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A NEW TEST FUNCTION
FOR UNCONSTRAINED OPTIMIZATION
Russell R. Barton
RCA Laboratories
Princeton, NJ 08540

Testing unconstrained optimization routines means, for the most part, testing them on near-quadratic topographies. For example, Rosenbrock's function looks nearly quadratic after the function value is reduced two orders of magnitude from the value at the standard starting point. Below is the code for a simple 'descending curved valley' function that has no minimum and never becomes quadratic. Also included is code for the gradient. Both are defined everywhere but at the origin. The shape is that of a children's slide whose ramp is curved like a corkscrew. Some performance measures relevant to this family of functions are:

1. the long run average number of function evaluations per unit of decrease in the function value;
2. the dispersion of the iterates about the bottom of the valley; that is, the standard deviation (or interquartile range, etc.) of the $\|x^*\| - R$ values, where $R$ is the corkscrew radius.

The circular form of the corkscrew can be distorted by changing 'PF' to a value other than 1. A value of 20 or more makes the trajectory appear back-and-forth rather than circular; the Hessian doesn't approximate this distortion well at the ends. This makes comparisons of quasi-Newton methods and pattern search methods like Nelder-Mead more interesting.

I would like to hear of other tests using this family of functions. I can be reached at the address above.

In Table 1, problem data other than $\eta$ in each of five test problem groups are given. In Table 2, test results on the number of quasi-trees in an optimal basis are shown for the first three problem groups. In Table 3, test results for the last two problem groups are shown. In addition to the number of quasi-trees at optimality, the number of iterations and the solution time - exclusive of I/O - in CPU seconds are given for these two last groups. These solution statistics were obtained by GRNET using the f77 compiler on a VAX 11/750 computer. GRNET uses an artificial starting basis and a candidate list pivot strategy. We note that the number of iterations and the solution time both vary inversely with the number of basis quasi-trees at optimality. Further, as this number increases, the solution time decreases faster than the number of iterations. This can be explained by noting that as the quasi-trees become smaller, the length of the path on which the basis representation of an incoming arc is nonzero also becomes smaller. Hence, the calculation of this representation, the ratio test, and the flow updates execute faster. Also, the updating of the node functions used to maintain the basis quasi-trees can be done faster.
ON THE NUMBER OF QUASI-TREES IN AN
OPTIMAL GENERALIZED NETWORK BASIS

by
Michael D. Chang
Michael Enquist

Department of General Business
College of Business Administration
The University of Texas at Austin
Austin, Texas 78712

1. Introduction

The solution of generalized networks by means of the primal simplex algorithm has been studied by a number of authors including Brown and McBride [1], Enquist and Chang [4], and Glover et al. [6]. Bases for these problems can be represented as a collection of quasi-trees, where a quasi-tree is a tree plus an additional arc. Specialized generalized network codes are about fifty times faster in solving these problems than general purpose linear programming codes [4], [6].

For pure networks, the problem generator NETGEN of Klingman, Najjar and Stutz [5] has been widely used. NETGEN has been extended to generate generalized network problems and this extension is known as NETGEN [6]. In computational tests conducted using problems generated by NETGEN as described in [4], we found that the number of quasi-trees in the optimal basis was typically one or two. In order to test the effects of the number of quasi-trees at optimality on solution times, we developed a new generalized network generator, GTGEN, which is described in Section 2. We also note that problems having a large number of basic quasi-trees at optimality are more amenable to solution by a parallel version of the primal simplex algorithm as described by Chang, et al. [3]. The test problems used in [3] were generated by GTGEN.
August 10-12, 1987: IFORS 87, Brussels, Belgium. Arising from (see page 12)
June 15-20, 1987: COAL ARW on Computational and Modeling Aspects of Mathematical Programming, Oslo, Norway (tentative)
May 14-16, 1987: TIMS/ORSA Joint National Meeting, New Orleans, USA
September 16-19, 1986: ENRO VIII, Lisbon, Portugal

Calendar of Meetings

The University College of Buckingham
Professor R. C. Daniel

Co-workers and colleagues

and his determination to improve the profession and enthusiasm of his colleagues in the application of theory to solving important problems. He has established a solid reputation in the field of mathematical programming and has applied it to real-life problems. His research and publication have been instrumental in the development of new techniques and methodologies.

