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NASA TECH BRIEF

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System for Computing Operational Probability Equations

This program SCOPE, originally designed for reliability studies of complex systems in the Saturn S-11, has application to systems in general.

The problem:

To generate exact functional reliability relationships between component and system, particularly for complex, highly redundant systems.

The solution:

To design a system (SCOPE) which computes an expression relating the probability of system success to the probabilities of success of its components. It is especially designed for complex system reliability studies.

How it's done:

A system is defined as a group of components designed to perform a specific function. Most space systems are designed with several success modes so that component failures need not cause system failure. A system having more than one success mode is said to possess redundancy, and the success modes are called success paths. Those success paths which contain only components essential to the successful operation of the path are called "minimal success paths" and they are used by SCOPE to compute the reliability equation. A reliability equation is simply the probability that any of its minimal success paths will work, thus the fundamental law for the addition of probabilities can be applied to the task of equation generation.

Previous research described a method for applying this law to the equation generation task. A recursion expression equivalent to this law is used to reduce computer time. Every system with n components contains less than 2^n minimal success modes. SCOPE generates all of a system's minimal success paths, and from these paths it computes the reliability equation by use of the recursion formula. In order to compute probabilities the APRDCT program (Apportionment-Prediction) must be employed since SCOPE only generates an equation and a set of minimal success paths. It should be noted that SCOPE will generate a reliability equation if minimal success paths are used, and an unreliability equation if minimal failure paths are used. This property is often useful when computing an equation for a system with more failure paths than success paths, since failure paths can be used then and the result subtracted from one to give the required reliability result.

Notes:

1. The program is written in FORTRAN IV language for use on the IBM-7094 computer.
2. Inquiries should be made to:

   COSMIC
   Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B69-10566

Patent status:

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

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