October 1971

Brief 71-10376

NASA TECH BRIEF

Marshall Space Flight Center

New Procedure for Determining Minimum Time Orbit Transfers

The problem:

To determine the minimum time for orbital transfer in a central force field when a fixed amount of propellant is available.

The solution:

The Minimum Time Orbit Transfer Program, which includes the time-minimizing function required for the propellant-constrained minimum time impulsive transfer between orbits.

How it's done:

The program considers transfers between coplanar circular orbits or unrestricted orbits. The total velocity change from orbit to orbit is defined, and the minimum time required for the given propellant constraint is derived. The different propellant constraints lead to the three basic operational modes. In mode one, only a single velocity change is allowed, enabling the minimum time intercepts between orbits to be calculated. In mode two, two impulses are assumed, and the sum of these impulses is limited to a preselected value. Modes one and two, then, are dependent upon a single parameter search. In mode three, the configuration of the vehicle is assumed known, and the analytical solution for elliptic and hyperbolic transfers can be derived.

Lambert's theorem provides the relationship needed for determining the transfer times associated with those trajectories which can link two orbits in all three modes.

When the program is used without the minimization procedure, all possible propellant constrained trajectories are generated. Through mode three, vehicular sizing may be explored. In addition, the basic formulation may be easily extended to include inclined circular orbits or inclined elliptic orbits. In such cases, there is an appreciable increase in the number of parameters which must be varied to determine the minimum time transfer.

Notes:

1. This program is written in FORTRAN IV for use on the IBM OS/360 computer.
2. Requests for further information may be directed to:

   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B71-10376

Patent status:

No patent action is contemplated by NASA.

Source: D. A. Davis of
The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-14804)

Category 09