No46

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# OPTIMA

MATHEMATICAL PROGRAMMING SOCIETY NEWSLETTER

## CALL FOR PROPOSALS

### 2000 International Mathematical Programming Symposium

**PROPOSALS FOR THE LOCATION OF THE XVII INTERNATIONAL MATHEMATICAL PROGRAMMING SYMPOSIUM, TO BE HELD IN 2000, ARE NOW BEING SOLICITED.**

The Symposium is held every three years under the auspices of the Mathematical Programming Society. By a tradition of the Society, the site of the Symposium has usually been alternated between places in and outside of North America. Thus, since the 1997 Symposium is to be held in Lausanne, locations within North America are preferred for the 2000 Symposium. Proposals for any site will be considered, however. Meeting dates during the month of August are also preferred.

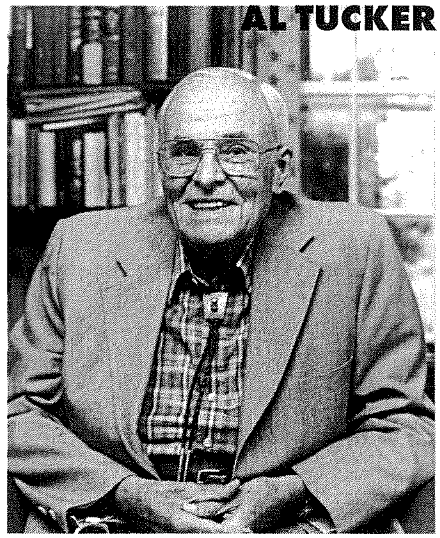
The main criteria for selection of the Symposium site are:

- Presence of mathematical programming researchers in the geographic area who are interested in organizing the symposium.
- Attendance open to prospective participants from all nations.
- Availability of an attractive facility with a sufficient number of meeting rooms, standard lecture equipment, and other facilities required by a Symposium.
- Availability of a sufficient supply of reasonably economical hotel and/or university dormitory rooms fairly near the meeting facility.

A copy of the Society's "Guidelines for Submission of Proposals" and further information can be obtained from the chairman of the Advisory Committee for the 2000 Symposium:

Robert Fourer (4er@iems.nwu.edu)
Department of Industrial Engineering and Management Sciences
Northwestern University
2225 North Campus Drive
Evanston, IL 60208-3119, U.S.A.

Other members of the Advisory Committee are Jens Clausen, Copenhagen (clausen@diku.dk), and Katta G. Murty, Ann Arbor (Katta.Murty@umich.edu).




# Memorial Resolution Honors First Rank Statesman of Mathematical Community

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*The following memorial resolution was adopted by the Faculty of Princeton University at its monthly meeting on March 6, 1995. It was written and presented to the Faculty by Harold Kuhn on behalf of a committee composed of Professors Kuhn, Joseph J. Kohn and Hale Trotter.*

**Albert William Tucker**, who was Albert Baldwin Dod Professor Emeritus of Mathematics, died at the age of 89 on January 25, 1995, after a long illness. He was one of the last surviving members of a group of mathematicians who, in the 1930's and '40's, transformed the Mathematics Department of Princeton University into an internationally renowned center for mathematical research. It is an impossible task to try to capture the unique quality of this man in a short memorial resolution. The lists of positions held, of honors conferred, and of projects completed are far too cold and impersonal to convey his essential achievements. Although much of this impressive record will be recounted, it is the human evidence that is most real and important. He was known to his friends, his colleagues, his students, and his children as "Al" and so I shall call him here.

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# Al Tucker Memorial Resolution

CONTINUED

Born and reared a Canadian, Al Tucker came to Princeton for graduate study in 1929 after receiving his B.A. and M.A. from the University of Toronto. This choice was made against the advice of his professors in Canada, who wanted him to study in Europe or, if he insisted on the United States, at Harvard or Chicago. His selection was made on the basis of a graduate catalog that listed courses by Veblen, Lefschetz, Alexander and Eisenhart in various areas of geometry that excited him. His single letter of recommendation, sent to Dean Henry B. Fine, went unanswered for many weeks; it was not known in Toronto that Fine had been killed in the first automobile related fatality on Nassau Street. When the letter was found, it was too late to apply in the regular way; however, on the basis of his teaching experience in Canada, Tucker was appointed a part-time instructor for the 1929-30 school year with a salary of $1,000 and free tuition.

Thus begun Al Tucker's distinguished career as a teacher. After completing his Ph.D. under Lefschetz, he joined the Princeton Faculty in 1933, was appointed Assistant Professor in 1934, Associate Professor in 1938 and Professor in 1946. He succeeded Emil Artin as Dod Professor in 1954, retiring to emeritus status in 1974. Princeton shared his teaching talents on a number of occasions, with Stanford, MIT, Dartmouth, Arizona State, as Phillips Visitor at Haverford College, as Visiting Lecturer for the Mathematical Association, as guest Lecturer at the Rockefeller Institute. He was Fulbright Lecturer at four Australian universities and lecturer at several European universities for the OEEC. In the year following his retirement, he was Mary Shepard Upson Visiting Professor of Engineering at Cornell University.

Behind this formal record stands a veritable army of active mathematicians who give evidence of a man who taught them with exquisite care and precision. Among them, one may cite John Milnor, who heard from Al Tucker the Borsuk conjecture on the total curvature of a knot and went to solve the problem while still a freshman. As another example: Marvin Minsky, a pioneer in artificial intelligence, who was taken on by Tucker as a Ph.D. student when no one else was either qualified or courageous enough to do so. As a last example: John Nash, who shared the 1994 Nobel Memorial Award in Economics for his Ph.D. thesis on noncooperative game theory written under Al Tucker's supervision in 1950.

His lectures sparkled with penetrating examples. Perhaps the most famous is an illustration of non-zero-sum game theory constructed for an expository seminar before a general audience of psychologists at Stanford in 1949-50. This game, which goes by the name of the Prisoner's Dilemma, has inspired countless research papers and several entire books. He was generous with his teaching materials as well. His examples and teaching exercises have found their way to the mathematical public more often than not through the books of others. With a tendency for procrastination that came from a deep seated perfectionism, his last book, coauthored with Evar Nering, appeared last year some eighteen years after it was begun.

Al Tucker was a statesman of the mathematical community of the first rank. He was a Council member and Trustee of the American Mathematical Society, President of the Mathematical Association of America, a Vice President of the American Association for the Advancement of Science (AAAS), Chairman of the Conference Board of the Mathematical Sciences (CBMS), and Chairman of the Mathematical Programming Society. It was characteristic that his service extended beyond the confines of individual mathematical organizations to strenghten our ties with other sciences through the AAAS and to unite the mathematical community through the CBMS. At the highest national level, his wisdom was sought as a member of the first President's Committee on the National Medal of Science and as a consultant to the President's Science Advisory Committee. In all of these positions, his colleagues learned to appreciate the wise deliberation with which he confronted any task, large or small.