Mr. Martin, your leadership has been an inspiration to those who have worked with you. Your dedication to the profession has been evident in your decision-making and problem-solving approaches.

My most profound memory of him will always be his enthusiasm and his ability to inspire others. With your expertise, his guidance, and your leadership, we can achieve greatness.

May the memory of Mr. Martin remain at the forefront of mathematical programming and continue to inspire us all.
THE 1987 CONFERENCE
OF THE COMMITTEE ON ALGORITHMS

The Committee on Algorithms has decided to arrange its next meeting at Chr. Michelsen Institute, Bergen, Norway on June 15-20, 1987. We are planning for an advanced research workshop with approximately 40 participants. The main goal of the workshop will be to discuss the present state and future avenues for the research in linear programming and combinatorial optimization. This will be achieved by letting the morning sessions be plenary discussions with key-note speakers. The afternoon sessions will be used for presentations of technical paper. The conference is still pending upon financial support.

The organizing committee consists of

Professor Martin Grötschel, Universitität Augsburg, Germany F. R.
Dr. Jan Telgen, Van Dien+Co, Utrecht, The Netherlands.
Dr. Stein W. Wallace, Chairman, Chr. Michelsen Institute, Bergen, Norway.
Professor Roger J-B. Wets, University of California at Davis.

Mailing address for the Conference
COAL-87 v/ Secretary Laila Fjeld
Chr. Michelsen Institute
N-5036 FANTOFT, Bergen
Norway

PROFESSOR MARTIN BEALE, FRS

The sadness of Martin Beale’s death in Cornwall on December 23, 1985 is perhaps mitigated for his friends and colleagues by the knowledge that at the end he was surrounded by the three most important things in his life - his family, his Christianity and his mathematics.

His richly deserved Fellowship of the Royal Society was primarily awarded in 1979 for his applications of mathematical and statistical techniques to industrial problems, and for his contributions to the theory of mathematical programming. With his Chair at Imperial College and his leading technical role at Scicon Limited, Martin was in a unique position to develop these techniques, and then to apply them to the hardest problems that industry could generate.

Martin used this blend of theory and state-of-the-art practice to encourage several generations of young mathematicians and computer scientists, both as research students and as co-workers at Scicon. Many of them have gone on to apply the theory and techniques that Martin developed in a variety of large scale mathematical programming computer codes.

Martin inspired his students and co-workers by his total intellectual commitment and honesty, his clarity of thinking, the richness of his ideas and, above all, by his supreme professionalism. It was exhausting working with him, keeping up with the constant flow of creativity and watching him strive to render the mathematics usable and efficient. This attention to detail was astounding until one realized that it all fitted into a coherent view of how things ought to be done.

In his teaching, too, Martin strived for succinctness and clarity. He was not the sort of mathematician who seeks to impress by obscurity. Ideas were to be expressed only, criticism received and improvements welcomed. He worked ceaselessly to improve even his elementary introductory lecture notes, fitting the new theoretical developments into his broad perspectives on the subject.
Jan Token.
certainly a very interesting topic. For more information contact Camolin.

I have expressed my support for this meeting on behalf of COAL since it is
the three days been expected. The is not the official COAL meeting but
the meeting is scheduled for the summer of 1987 but neither the place nor
the program are decided.

Meeting on Modelling: Camolin. Within one of the organizers of a (pre-

sented) NATO ASI on "Modelling Aspects of Mathematical Programming".

Panel are registered.

