NASA TECH BRIEF

Study of Random Process Theory Aids Digital Data Processing

The problem:

To devise new and improved means of applying statistics and random process theory to the technologies of meteorology, vibration, acoustic measurements, and other random processes. Methods are also desired for reducing data editing and computer usage time, increasing accuracy of statistical estimates of processed data, and determining possible future applications for existing data reduction equipment.

The solution:

A study in which techniques for estimating correlation functions and power spectral densities for all classes of random processes, including nonstationary, stationary, gaussian bivariate, etc., in addition to deterministic processes, are described in a rigorous mathematical sense. In this study, aids to implementing the processing techniques are given, including a complete thesis on the synthesis of optimal digital filters. The technique of digital heterodyning, and methods of applying these techniques for use on a general purpose digital computer are also presented to further aid the processing engineer.

Notes:

1. The following material is presented in this set of studies:
   - A. Digital Filtering
     - (1) Time and frequency relationships
     - (2) Synthesis of optimum digital filters
     - (3) Optimum filters with the constraint of unity DC gain
     - (4) Notch filters
     - (5) Digital heterodyning
   - B. Correlation Function
     - (1) Summary of available computational methods
     - (2) "Half-polarity" correlator analysis
     - (3) Comparison of "Half-polarity" and "Full-precision" correlators
     - (4) Correlation of signal plus noise
     - (5) Computer techniques of calculating correlation functions
   - C. Optimal spectral smoothing
   - D. Deterministic data processing
   - E. Nonstationary spectrum analysis
     - (1) Theory
     - (2) Experimental results
   - F. Nonstationary correlation analysis
     - (1) Theory
     - (2) Experimental results
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10309

Patent status:

No patent action is contemplated by NASA.

Source: G. W. Bordner, et al.,
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