NASA TECH BRIEF

NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Polynomial Manipulator AP-168

The problem:

A single program was needed to combine the many different analysis techniques used to evaluate and manipulate polynomials.

The solution:

The Linear Systems Design Evaluation Program, AP-168 was written as a pseudo instruction abstraction which allows the user to enter polynomials of the Laplace operators and to manipulate these polynomials in any way he chooses.

How it's done:

Input data are coded to indicate type of input as follows:

    P Polynomial
    N Numerator of polynomial ratio
    D Denominator of polynomial ratio
    C Constants

This code is placed in column 9 of the card. The identification number by which the data is to be referenced is placed in columns 11-12. Data may be in any order, as the code and identification number are used for the arrangement internally. The end of the input data is denoted by placing a nonzero integer in column 1 of the last P, N, D, or C card.

The program makes use of three so-called registers, the AC, MQ, and GREG. The AC and MQ hold the various polynomials and polynomial ratios as a result of the manipulations performed. The GREG holds the constant used in the last manipulation performed using a constant. *Specific registers are used for each operation code.* Addition, subtraction, and *all* operations with constants use the AC register. For the other codes, most operations on the MQ are denoted by a Q as the last letter of the code.

In setting up the problem, the polynomials, polynomial ratios, and constants are referenced by such

names as P1, R5, C3, etc. The polynomials and polynomial ratios are held internally in separate arrays; therefore R1 is different from P1. Once manipulations have been started, the mode of operation must be consistent throughout (the mode is either R or P). Provision is made for changing modes using the CHM operation code. There is also an automatic change in mode from P to R when polynomials are divided. Only polynomials may be manipulated when in the P mode, unless CHM R is used or two polynomials are divided. Only ratios may be manipulated when in the R mode, unless CHM P is used.

AP-168 provides an error recovery, should an error in the input data, manipulations, or control cards occur. A number of cases may be input, and should an error occur in the input data, the program will print out all cards skipped until it reaches a $DATA card with no error recovery option. The program will then start over. Should an illegal change in mode, operation code, etc., be entered in the manipulations, the program will print all cards skipped until *either* a $DATA *or* $JAM card with no error recovery option is reached. The Fortran monitor will give the normal error stop, and the program will be deleted when an error occurs in a library routine such as SINF, COSF, etc. If the word NOGO appears in columns 13-16 of a $DATA or $JAM card, the error recovery recognizes this as a signal to delete the whole job from the computer. These options allow saving time on sections, depending on previous manipulations where errors occurred. The NO-NOGO options are ignored unless an error occurs.

The following errors will cause the error recovery routine to be entered: illegal change of mode of operation, illegal control work or operation code (misspelling), using identification numbers outside the

(continued overleaf)

allotted range, punching in incorrect columns, and omitting required input data.

The basic restrictions of the program are: input polynomial identification numbers must be between 1 and 40 inclusive; input polynomial ratio identification numbers must be between 1 and 20 inclusive; input constant identification numbers must lie between 1 and 100 inclusive; input polynomials or polynomial ratios must be of degree 25 or less; generated polynomial or polynomial ratios must be of degree 50 or less; stored polynomials must have identification numbers between 100 and 139 inclusive; stored polynomial ratios must have identification numbers between 100 and 119 inclusive; maximum of 50 gains entered for root locus; maximum of 300 points plotted in the frequency response (all calculated points are printed; first 300 are also plotted); and maximum of 500 points plotted in the time response (all calculated points are printed, first 500 are also plotted).

Notes:

1. This program can be used to establish guidance and control stability criteria for servomechanism systems.

2. Inquiries concerning this program may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10103

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: G. E. Tutt, et al
of North American Aviation, Inc.
under contract to
Manned Spacecraft Center
(MSC-1231)