Al Tucker's initial research interests were in topology as a student of Solomon Lefschetz. Although he had a substantial introduction to applied mathematics during World War II, a major shift in his research occurred in the summer of 1948, when he initiated a research project with two graduate students on the relationship between linear programming and the theory of games. That project, with major support from the Office of Naval Research, continued until 1972. The special quality of Tucker's leadership is shown by the large number of young people who produced basic results in game theory, mathematical programming, and combinatorics while participants in this project.

In the '50's and '60's, Al Tucker was in the forefront of efforts to reform the mathematical curriculum at all levels. Again the measure of his service is not in the number of offices held, which were numerous, but rather in the quality of the final products and in the many jewels of expository mathematics that bear the imprint of his clarity and elegance.

Out of his many achievements, I know that he was most proud of two which must be cited here. In 1934-39 he was in charge of the *Princeton Mathematical Notes* and then organized and managed their successor, the *Annals of Mathematics Studies* from 1941 to 1949. This was the first paperback series produced by photo-offset technology from typewritten manuscripts that brought important works of higher mathematics to a wide audience of students and researchers at a reasonable cost. He co-edited six of the first 100 volumes himself.

A second project was undertaken when Al Tucker was 79. He then initiated an oral history of mathematics at Princeton in the 1930's. Funded by the Sloan Foundation, it consists of roughly three dozen interviews and more than 100 hours of tape recordings. The interviews explore the conditions that enabled Princeton to develop the best mathematics department in the world. Of the three dozen interviewees, he was acknowledged by the director of this project to be the most responsive and to have the best memory.

One of the most fitting tributes to the qualities of Al Tucker's life in mathematics was composed by John Sloan Dickey, President of Dartmouth College, and read on the occasion of the award of an honorary degree of Doctor of Science in June, 1961. It captures such a large share of the debt we owe him that it seems proper to paraphrase it here:

"[Over six] decades ago [he] began an academic career at Princeton which became a mission to mathematics. In a field where scholarship scores only if the idea is both new and demonstrably true, [his] ideas have won their way in topology, in the theory of games, and in linear [and nonlinear] programming. But even in mathematics a mission is more than ideas; it is also always a man, a man who cares to the point of dedication, whose concern is that others should care too, and who can minister to the other fellow, as the need may be, either help or forbearance. Because [Al Tucker embodied] in extraordinary measure both [the] profession's love of precision and man's need for conscientious leadership, mathematics in America at all levels is today higher than it was and tomorrow will be higher."

OPTIMA

# ROGER J.-B. WETS interview

**Roger J.-B. Wets** *received the 1994 Dantzig Prize, for his contributions to all aspects of stochastic programming and to variational convergence in the approximation of infinite-dimensional problems. The prize was jointly awarded to Claude Lemaréchal who was interviewed in the previous issue of* OPTIMA. *The Dantzig Prize is awarded once every three years by the Mathematical Programming Society and the Society for Industrial and Applied Mathematics to recognize original, broad and deep research making a major impact on the field.*

*Among Wets' many important contributions to stochastic programming are fundamental investigations into the geometry of the solution set, the properties of the value function, conditions for existence and stability of optimal solutions, and the structure of dual problems. On the algorithmic side his contributions include the basic and fundamental L-shaped method. Wets has also been very active in applications ranging from the environment to finance.*

*Wets received his Ph.D. in Engineering Sciences in 1964 from the University of California at Berkeley. From 1964 until 1970 he was a staff member of the Mathematics Group of the Boeing Scientific Research Laboratories in Seattle. He then joined the University of Chicago, and in 1972 he joined the University of Kentucky. Since 1984 he has been at the Department of Mathematics at the University of California at Davis.*

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OPTIMA: *How did you start your work in stochastic programming?*

**RW**: When I finished high-school, due to special circumstances I had to get involved in the family's business that included a small cardboard factory. While I was taking care of the daily management of the company, I also studied for a degree in applied economics. After I had worked for the company for about five years and realizing that I had only limited interest in staying in the business world, I went back to studying some mathematics. Because of my background, I took a course in operations research from Jacques Dréze at Université Catholique de Louvain. I think it was the only such course offered in western Europe at that time. After I indicated to Dréze that I was interested in optimization, he suggested that I should go and study with Dantzig at Berkeley. So in some way he was the person responsible for getting me in this field. At Berkeley, I eventually got to the stage where I had to discuss a possible thesis topic with George Dantzig. While spraying the roses in his garden, Dantzig said, "You know, Roger, you like optimization, probability theory and economics, so why don't you work in uncertainty?" Although I had no idea what he meant by "work in uncertainty," the subject seemed like it had the right mix. So I started to look at the few papers dealing with the subject.

OPTIMA: *Once you had surveyed the literature, what was the first problem you decided to work on?*

**RW**: The first problem I looked at that was beyond the problems that Dantzig had studied was the manufacturing of antifreeze for an oil company. That problem led naturally to introducing the notion of *induced constraints*. These constraints are not explicitly included in the formulation of the problem but are induced by the "future" of the system. They are generated by the need to only choose decisions (at the present time) that will guarantee future feasibility, i.e., limit the choice to decisions that are such that, whatever occurs, it will be possible to find feasible solutions in the future. In fact, what always motivated my work, even the most theoretical parts, was a specific application that would represent a class of potential applications.

OPTIMA: *What is the main question in stochastic programming?*

**RW**: Solving stochastic programming problems and being able to give a full analysis/interpretation of the solution is the only question that really matters. If we concentrate on solving problems, I consider the question of *designing valid approximation schemes* as central to the subject. Stochastic programming problems are basically infinite-dimensional optimization problems, so to solve them one has to approximate them somehow. And that's quite difficult, because in order to approximate you should have the possibility of calculating bounds, and in the case of some large problems it might be very difficult to get to that point. The basic approach to solving stochastic programming problems is almost always the same: you construct a very efficient algorithm for a certain class of deterministic problems with a given structure. The special structure is that of a stochastic programming problem involving a distribution for random elements with finite (manageable) support, i.e., there are only a finite number of possible realizations for the random parameters of the problem. Let's call such an algorithm the *core algorithm*. The next step is to justify the discretization. By this I mean that once you have a solution provided by the core algorithm, you need to be able to claim that this solution is reasonably good for the originally formulated problem. This is done in two different ways: either you try to establish bounds by an approximation technique, or you use sampling which gives a probabilistic justification saying that the solution you obtained is going to be valid with a high level of reliability.

## interview

OPTIMA: ***Could you mention and explain some of your results that had a big impact on the field?***

**RW**: On the algorithmic side, i.e., in the design of the "core" algorithm, there is the so-called *L-shaped method* and the *progressive hedging algorithm*, based on the aggregation principle for stochastic optimization problems. In 1965-66, R. Van Slyke was working at the interface between optimal control and mathematical programming and was interested in the design of an algorithmic procedure that would handle state-constraints efficiently. Once the problem was formulated as a mathematical programming problem, the linear constraints had an L-shaped structure. So did the formulation of a two-stage linear stochastic programming problem. We designed a decomposition procedure that would make efficient use of this special structure. It is really a cutting plane method and, as was pointed out by E. Balas when we showed him the galley-proofs, was along the lines of a method suggested by Benders for mixed integer programming. But in the case of stochastic programs with recourse, one is able to simplify tremendously the work required to generate both optimality cuts by relying on bunching/sifting techniques, and feasibility cuts by relying on a partial ordering of the possible realizations. There are now a number of variants and extensions of this method (Ruszczynski's regularized version, Birge's nested decomposition for multistage problems, Gassmann MSLiP, for example) that have been suggested and implemented, including some methods relying on sampling to generate the cuts such as the stochastic decomposition method (Higle and Sen) or the method proposed by Dantzig, Glynn and Infanger that relies on importance sampling.

