NASA TECH BRIEF

HICOV (Newton-Raphson Calculus of Variation with Automatic Transversalities)

The problem:

In generating trajectories that are optimum with respect to payload placed in an earth orbit, there arises a need for analytically forming the transversality equations and their respective partial derivatives.

The solution:

A computer program which generates the desired trajectories through the use of a subroutine package which produces the terminal and transversality conditions and their partial derivatives.

How it's done: ·

The Wierstrass condition defines the control variables, or steering angles, which appear in the differential equations of motion, while the transversality conditions are used along with the physical cutoff conditions to determine the nine boundary conditions. The partial derivatives are used to solve for the desired boundary conditions and then determine the gain matrices for the steering angles. The gain matrices are used to write the guidance functions which reduce to linear polynomials in the state variables. The state variables can be stored onboard the vehicle for guidance purposes.

The transversality generator program along with the Formac subroutine package, TAC, generates the terminal and transversality conditions and their partial derivatives. The package uses a formula manipulation language which is an extension of Fortran. It allows the programmer to arrive at a single analytic solution, following it by multiple numeric evaluations.

The terminal conditions are input into the program and a Fortran IV source deck for the calculation of the solutions is generated on tape. Included in the tape source deck are a deck name, calling sequence, type statements, dimension statements, and analytic expressions as desired. The tape can then be punched on cards and used directly with a program or called in by a program through the use of $IEDIT.

Using this subroutine package, the programmer is able to automatically arrange his analytic solution(s) in form suitable for numeric evaluation.

Notes:

1. This program is written in Fortran IV and Formac for the IBM 7094 computer.
2. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10232

Patent status:

No patent action is contemplated by NASA.

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