PACKAGE ID - 001181SUN0000 OPTIMIZE-M

KWIC TITLE - Nonlinear Global Optimization Using Curdling Algorithm in Mathematica Environmet

AUTHORS - Loehle, C.
Argonne National Lab, IL (United States)

LIMITATION CODE -COPY **AUDIENCE CODE -** LIM

COMPLETION DATE - 07/01/1997 **PUBLICATION DATE -** 07/01/1997

DESCRIPTION - An algorithm for performing optimization which is a derivative-free, grid-refinement approach to nonlinear optimization was developed and implemented in software as OPTIMIZE. This approach overcomes a number of deficiencies in existing approaches. Most notably, it finds extremal regions rather than only single extremal points. the program is interactive and collects information on control parameters and constraints using menus. For up to two (and potentially three) dimensions, function convergence is displayed graphically. Because the algorithm does not compute derivatives, gradients, or vectors, it is numerically stable. It can find all the roots of a polynomial in one pass. It is an inherently parallel algorithm. OPTIMIZE-M is a modification of OPTIMIZE designed for use within the Mathematica environment created by Wolfram Research.

PACKAGE CONTENTS - Media Directory; Software Abstract; User's Guide; Media Includes Source Code, User's Guide;

SOURCE CODE INCLUDED? - Yes

MEDIA QUANTITY - 1 3.5 Diskette

METHOD OF SOLUTION - The state of the art for nonlinear optimization is sophisticated, but has several notable deficiencies. All extant algorithms assume that a single extreme value is sought, and they stop when a convergence criterion indicates that this extremum has been reached. Many problems exhibit multiple minima or are flat in the optimal region. The multiple minima may represent alternative solutions, and provide useful information for any real world problem. A flat region around the optimum represents a vague optimal region. In the real world, such a case correspond to a control problem where the control variables do not need to be controlled very tightly to achieve an optimal result. Existing algorithms do not provide this information. If it is known that there are multiple minima conventional algorithms require that the user provide an initial guess close to each minimum. Since the user generally has no idea where such optima are, or even how many there are, the program must be run multiple times to find the minima. Most of these algorithms require a good initial guess by the user for convergence to be efficient. Curdling is a grid refinement algorithm. An initial coarse grid is laid across control space and

PACKAGE ID - 001181SUN0000 OPTIMIZE-M

METHOD OF SOLUTION -(CONT) the function evaluated at each point. For a function of a single variable, X, n points are distributed across the range of X values being evaluated. For a function of m variables, n to the m points are laid in a m-dimensional grid. At each point, X, the function value Z(X) is obtained by a call to a user-supplied function. The range (R) of Z values over the grid is obtained. The contraction coefficient (C) determines which points will be kept to the next iteration. At the next iteration, the interval on X is halved, and points are added in each direction at this distance for all points kept previously.

COMPUTER - SUN

OPERATING SYSTEMS - Any Unix environment utilizing the proprietary Wolfram Research Mathematica software

PROGRAMMING LANGUAGES - C

SOFTWARE LIMITATIONS - OPTIMIZE-M is a single user system; the problem size is limited only by the amount of available RAM storage, and the dynamic memory allocation feature makes memory limitations unlikely.

SOURCE CODE AVAILABLE (Y/N) - Y

UNIQUE FEATURES - The program has a number of advantages: Extremal regions, not just single points, can be identified and graphically depicted as an aid to decision-making. Flat response surfaces near the optimum do not cause convergence problems, but are merely part of the solution within the indifference bounds. Local minima do not cause premature termination. No derivatives are required. the user does not need to know how many optima exist nor to supply good initial guesses. For polynomials, all roots are found in one run. For nonlinear least squares, the size of the indifference region indicates the extent of lack of fit, and the existence of multiple regions in control space indicates model indeterminacy. The algorithm is inherently parllel. The input of parameters and model execution are interactive. No gradient search is performed, and the algorithm is numerically stable.

RELATED SOFTWARE - OPTIMIZE

OTHER PROG/OPER SYS INFO - OPTIMIZE-M is set up to run in conjunction with the proprietary Wolfram Research Mathematica software. Mathematica functions define the user function to be optimized and the constraints. Mathematica calls OPTIMIZE-M to solve the system and the output is directed to the Mathematica notebook.

HARDWARE REQS - The software will run on any machine with normal RAM limits.

PACKAGE ID - 001181SUN0000 OPTIMIZE-M

TIME REQUIREMENTS - Small problems run in 2-15 seconds on a Sun workstation.

REFERENCES - Craig Loehle, OPTIMIZE-M User's Manual, July 1997.

ABSTRACT STATUS - Submitted 8/8/97. Released AS-IS 10/23/97

SUBJECT CLASS CODE - P

KEYWORDS -
COMPUTER PROGRAM DOCUMENTATION
O CODES
OPTIMIZATION
NONLINEAR PROBLEMS
POLYNOMIALS
ALGORITHMS
MESH GENERATION
ITERATIVE METHODS
NUMERICAL ANALYSIS

EDB SUBJECT CATEGORIES -
990200

SPONSOR - DOE/ER

PACKAGE TYPE - AS - IS