Scenario analysis is an alternative approach to stochastic programming when there is uncertainty about some of the parameters of an optimization problem. In scenario analysis, one considers all possible scenarios (possible values, or realizations, of the parameters). For each of these scenarios, one solves the corresponding optimization problem which will yield a number of different solutions. However, such a solution isn't very good if the actual values assumed by the parameters are different from the specific scenario used to generate the solution. The progressive hedging algorithm enables us to proceed in a manner similar to scenario analysis and then modify the individual "scenario problems" so that their solutions converge to the optimal solution of the stochastic optimization problem. I had been impressed at a conference in Bad Windsheim, Germany, by a report about the use of nonlinear programming to design an optimal management plan for a hydroelectric power system which involved solving a nonlinear programming problem nearly 18,000 times to take potentially different weather patterns into account. The idea that users might be willing to solve a large number of optimization problems to gain some insight in what might be a robust decision suggested that they would also be willing to consider methods for stochastic programming problems that would arrive at a solution by exploiting the information gained from solving (deterministically) a large number of cases. In 1986, R.T. Rockafellar and I had to stay overnight in Beijing. Probably in order to give ourselves some justification for not getting involved in some urgent (but less pleasant) tasks, we started to discuss the possible design of an algorithmic procedure for stochastic optimization problems that would never require more than solving deterministic versions of the given problem, albeit numerous times. We quickly came to the realization that the key was to exploit a certain decomposition of the problem based on relaxing the nonanticipativity restrictions that model the fact that a decision at stage $t$ can only take into consideration the information available at time $t$. Our work in the early '70s on optimality and duality for stochastic optimization problems had for the first time shown that a price system could be attached to these restrictions, i.e., that nonanticipativity could be introduced explicitly as a constraint. This eventually led to the progressive hedging algorithm where "progressive hedging" is supposed to suggest that although one solves the problem scenario by scenario, the nonanticipativity restrictions are progressively enforced through a price mechanism.

On the approximation side, very early on researchers such as A. Madansky, W. Ziemba, P. Kall, etc., in stochastic programming had been concerned about "bounds." It was clear that one couldn't expect that finding a "solution" to a stochastic programming problem would have the same meaning as finding a solution of a deterministic optimization problem. A general stochastic programming problem can't be solved, at least not in finite time! In '73 G. Salinetti came to work on her research under my supervision, and we thought we should try to develop some convergence results for stochastic programming problems that in particular would justify, or not, the discretization of the measure associated with the random events. Since random parameters in a stochastic optimization problem possibly affect both the objective and the constraints, we were led to work with a convergence notion that would handle optimization problems from a global viewpoint. The work in convex analysis in the '60s had already stressed the importance and the usefulness of the "epigraphical" approach, and this led us to rely on epi-convergence (a term only coined at a later time) to study and obtain convergence results for stochastic programming problems. As this technique became more familiar, it was exploited to obtain convergence results for the optimal solutions of "sampled" problems, to make the connection between stochastic programming and mathematical statistics. Now there is even a powerful law of large numbers for stochastic optimization problems.

OPTIMA: ***If you look at the applications you have worked on, could you say that we are now at a point where we have "standard" tools available to solve them?***

**RW**: There are now quite efficient computer codes that will solve linear multistage stochastic programming problems, and although there are no commercial packages available at this time, at least one of them, the SP/OSL code of A. King at IBM, is of that quality. There are a number of high quality experimental codes that have been written, even for parallel processors. Among the *interview*

developers of computer codes I should mention: A. Gaivoronski, T. Szantai, J. Birge, G. Gassmann, L. Nazareth, K. Ariyawansa, G. Infanger, J. Mulvey, A. Ruszczynski, H. Vladimirou, S. Zenios, J. Higle, S. Sen, ..., and I am certainly forgetting some.

OPTIMA: ***What are the areas of stochastic programming where still a lot of work has to be done, and what is the most important open theoretical question?***

**RW**: There is probably no single question that can be identified as "the most important theoretical question" because there are quite a number of stochastic programming models (recourse models, models with chance constraints, and variants thereof), each one with its own particular collection of open questions. After this disclaimer, I think that the most important questions are related to *solution validation*. Since it's almost always impossible to solve the full version of a stochastic programming problem, and one has to be satisfied with a solution generated by solving an approximating problem, one must be able to accept or reject this proposed solution as a reasonably good solution of the full version. For certain classes of problems, bounds can be computed, but even then obtaining sharp bounds might involve almost as much work as solving an only slightly reduced version of the full problem. For multistage stochastic programming problems, even the calculation of rough bounds might be quite involved. But stochastic programming problems have properties that we have not yet been able to translate in quantitative terms and exploit computationally. For example, the objective of the deterministic equivalent problem is usually quite flat in a region, say R, surrounding the optimal solution. Although Lipschitz continuity results have been obtained for this objective function, the Lipschitz constant in these results would certainly not allow us to conclude anything about this function being "nearly flat" in the region R. But there are also many other exciting/open questions in this area. I even recently wrote a paper about "Challenges in Stochastic Programming" which is to appear in Mathematical Programming in a special issue devoted to stochastic programming. Let me just mention a few of the issues mentioned in this paper: the distribution problem, stochastic integer programming, the relationship between recourse and chance-constrained models, the evaluation of information, and the extension of the multistage models to continuous time models.

OPTIMA: ***With which other fields does stochastic programming interact?***

**RW**: Since all deterministic optimization models have a stochastic version, there is a high level of interaction with the methodology of linear and nonlinear programming, both at the theoretical and computational level. And I should even add combinatorial optimization now that there are researchers that have started to investigate stochastic integer programming. The work on large-scale systems can easily be justified by the need to solve stochastic programming problems. So contributions to stochastic programming methods turn out to also yield contributions to decomposition methods and related topics. The approximation theory for variational problems, in particular, the theory of epi-convergence, has three roots. One of them is the classical calculus of variations, dealing with the limits of integral functions. Another motivation came from the study of partial differential equations with highly oscillating coefficients (homogenization). The third root is the design of approximation schemes for stochastic programming.

Stochastic programming has also contributed a number of new ideas in probability and statistics, and I expect this interaction to bear many fruits in the future. One of them was the work on exponential families of distributions and log-concave measures initiated by A. Prekopa. There are now also new and quite general laws of large numbers for function spaces that came from what was needed in stochastic programming.

