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Brief 71-10390

NASA TECH BRIEF

NASA Pasadena Office

Double Precision Trajectory Program (DPTRAJ 2.2C)

The problem:

To compute the precise trajectory of a space probe moving in the solar system and subject to a variety of forces.

The solution:

A generalized high precision trajectory program for mission use and research.

How it's done:

The differential equations of motion of the space probe are integrated by a second-sum numerical integration scheme relative to some central body (Cowell method). The equations are solved for the probe only, ignoring the negligible perturbations of the probe on the sun and planetary and lunar bodies. Hence, it is sufficient to obtain positions and velocities of the bodies in the form of planetary and lunar ephemerides in some convenient reference frame. The coordinates have been traditionally referred to the Cartesian system based on the Earth mean equator and equinox of 1950.0. To obtain information about the probe or any of the bodies in some other reference frame, an appropriate transformation must be applied to the 1950.0 frame.

Upon integration of the equations of motion, the following information is available: a probe ephemeris; planetary and lunar ephemerides; a list of events involving the probe (such as closest approach to a certain body, attainment of a given distance from some body, etc.); and a list of epochs.

Due to its size, the program was written in four parts called links: ODIN, TRIC, PATH, and POST. Each link consists of a primary subroutine and a series of secondary subroutines. Transfer between secondary subroutines within each link is automatic. Transfer between links requires a return to the main program. Each link accepts input from either external sources or other links, performs its portion of the problem, and outputs its results to the user or to subsequent links.

ODIN sets up the arrays of nominal parameter values used by the program. TRIC performs any required coordinate transformations. Its major function is to convert the initial input conditions to Cartesian coordinates in the Earth mean equation and equinox of 1950.0 system for link PATH. An extensive set of transformations is available for this purpose. TRIC may also be used as a separate option, resulting in printed output of the transformed coordinates in a specified system.

PATH numerically integrates the equations of motion. Inputs to PATH are the double-precision planetary ephemeris, the ODIN user inputs, and the probe injection conditions obtained either by TRIC or by user input. Outputs include the probe ephemeris file and a file containing end-of-step information. POST produces the printed output for the main program. Inputs to POST are the double-precision planetary ephemeris, the PATH-generated probe ephemeris, and the ODIN user inputs. The output is a printed history of the probe trajectory, with the level of detail being specified by the user.

A control program interprets the user's request and calls in the links in the proper order for execution. Options permit any combination of the four links, and each link may be executed more than once, if desired.

The programmer's Reference Manual consists of seven volumes:

Volume I - Design and implementation of models
Volume II - Link ODIN
Volume III - Link TRIC

(continued overleaf)

Volume IV - Link PATH
Volume V - Link POST
Volume VI - User's guide
Volume VII - Technical Memorandum 33-451

Notes:

1. This program is written in FORTRAN V for use on the UNIVAC-1108 Exec 8 Computer.
2. Requests for further information may be directed to:

   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B71-10390

Patent status:

No patent action is contemplated by NASA.

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