Panel Programming Algorithm" is scheduled. I am the co-organizer. So far 7

Eur. OFI At this meeting to held in Lisbon, Portugal from Sepember-

8-12. 1986, A COAL session "Computation and Optimization of Mathematical-

Programs" was registered.

The whole thing is still pending financial support.

The announcement on p. 14) contains more information. Of course

The meeting will be an Advanced Research Workshop focused on prop-

Panel Beta (Norway). The meeting is scheduled for June 12-20, 1987, please

Panel Meeting: As the site for the next meeting of COAL we selected

The motion was approved by the council.

To be included in the "Instructions to Authors" as "Notes for Authors".

COUNCIL MEETING: As the site for the next meeting of COAL we selected

NOTES FROM THE CHAIRMAN.
GLOBAL OPTIMIZATION STUDY

A computational study of algorithms for global optimization will be carried out in accordance with guidelines discussed during a recent SDS-IIASA workshop in this area.

As a first step, appropriate test problems are being assembled featuring arbitrary objective functions and constraints. (Test problems for the special case of concave functions subject to linear constraints are available from J. B. Rosen, 136 Lind Hall, Minneapolis, MN 55455, U.S.A.).

Those interested in contributing to the computational study are invited to contact C. G. E. Boender and A. H. G. Rinnooy Kan, Econometric Institute, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands.

NOTES FROM THE U.S. CO-EDITOR

This issue contains two technical papers. The first, by M. Chang and M. Enquist of the University of Texas, describes a test problem generator for (linear) generalized network optimization problems that provides control over the number of quasi-trees in the optimal solution, and it also reports that solution times are inversely proportional to this parameter. The second paper, authored by R. R. Barton of RCA Laboratories, provides code for a family of difficult two-variable unconstrained optimization problems.

Jerry Kreuser, reporting on the establishment of SIGCMP as the successor to SIGMAP, notes that, due to complex ACM distribution requirements, a few more signatures of ACM members are required. He anticipates no problems in collecting these, and is optimistic that final approval of SIGCMP will be possible at the October ACM meeting in Dallas.

The Executive Committee of the Mathematical Programming Society has authorized the acceptance of a limited amount of appropriate advertising for publication in the COAL Newsletter. Ads will be sold by the page only, at a rate of $100 US per page. Ad copy may be sent to either co-editor, but checks should be made payable to “University of Wisconsin”. The MPS mailing list need to distribute the COAL Newsletter contains approximately 700 names.

Robert R. Meyer
EX OFFICIO MEMBERS

The newsletter's primary objective is to provide a vehicle for the rapid dissemination of new results in computational mathematics and programming. To date, our objective has been to expedite the transmission of updated information and new results. The newsletter is intended to meet certain standards of quality, elegance, and economy, even if it means making sacrifices in other respects. The committee on Algorithms is interested in computational developments in mathematics and computer science, particularly in the areas of numerical and symbolic computation. The committee on Algorithms is interested in computational developments in mathematics and computer science, particularly in the areas of numerical and symbolic computation.
## Mathematical Programming Society
Committee on Algorithms Newsletter

**NO. 14**

<table>
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<tr>
<th>Robert R. Meyer</th>
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</tr>
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<tr>
<td>June 1986</td>
<td>Jens Clausen</td>
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### CONTENTS

- Notes from the U.S. Co-editor
  - R.R. Meyer
  - Page 1
- Notes from the COAL Chairman
  - J. Telgen
  - Page 2
- Professor Martin Beale, FRS
  - Page 3
- On the Number of Quasi-Trees in an Optimal Generalized Network Basis
  - Michael D. Chang and Michael Enquist
  - Page 5
- A New Test Function for Unconstrained Optimization
  - Russell R. Barton
  - Page 10
- Calendar of Meetings
  - Page 13
- The 1987 Conference of COAL
  - Page 14
- IFORS
  - Page 15
- Global Optimization Study
  - Page 16