OPTIMA: ***What is your feeling about the future of optimization and, more particularly, of stochastic programming?***

**RW**: Optimization is, of course, a fundamental human activity and has been a major modeling tool in the physical and social sciences. Because of this, it has constantly motivated the development of mathematical theories and techniques (calculus, the calculus of variations, significant portions of analysis, algorithmic procedures, etc.). There seems to be no reason why this shouldn't go on as long as there is some interest in finding "best" solutions. From a more limited viewpoint, I see some shift in the center of interest for the mathematical programming community. Our motivation has mostly come from the operations research-type problems. I suspect that engineering-type problems will become a more important source of motivating problems, and that will affect both the theoretical and computational developments. Typically, engineering-type problems are infinite dimensional in nature and not necessarily convex. This should stimulate work on approximations, large scale systems, and global optimization. As far as stochastic programming is concerned, I think the future is very bright now that the computational tools are becoming available. Since most important decision problems almost always involve some uncertainties, and since the solution of any model that doesn't take these uncertainties into account can be seriously flawed, even sometimes suggesting just the opposite course of action, I suspect that in the future any good decision maker confronted with an important decision will only let himself be guided by solutions generated by stochastic optimization models. Not only are stochastic programming problems of immediate practical interest, they are challenging conceptually, mathematically and computationally. That's what makes it so stimulating.

– KAREN AARDAL

# SOFTWARE & computation

**THIS** is the first regular article on computation and software. With time, I hope to develop this column into a standard format which will feature descriptions of optimization software, interviews with their developers, and informational pieces on modeling and computational issues. From time to time I will also invite a prominent researcher to write a feature article on the state of the art for solving specific classes of problems. The content of the column in this issue is primarily informational.

**TWO OF THE SERVICES** envisioned for this column are: (1) to provide readers with information for identifying and locating the best available software for their work and (2) to keep readers abreast of developments in computational technology. The latter would include both new mathematical procedures and their implementations on various architecture computers. Much of the information in (1) is published in newsletters of different professional societies. As it comes to my attention, I will provide it to the readers of OPTIMA. Please forward to me by e-mail any information and announcements which you would like to see receive wider circulation. As for the information in (2), I will rely on authors of methodology and vendors of software and hardware to contribute items to be communicated to members of the Mathematical Programming Society. I welcome e-mail correspondence on any matter of interest.

**THE COLUMN** in this issue will be devoted to problems and solutions in nonlinear and nonconvex programming. These problems have traditionally been relegated to academic pursuits with few real-world applications since large-scale instances were effectively intractable. But with the increasing use of heuristics coupled with the availability of fast and affordable computers, some promising progress is being made on a number of problems. Because most nonlinear and nonconvex programming techniques are based on solving a sequence of approximating linear or quadratic programs or models, our ability to solve efficiently large instances of these latter problems largely governs the tractability of the former problems. Unfortunately, popularity of a software product is not always positively correlated with its effectiveness, especially when it is too difficult to use correctly. Early nonlinear programming codes required the user to supply subroutines for all problem functions and their derivatives. Changing problem parameters involved editing and recompiling subroutines which added to the tedium of the task. Recent developments in algebraic modeling languages and automatic differentiation have done more to popularize nonlinear programming than decades of theoretical advances because now the power of the methods are placed in the hands of end-users who do not have to be nonlinear optimization researchers in order to understand how to input the problem and to interpret the solution output.

**THERE IS** still a long way to go before methods, software and hardware will come together to routinely solve the most persistent engineering design and real time control problems. However, the rate of progress should accelerate as more scientists and researchers embrace the many opportunities that are opening up to explore new paths for surmounting previously unreachable peaks. In order to contribute to that end, I offer below a sampling of software and reference material to (hopefully) launch some of our readers into this fruitful field of endeavor.

**THE APRIL 1995** issue of *OR/MS Today* (the INFORMS news magazine) contains a survey of nonlinear programming software by Stephen Nash. It lists 30 packages, both commercial and public domain, and includes pricing and all correspondence information. The packages are compared by the modeling languages they support, the platforms they run on, the algorithms they use, and the size of the problems they can solve. The listed software (usually by acronym) is as follows: AMPL, Constrained Maximum Likelihood, Constrained Optimization, CUTE, DFNLP, DOC (Direct Optimal Control), DOC/DOT, FSQP/CFSQP, GAMS, GINO, GRG2, IMSL FORTRAN and C Libraries, INTPT, LANCELOT, LINGO, LSSOL 1.02, MATLAB NAG Toolbox, MATLAB Optimization Toolbox, MINOS 5.4, NAG C Library, NAG FortMP, NAG FORTRAN Library, NLPQL, NPSOL 4.06, OPTIMA (no relation to this newsletter!), SLP, Smart Optimizer (SOPT) V1.2, SPRNLP, SQP, and What's Best! Future software surveys in *OR/MS Today* are scheduled for:

| | |
|---|---|
| **June** | Algebraic Modeling Languages |
| **August** | Simulation |
| **October** | Linear Programming |
| **December** | Scheduling. |

**CONFERENCES AND JOURNALS** devoted to computational issues in nonlinear and nonconvex programming continue to grow unabated, especially on focused applications areas. Some conferences are more like workshops dedicated to a single family of problems. Established journals for methodological developments in addition to *Mathematical Programming* Series B, include the *INFORMS Journal on Computing, SIAM Journal on Scientific Computing, Computational Optimization and Applications, Optimization Methods and Software*, and the *Journal of Global Optimization*, to name only a few. New journals that come to mind include the *Journal of Heuristics* (edited by Fred Glover), *Computational and Mathematical Organization Theory*, and *Reliable Computing* (formerly *Interval Computations*). Recently concluded conferences include the State of the Art in Global Optimization: Computational Methods and Applications held at Princeton University in April and the DIMACS Workshop on Global Minimization of Nonconvex Energy Functions: Molecular Conformation and Protein Folding held at Rutgers University in March. Proceedings of these two conferences are forthcoming.

**UPCOMING CONFERENCES** include the IMACS/GAMM International Symposium on Scientific Computing, Computer Arithmetic and Validated Numerics to be held at Bergische Universitat, Wuppertal, Germany, in September 1995, the Third Workshop on Global Optimization to be held in Szeged, Hungary, in December 1995, and the Fifth INFORMS Computer Science Technical Section Conference to be held in Dallas, Texas, in January 1996.

