# NASA TECH BRIEF



## Computer Program for Mass Optional Solutions of Some Endpoint Trajectory Problems

The calculation of trajectories is required for a variety of orbital problems such as orbit transfer, rendezvous, lunar transfer, and lunar launch. In all cases optimization of trajectories for minimal propellant consumption is a prime concern. This program incorporates the coast arc device into a three-dimensional fixed end-point steepest ascent computer program. There is no restriction on the magnitude of thrust or on initial or final orbit characteristics. The initial conditions and desired terminal conditions of a transfer trajectory can be specified in conventional orbital elements or in spherical coordinates.

The equations of motion are evaluated in spherical coordinates whatever the form of the input. Hence, the program actually calculates a trajectory between any two points in space defined by initial and final position vectors. The corresponding end point velocities are equally arbitrary. Problems can be handled which, on the surface, do not appear to fall within the orbit transfer category.

The problem of thrusting flight in a vacuum in the presence of two-body forces only is formulated in the calculus of variations and solved by the method of steepest ascent. Optimal thrust directions and thrust durations are found for a variety of orbital transfer problems in two or three dimensions. Constant thrust and specific impulse are assumed.

**Notes:**

1. The program can be used on either the IBM 7094 or SRU 1107 and has been written in Fortran IV language.
2. Aerospace, missiles, ballistics, physics, and geology have some general similarity in flight problems, either of projectiles or particles, to which this program is applicable. Also this technique could be of value in other isolation techniques such as the calculus of variation or Newton–Raphson.
3. Inquiries concerning this program may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10310

**Patent status:**

No patent action is contemplated by NASA.

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