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Analytic Procedures for Determining Dimensional Redundancies in Electronic Devices

The problem:

Many modern electronic devices and their associated physical phenomena are extremely complex. Although there exists literature containing functions describing these phenomena, the functions require complex calculations to determine certain characteristic variables and constants.

The solution:

Analytic procedures have been developed which ascertain dimensional redundancies in the mathematical functions, describe the electronic phenomena and devices, and systematically remove them. These procedures have been compiled in computer program routines. Two main computer programs have been developed: the first determines a complete B-matrix and the second optimizes the matrix.

How it's done:

A dimensional matrix is formed by displaying the dimensions of the variables in a tabular arrangement, with the entries of the matrix determined by the exponent to which the dimension of the variable is raised.

The first main program forms the complete B-matrix from the dimension matrix. The input consists of the order of the dimension matrix and its elements. A feature of this program is that it is possible to specify the variables, in a dimension matrix, which will form dimensionless products.

There are three subroutines to the main program.

(a) The first looks for common factors in the column vectors of the B-matrix and removes them;
(b) the second transposes the dimension matrix; and
(c) the third row-reduces the matrix.

The second main program for optimizing the B-matrix includes seven subroutines. The input consists of the complete B-matrix, obtained from the first main program, and the output includes all optimal B-vectors with the sum of the absolute value of the elements and the number of zero elements.

The subroutines do the following:

(a) read in complete B-matrix;
(b) examine whether matrices of rank N-1 (where N is the number of columns of the complete B-matrix) could be obtained by deleting a finite number of rows from the complete B-matrix;
(c) reduce the matrix to a canonical form, and the number of rows having zeroes is counted to determine the rank of a matrix;
(d) calculate and store the associated B-vectors;
(e) divide each element of the associated B-vectors by the highest common factor;
(f) determine the sum of the absolute value of the elements and the number of zero elements in the optimal B-vectors; and
(g) examine each associated B-vector for a common factor (if a common factor exists it is removed).

These programs, written in FORTRAN IV, are listed and available for use.

Note:

Requests for further information may be directed to:

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