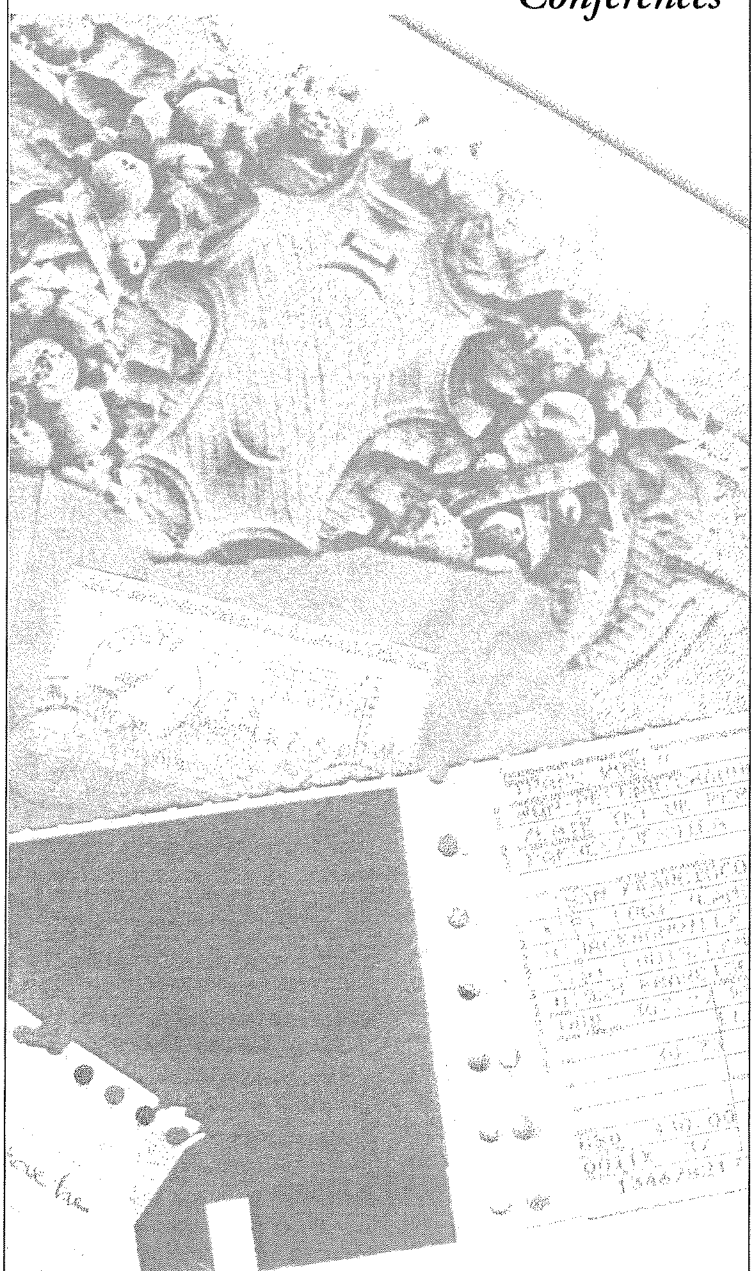
**IN A FUTURE ISSUE** of OPTIMA we plan to publish a list of internet sites that provide either access to or information on optimization software, test problems and problem generators, both commercial and public domain. Readers are encouraged to supply information for this list; I would like it to be as complete as possible.

- FAIZ AL-KHAYYAL

O P T I M A

# CONFERENCE NOTES

## *Forthcoming Conferences*



- Franco-Japanese and Franco-Chinese Conference on Combinatorics and Computer Science, Brest, France, July 3-5, 1995
- Conference on Optimization '95, Braga, Portugal, July 17-19
- International Symposium on Operations Research with Applications in Engineering, Technology, and Management (ISORA), Beijing, Aug. 19-22, 1995
- International Workshop on Parallel Algorithms for Irregularly Structured Problems, Lyon, France, Sept. 4-6, 1995
- Symposium on Operations Research 1995, University of Passau, Germany, Sept. 13-15
- AIRO '95 Annual Conference, Operational Research Society of Italy, Ancona, Italy Sept. 20-22, 1995
- ICCP-95-International Conference on Complementarity Problems: Engineering & Economic Applications, and Computational Methods, Baltimore, Maryland, U.S.A. Nov. 1-4, 1995
- Third Workshop on Global Optimization, Szeged, Hungary, December 10-14, 1995
- Conference on Network Optimization, Feb. 12-14, 1996, Center for Applied Optimization, Gainesville, Florida
- Workshop on SATISFIABILITY PROBLEM: THEORY AND APPLICATIONS Rutgers University March 11-13, 1996
- IPCO V, Vancouver, British Columbia, Canada, June 3-5, 1996
- IFORS 96 14th Triennial Conference, Vancouver, British Columbia, Canada, July 8-12, 1996
- International Conference on Nonlinear Programming, September 2-5, 1996, Beijing, China
- XVI International Symposium on Mathematical Programming, Lausanne, Switzerland, Aug. 1997

OPTIMA

## Report on the Oberwolfach Conference on Computational and Applied Convexity January 29 - February 4, 1995 Oberwolfach, Germany

This conference, organized by P. Gritzmann (Trier), V. Klee (Seattle) and P. Kleinschmidt (Passau) was attended by 38 participants from classical convexity theory, mathematical programming, computational geometry and computer science.

The presentations revealed exciting new developments in a field where, typically, the problems are algorithmic in nature, and the underlying structures are geometric with a special emphasis on convexity. The questions are usually motivated by practical applications in mathematical programming and computer science as well as other, less mathematical, areas of science.

Some lectures were devoted to integer programming and polyhedral combinatorics (William R. Pulleyblank, Andreas Hefner, Panos Pardalos). A new approach (Rekha R. Thomas) based on Gröbner bases and Newton-polytopes was presented. New results, some general, some related to particular applications, were given which utilize polyhedral approaches for solving large-scale combinatorial optimization problems. Various lattice point problems were studied, in part from the viewpoint of integer programming.

Other talks dealt with linear optimization (Robert M. Freund, Uriel G. Rothblum), convex optimization problems (Farid Alizadeh, Dorit Hochbaum), and semi-definite programming. New algorithms, partly motivated by results from classical convexity theory, were presented, and new insight was gained in known methods. There were also reports on some special purpose approaches which were tailored to particular practical applications.

Geometric aspects of nonlinear (smooth and nonsmooth) optimization were scrutinized in some other lectures. Geometric partitioning and covering problems turned out to be particularly relevant to global optimization (Pierre Hansen, Reiner Host).

Another group of talks focussed on the computation and optimization of certain geometric functionals. One of these was motivated by the Hadamard determinant problem. Some centered on algorithmic reconstruction problems which are related to problems in computer vision or computer tomography (Alexander Hufnagel, Peter Gritzmann). In this context the algorithmic theory of convex bodies played an important role.

Also presented were new algorithmic and theoretical results in geometric graph theory, the theory of polytopes, tilings, and related combinatorial objects, (Ludwig Danzer, Marek Karpinski, Victor Klee, Jeffrey C. Lagarias, János Pach, Shmuel Onn). One of the lectures (Günter M. Ziegler) surveyed the outstanding new results of Richter-Gebert on the realization space of convex polytopes, which solve a large variety of long-standing open problems in polyhedral theory.

The conference showed that even though the participants belonged to different fields with quite different tool-boxes, approaches, and ideas for solving their problems, there is a deep and close connection which is centered around the basic concept of convexity.

In addition to those mentioned above, lectures were given by Imre Bárány, Jürgen Bokowski, Thomas Burger, James V. Burke, Dietmar Cieslik, Komei Fukuda, Martin Henk, Petar Kenderov, David G. Larman, Horst Martini, Jiří Matoušek, Diethard Pallaschke, Svatopluk Poljak, Ricky Pollack, Nagabhushane Prabhu, Peter Recht, Joseph Stoer, and Eckhard Weidner.

P. PARDALOS

## Franco-Japanese and Franco-Chinese Conference Combinatorics and Computer Science, Brest, France July 3-5, 1995

The 8th Franco-Japanese, 4th Franco-Chinese Conference will focus on presentation of new results from various branches of Combinatorics and Computer Science and discussion of new problems of common interest. Topics will include combinatorial (optimization) problems in architectural synthesis, artificial intelligence, image processing, logic synthesis, parallel and distributed computing, scientific computing, and theoretical computer science.

