding unperturbed value. Further, the reference body is changed as necessary, with the Earth, another planet or the Sun selected as the reference body whenever that body would otherwise contribute the largest perturbing force.

Numerical ambiguities, such as would be introduced by circular orbits or zero inclination, are avoided by defining the problem in terms of parameters which have real physical significance (position and velocity vectors) directly related to measurable quantities.

Flexibility is provided by means of numerous options available to the user through a detailed system of control cards which can be selected in adapting the program to wide variations in problem type and complexity. In addition, a subroutine, MODIF, permits the user to modify program parameters which normally are constant.

Notes:

1. This program is written in FORTRAN IV to be utilized by the IBM-360 computer.
2. Inquiries concerning this program should be directed to:

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   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: GSC-11576

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