# NASA TECH BRIEF

## Digital Filter Synthesis Computer Program

A digital filter synthesis computer program has been developed to express any continuous function of a complex variable in approximate form as a computational algorithm or difference equation.

Given an analog prototype of the desired filter and a sampling interval, analog filter critical frequencies are computed along with a new frequency-scaled filter function, $F(s)$, which is the transfer function for the real-time analog equivalent network.

The bilinear transform method is used on $F(s)$ to make the transformation from the s to the z plane. The resulting function $F(z)$, is the digital equivalent of a transfer function and can be represented by the expression

$$Fz = \frac{\Sigma Anz^{-n}}{\Sigma Bnz^{-n}} = \frac{O(z)}{I(z)}$$

where $O(z)$ is the output data function of z, $I(z)$ is the input data function of z, and An and Bn are, respectively, the numerator and denominator coefficients of the digital transfer function.

Solving for the function $O(z)$, which represents the desired output digital data list, the program obtains the difference equation that represents the nearest digital equivalent to the analog prototype within the limitations allowed. The coefficients, An and Bn, of this difference equation are listed for each filter configuration.

Once the difference equation has been developed, digital filtering can be performed by the program on any input data list.

**Notes:**

1. This program is written in Fortran IV for use with the IBM 7090/94 computer with IBSYS Executive monitor.
2. This program has broad general application and a particular usefulness in the computer simulation studies of space instrument systems.
3. Inquiries concerning this program may be directed to:

      COSMIC
      Computer Center
      University of Georgia
      Athens, Georgia 30601
      Reference: B68-10164

**Patent status:**

No patent action is contemplated by NASA.

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