There will be a series of 30-minute contributed talks. The preliminary list of speakers includes C. Berge, H. Fleischner, P. Hell, T.C. Hu, and H. Noltemeier.

Publication of the proceedings in a recognized journal/series will be considered.

**CONTACT ADDRESS:**

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fax: +33 98016131,
e-mail: ccs95@univ-brest.fr

## *First Announcement and Call for Papers*

## International Conference on Nonlinear Programming September 2-5, 1996 Beijing, China

CALL FOR PAPERS

An International Conference on Nonlinear Programming will be held at the Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Sciences, Beijing, China, from September 2-5, 1996. It is organized by the Chinese Academy of Sciences and the Chinese Natural Science Foundation.

Invited lectures on recent advances of nonlinear programming will be given. A preliminary list of invited speakers includes: J. Burke, R. Byrd, T. Coleman, A.R. Conn, J. Moré, J. Nocedál, M.J.D. Powell, R.B. Schnabel, M. Overton, K. Tanabe, R. Tapia, Ph. Toint, H. Wolkowitz and M.H. Wright.

A limited number of short (20 minutes) papers will be accepted for presentation. Papers on theoretical, computational and practical aspects of nonlinear programming are welcome.

In part, this meeting is intended to honor the many contributions of Professor M.J.D. Powell to Optimization. It is hoped that this meeting will be similar to the one which Professor Powell organized in Cambridge in 1981. There will be no parallel sessions. Apart from the invited lectures and submitted short talks, there will be also discussion sessions. The conference proceedings will be published by an international publisher, and all the papers will be reviewed.

One or two sightseeing tours, including visiting the Great Wall, will be organized by the conference. There is also a possibility of a post conference tour to Xi-an, an ancient capital of China, depending upon the number of interested participants.

Prospective participants other than invited speakers should send their pre-registration giving address (postal and e-mail, if available) and accommodation preference (single or double bedroom in hotel) to the address below by post or e-mail before July 31, 1995. A second announcement will be sent in September 1995 to all those who pre-register.

International Organizing Committee:

A.R. Conn (IBM Watson Research Center, Yorktown Heights, USA); J. Nocedál (Northwestern University, USA); Ph. Toint (University of Namur, BELGIUM); and Y. Yuan (Chinese Academy of Sciences, CHINA).

For further information, please contact the following address or any of the International organizing committee:

Prof. Ya-xiang Yuan State Lab. of Scientific and Engineering Computing ICMSEC, Chinese Academy of Sciences, P.O. Box 2719, Beijing 100080, China
Tel:+86-10-255-9001,+86-10-254-5820
FAX: +86-10-254-2285
e-mail: yyx@lsec.cc.ac.cn

### Third Workshop on Global Optimization
### Szeged, Hungary
### December 10-14, 1995

This workshop is being organized by the Austrian and Hungarian Operations Research Societies. Many technical, environmental and economic problems have challenging optimization aspects that require reliable and efficient solution methods. Many of these problems belong to the class of nonlinear and nonconvex optimization problems where standard optimization methods typically fail since local optima, different from the global ones that we aim to find, exist.

The workshop focuses on theoretical, modelling and algorithmic issues of global optimization problems with special emphasis on their real-life applications. The workshop aims at discussing and further developing the most recent results in the wide range of diverse approaches to global optimization problems.

After the first (1985) and the second (1990) Workshops held in Sopron, Hungary, we are glad to announce the Third Workshop on Global Optimization. From our preliminary discussions at various occasions during the last two years, we know that the overwhelming majority of the earlier participants and many other colleagues are interested. Thus we look forward to a meeting that is very likely to match or even surpass the very successful two earlier meetings.

**Program Committee:**
Pierre Hansen, Reiner Horst and Panos M. Pardalos

**Organization Committee:**
Immanuel Bomze and Gabriele Danninger, University of Vienna, Vienna, Austria,
**bomze@eos.smc.univie.ac.at**

András Erik Csallner and Tibor Csendes, József Attila University, Szeged, Hungary,
**csendes@inf.u-szeged.hu**

Organizing Committee Address:

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Phone: +36 62 310 011 (ext. 3839),
Fax: +36 62 312 292
E-mail: **globopt@inf.u-szeged.hu**

More information, including a registration form, can be found on the WorldWideWeb at site **http://www.inf.u-szeged.hu/~globopt/** or obtained via anonymous ftp from **ftp.jate.u-szeged.hu**, in the directory pub/math/optimization/globopt.

### Workshop on
### SATISFIABILITY PROBLEM: THEORY AND APPLICATIONS
### Rutgers University
### March 11-13, 1996

The satisfiability (SAT) problem is central in mathematical logic, computing theory, and many industrial application problems. The main focus of this workshop is to bring together the best theorists, algorithmists, and practitioners working on the SAT problem and its industrial applications. This workshop will feature the application of theoretical/algorithmic results to practical problems as well as the presentation of practical problems for theoretical/algorithmic study. Major topics to be covered in the workshop include: practical and industrial SAT problems and benchmarks, significant case studies and practical applications of the SAT problem and SAT algorithms, new algorithms and improved techniques for satisfiability testing, specific data structures and implementation details of the algorithms, and the theoretical study of the problem and algorithms. As an important activity of the workshop, a set of SAT problem benchmarks derived from practical industrial engineering applications will be provided for algorithm benchmarking.

**Organizers:**
Ding-Zhu Du, Jun Gu, and Panos Pardalos
E-mail: **dzd@cs.umn.edu**, **gu@enel.ucalgary.ca**, **pardalos@ufl.edu**

**Advisory Committee:**
Bob Johnson, David Johnson, Christos Papadimitriou, Paul Purdom, Benjamin Wah

# CALL FOR PAPERS

### IPCO V
### Vancouver, British Columbia, Canada
### June 3-5, 1996

The Fifth IPCO Conference On Integer Programming and Combinatorial Optimization will be held in Vancouver, British Columbia, and is sponsored by The Mathematical Programming Society. The conference will be held on the campus of the University of British Columbia. The campus is situated on the tip of Point Grey, with easy access to beaches, parks, and mountains. There will be a welcoming reception Sunday night and a social dinner on Tuesday night on top of Grouse Mountain which overlooks Vancouver. Reduced-rate dormitory as well as hotel accomodations will be available.

This series is held every year in which no MPS International Symposium takes place, and this meeting will highlight recent developments in theory, computation, and applications of integer programming and combinatorial optimization.

Topics include but are not limited to:

- polyhedral combinatorics
- integer programming
- cutting planes
- branch and bound
- geometry of numbers
- semi-definite relaxations
- computational complexity
- network flows
- matroids and submodular functions
- 0,1 matrices
- approximation algorithms
- scheduling theory and algorithms

In all these areas, we welcome structural and algorithmic results, revealing computational studies, and novel applications of these techniques to practical problems. The algorithms studied may be sequential or parallel, deterministic or randomized.

During the three days approximately 30 papers will be presented in a series of sequential (non-parallel) sessions. Each lecture will be 30 minutes long. The program committee will select the papers to be presented on the basis of extended abstracts which should be submitted as described below.

