NASA TECH BRIEF

Computer Program for Parameter Optimization

The problem:

To develop multivariable search techniques for practicing engineers concerned with the optimization of nonlinear, parametrically-defined systems.

The solution:

A flexible, large scale digital computer program designed for the solution of a wide range of multivariable parameter optimization problems.

How it's done:

The program has the ability to solve constrained optimization problems involving up to one hundred parameters. Nine search techniques are available for problem solutions; they are:

Sectioning—The local performance minima in a sequence of searches parallel to the coordinate axes are located; and hence, by repetition, the extremal of the multivariable function is located.

Adaptive Creeping—This method is similar to sectioning, but instead of finding the local minima parallel to the axes, this search merely introduces small perturbations in the minimizing direction. The size of these perturbations is determined adaptively by the search algorithm.

Steepest-Descent—This method searches along a sequence of rays determined by the local direction in which performance decreases most rapidly for a given perturbation measure. Three perturbation measure options, together with the relevant weighting matrices are available within the program.

Quadratic Search—Except for the search directions, this method is similar to the steepest-descent method. The directions are aligned through the extremals of a sequence of locally osculating second order surfaces (as opposed to the first order tangent planes employed in the steepest-descent search).

Davidon's Method—This method is a particular form of the steepest-descent search. It progressively approaches the second-order quadratic search from information obtained by a sequence of first order steepest-descent searches.

Random Point Search—The performance is evaluated at a set of uniformly distributed random points in the parameter space in a Monte-Carlo-like manner.

Random Ray Search—Small perturbations are introduced sequentially along a series of randomly directed rays in the control space.

Pattern—This method explores the linear ray defined by the first and last point of a preceding search or search sequence.

Magnification—This method searches the direction defined by a proportional change in all parameters.

The searches may be employed separately or in any sequential combination. The optimization program may be rapidly coupled to a wide class of parameter optimization problems, including systems which have previously been synthesized as digital computer programs.

Notes:

1. This program is written in FORTRAN IV for use on the IBM 7094 or 360 computers.
2. Inquiries should be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10453

Patent status:

No patent action is contemplated by NASA.

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