The proceedings of the conference will contain full texts of all presented papers. Copies will be provided to all participants at the time of registration.

A World-Wide Web page has been set up describing the history and scope of IPCO, with pointers to pages about the site and local universities. It also will be updated to contain the most recent information about the conference. The URL is **http://acme.commerce.ubc.ca/stmv/ipco.html**.

PROGRAM COMMITTEE:

William H. Cunningham (Chair), University of Waterloo; William J. Cook, Columbia University; Gerard Cornuejols, Carnegie Mellon University; Jan Karel Lenstra, Eindhoven University of Technology; Laszlo Lovasz, Yale University; Thomas L. Magnanti, Massachusetts Institute of Technology; Maurice Queyranne, University of British Columbia; and Giovanni Rinaldi, Istituto de Analisi dei Sistemi ed Informatica, Rome.

ORGANIZING COMMITTEE:

Maurice Queyranne (Chair), **quey@acme.commerce.ubc.ca**;
Frieda Granot, **Frieda.Granot@mtsg.ubc.ca**;
and S. Thomas McCormick, **stmv@acme.commerce.ubc.ca**

Faculty of Commerce University of British Columbia Vancouver, BC Canada V6T 1Z2
Fax: +1 (604) 822-9574

INSTRUCTIONS FOR CONTRIBUTORS:

Persons wishing to submit a paper should send eight copies of an extended abstract before October 31, 1995, to the following address:

Ms. Jessie Lam, H.A. 459, Faculty of Commerce, University of British Columbia, 2053 Main Mall, Vancouver, BC Canada V6T 1Z2

telephone +1 (604) 822-8505 fax +1 (604) 822-9574

NEXT PAGE

The extended abstract should be between five and 10 pages (typed, double spaced), i.e., approximately 2,000 words. TeX and LaTeX abstracts must use the single-column "article" style in at least eleven-point size. The abstract must provide sufficient detail concerning the results and their significance to enable the program committee to make its selection. Please include an e-mail address with your submission if possible.

Authors of all accepted papers will be notified by January 31, 1996. Notification will be by e-mail if an address is supplied; titles and authors of accepted papers will also be posted on the conference's Web page.

Final full versions of all accepted papers must be provided, in camera-ready format, by March 10, 1996. This will enable the proceedings to be printed and made available at the time of the meeting.

It is intended to publish the proceedings in the Springer Lecture Notes of Computer Science. Further details concerning the format of the final versions of the papers for the proceedings will be provided with notification of acceptance. The format will also be available from the conference's Web page, see above.

Papers in the proceedings will not be refereed, and it is expected that revised versions will subsequently be submitted for publication in appropriate journals.

DATES:

October 31, 1995: Deadline for submission of abstracts; January 31, 1996: Notification of acceptance of papers; March 10, 1996: Deadline for submission of papers and deadline for early registration.

## IFORS 96 14th Triennial Conference Vancouver, British Columbia, Canada July 8-12, 1996

The 1996 International Federation of Operational Research Societies conference will provide a bridge to link researchers and practitioners in OR.

A number of sessions have been arranged, but we welcome further suggestions. Papers will be invited from prominent researchers and practitioners by session organizers. Every national and kindred member society of IFORS is also invited to present a national contribution. Authors wishing to contribute papers are requested to submit an abstract not later than October 31, 1995.

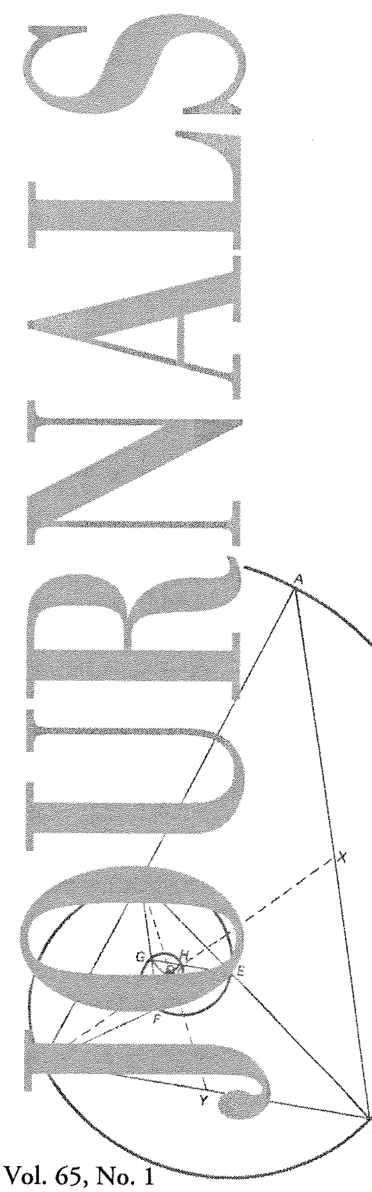
Abstracts of all papers will be published in advance of the conference. Several issues of Vol. 4 (1997) of *International Transactions in Operational Research* (ITOR) have been reserved for publication of papers presented. Authors are encouraged to prepare full papers for submission to this journal. All submitted papers will be refereed. Submission details and deadlines will be included in the Invitation Programme. A subscription to Vol. 4 of ITOR in six issues will be provided to each registrant as part of the registration package. Commercial exhibitors are invited to show books and computer software that have relevance to OR problem solving methodology.

The Invitation Programme will be mailed during the Fall of 1995 to all who sent an Abstract Submission or request for information to the IFORS 96 secretariat and to all authors. All participants will be required to register using the registration form included in the Invitation Programme.

Submit three copies of the abstract in English or French including title, 50-word abstract, authors name(s), organization, and mailing address. Presenting author should be listed first or underlined. Include cheque or money order for $100CAD (Canadian Dollars) payable to: IFORS 96. To pay by VISA or Mastercard include card number, expiration date and signature on one submission page. The fee will be returned if paper is not accepted. Otherwise, it will be credited toward registration fee. Abstract fee is non-refundable after December 31, 1995.

Conference Secretariat, IFORS 96, Venue West Conference Services Ltd., 645-375 Water Street, Vancouver, British Columbia, Canada V6B 5C6

Phone: (604) 681-5226 FAX: (604) 681-2503

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C. Zhu, *"Solving large-scale minimax problems with the primal-dual steepest descent algorithm."* [Erratum to *Math. Programming* 67 (1) (1994) 53-76]

# BOOK REVIEWS

## *Eigenvalues of Matrices*

by F. Chatelin

John Wiley and Sons, Chichester, 1993

ISBN 0-471-93538-7

A solver of eigenvalues is usually one of the fundamental blocks in many computer software packages to analyze and simulate the behavior of structures, various processes in physics and chemistry, economy, etc. In recent years efficiency of the solvers of eigenproblems has improved dramatically, resulting in solutions and computer simulations of very complex and large problems. This improvement has become possible mainly by combining progress in computers and progress in the theory of matrices and eigenvalues.

This book presents a modern and complete mathematical theory of the eigenvalue problems for matrices. Based on functional analysis and linear algebra, the author discusses various strategies and approximation methods in a general, though relatively simple, way. The mathematical proofs are presented in compact, clear patterns; many theoretical and numerical concepts are illustrated geometrically.

**"This book presents a modern and complete mathematical theory of the eigenvalue problems for matrices. Based on functional analysis and linear algebra, the author discusses various strategies and approximation methods in a general, though relatively simple, way."**

The first two chapters present fundamentals of linear algebra and functional analysis. Invariant subspaces, bases of and distances between two subspaces, spectral decomposition and projection are introduced and related to convergence of various iterative procedures. The third chapter shows examples of practical applications of the eigenvalues analysis, from mathematics to economy, chemistry and structural dynamics. Chapter 4 discusses the spectral conditioning and stability of the iterative processes. The analyses of *a priori* and *a posteriori* errors are presented. In Chapter 5 the convergence of a Krylov sequence of subspaces is analyzed. The last two chapters (Ch. 6 and 7) discuss methods of calculating eigenvalues for large matrices based on subspace iterations techniques. These methods are considered the most efficient and, in fact, are presently the most popular in computer applications. Chapter 6 presents the numerical methods of obtaining a set of extreme eigenvalues for large Hermitian (the Lanczos method) or non-Hermitian (the Arnoldi method) matrices. In Chapter 7 methods that use the concept of the Chebyshev polynomials for computing the eigenvalues of greatest real part of non-symmetric matrices are outlined.

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Most concepts and methods discussed are illustrated by numerous exercises and examples, some of them solved in the appendix.

The book, due to its mathematical vocabulary, notation and jargon, is essentially intended for mathematicians. However, researchers and students from other areas, who want either better understanding of the numerical algorithms or better orientation amongst numerous alternative iterative procedures now available, should also find it interesting and useful.

–W. SZYSKOWSKI

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## *Convex Analysis and Minimization Algorithms I and II*

by J.-B. Hiriart-Urruty and C. Lemaréchal

Springer-Verlag, Berlin, 1993

ISBN 3-540-56850-6 AND 3-540-56852-2

These two volumes comprise a comprehensive introduction to those areas of convex analysis and optimization that bear on the practical problem of instructing a computer to locate the minimizer of a convex function over *n*-dimensional Euclidean space. This innovative text is well written, copiously illustrated, and accessible to a wide audience. However, it is devoid of exercises and fails to deliver a reliable minimization algorithm. The former omission is important given the authors' pedagogical ambitions while the latter is a consequence of the state of the art and the authors' intent "to demonstrate a technical framework, rather than to establish a particular result." Let us take a closer look.

A smooth convex function, $f$ is minimized by a zero of its gradient, $\nabla f$. Minimization algorithms for such problems enjoy powerful convergence properties and wide use. Dropping the smooth assumption we recall that a minimizer is an element of the subdifferential, $f$, the collection of vectors dominated by the directional derivative of $f$. The design of an effective minimization algorithm in this case is considerably more difficult. The progress made to date has required a much closer study of convex analysis than was necessary in the smooth case. Hiriart-Urruty and Lemaréchal attempt to present this closer study and its numerical application in a manner accessible to one whose mathematical background may not exceed calculus. Given their prominent roles in the development of the field and their open faced enthusiasm for its interplay between theory and practice, it should come as little surprise that the authors have largely succeeded in their task.

**"Given their prominent roles in the development of the field and their open faced enthusiasm for its interplay between theory and practice, it should come as little surprise that the authors have largely succeeded in their task."**

Volume I constitutes an outstanding introduction to the fields of convex analysis and minimization algorithms. The text begins with a chapter on each, the first on convex functions of one variable and the second on optimization algorithms for smooth functions. Convex sets, convex functions of several variables, and constrained convex minimization are then considered. The volume closes with an application of a modified steepest descent algorithm to a general nonsmooth convex function. The modification being the substitution of the full subdifferential for the gradient. The authors, by this time, have prepared the reader to the degree that he understands *why* such an application is satisfactory neither on theoretical nor on practical grounds. This whets the reader's appetite for the more refined techniques of Volume II.

The second volume opens with a conceptual algorithm for producing a descent direction without necessarily computing the entire subdifferential. The authors make this concept implementable at the cost of further extending the notion of derivative. In particular, they require the ε-subdifferential, $_{\varepsilon}f$, the collection of vectors dominated by ε plus the di-

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rectional derivative of $f$. The calculus of such subdifferentials and their relation to the convex conjugate of $f$ is developed in some detail prior to their proposal of a preliminary $\varepsilon$-descent algorithm. Its careful scrutiny leads the authors to the improved Algorithm 3.4.2 of Chapter XIV. After a number of numerical tests, the authors conclude that the "algorithm can be viewed as a robust minimization method," though "the need for a parameter hard to choose (namely $\varepsilon$) has not been totally eliminated," and hence that the algorithm "does lack full reliability." The reader who, having eagerly swallowed the bait in the final chapter of volume I, willingly accepted the $\varepsilon$-subdifferential and its analytical baggage may well find frustration in this "lack full reliability." The authors, I believe, would argue that they never promised a general purpose algorithm and that a reader who insists on extracting a practical tool from a mathematics text will find frustration more often than not.

Indeed, one cannot judge a text that purports to "light the entrance of the monument Convex Analysis and Minimization Algorithms," in terms of its ability to deliver a working piece of code. The authors have in fact lit considerably more than just the entrance. Who shall benefit? This dialectic of theory and algorithm seems to me especially well suited to a sophomore/junior level year-long introduction to computational science, a major that has begun to stand on its own. The first volume raises all the right questions but in a sufficiently narrow context, namely convex. This permits the young reader to actually focus on a specific tractable problem, something that is often missing from a survey-like introductory course. The second volume, being perhaps too narrow to constitute the remainder of such introduction, is amenable to hopping and affords many opportunities to address broader issues in the larger arenas of nonlinear programming and nonsmooth analysis. The appeal of these volumes is in no way limited, however, to an undergraduate audience. One can easily imagine building a graduate seminar around volume II while the ample bibliography together with the bibliographic comments associated with each of the chapters makes the set an invaluable resource for research.

–STEVEN COX

# APPLICATION FOR MEMBERSHIP

Mail to:
**The Mathematical Programming Society, Inc.**
**c/o International Statistical Institute**
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**2270 AZ Voorburg**
**The Netherlands**

Cheques or money orders should be made payable to **The Mathematical Programming Society, Inc.**, in one of the currencies listed below. Dues for 1995, including subscription to the journal *Mathematical Programming*, are HFL100.00 (or USD55.00 or DEM85.00 or GBP32.50 or FRF300.00 or CHF80.00).

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Nº 46

**JULY** 1995

**Egon Balas** (Carnegie-Mellon) received the 1995 John von Neumann theory prize for his career work in integer programming. The award was made at the Spring INFORMS meeting in Los Angeles. ❦ The executive committee of MPS is planning to create a home page on the World Wide Web. More news follows soon. ❦ The book, ***Network Flows***, by R.K. Ahuja, T.L. Magnanti and J.B. Orlin received the Lanchester Prize at the Fall 1994 ORSA/TIMS meeting. ❦ Deadline for the next OPTIMA is September 15, 1995.


O P T I M A

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