
MODELS AND ALGORITHMS FOR GLOBAL OPTIMIZATION

Essays Dedicated to Antanas Žilinskas on the Occasion of
His 60th Birthday

Optimization and Its Applications

VOLUME 4

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Aims and Scope

Optimization has been expanding in all directions at an astonishing rate during the last few decades. New algorithmic and theoretical techniques have been developed, the diffusion into other disciplines has proceeded at a rapid pace, and our knowledge of all aspects of the field has grown even more profound. At the same time, one of the most striking trends in optimization is the constantly increasing emphasis on the interdisciplinary nature of the field. Optimization has been a basic tool in all areas of applied mathematics, engineering, medicine, economics and other sciences.

The series *Optimization and Its Applications* publishes undergraduate and graduate textbooks, monographs and state-of-the-art expository works that focus on algorithms for solving optimization problems and also study applications involving such problems. Some of the topics covered include nonlinear optimization (convex and nonconvex), network flow problems, stochastic optimization, optimal control, discrete optimization, multi-objective programming, description of software packages, approximation techniques and heuristic approaches.

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birthday



Antanas Žilinskas

Preface

Antanas Žilinskas was born on January 5, 1946 in Lithuania. He graduated with a gold medal from 2nd Kaunas Gymnasium in 1963 and with a distinction diploma of Electrical Engineering from Kaunas University of Technology in 1968. His Ph.D. studies (aspirantur) at Lithuanian Academy of Sciences lasted from 1970 to 1973. The Candidate of Sciences (Ph.D.) degree in Technical Cybernetics (1973) has been received from Kaunas University of Technology. The Doctor of Mathematical Sciences degree (Habilitation, 1985) has been received from St. Petersburg (Leningrad) University. The title Senior Research Fellow (1980) has been conferred by the Presidium of Academy of Sciences, and the title Professor (1989) by Vilnius Pedagogical University. He has been awarded (with V. Šaltenis and G. Dzemyda) Lithuanian National Award for scientific achievements of 2001 for the research on “Efficient optimization methods and their applications”.

A. Žilinskas joined the Institute of Mathematics and Informatics in 1973 starting with a position of junior research associate, worked as a senior research associate reaching the highest rank of principal researcher which is his main position now. Apart from working in the research institute he was a lecturer at Vilnius Pedagogical University 1986–1988, where he founded a department of Informatics in 1988 and held a position of professor and head of this department 1988–1993. He worked later as a professor of this department until 2000. He founded a Department of Applied Informatics at Vytautas Magnus University in 1994, and from then he holds a position of professor and head of this department. A. Žilinskas taught Optimization theory and methods at all levels; Operations research; Analysis of algorithms at all levels; Calculus, Statistics, and Linear algebra for undergraduates.

A. Žilinskas held a visiting Konrad Zuse professorship at Dortmund University (1990/1991 academic year). As a visiting research professor he worked also at Åbo Akademi, Technical University Aachen, Copenhagen University, London University (UCL).

A. Žilinskas is an academician of International Engineering Academy. He is a member of American Mathematical Society, IEEE including Computer

Society and Computational Intelligence Society, IFIP Working Group 7.6 on Computer Aided Optimization Based Modeling and Optimization. He is a member of editorial boards of international journals *Journal of Global Optimization*, *Control and Cybernetics*, *Informatica*. He is a reviewer for *Mathematical Reviews*, *Zentralblatt für Mathematic*, book section of *INFORMS Interfaces*.

Many projects were fulfilled by A. Žilinskas for industry in seventies and eighties; e.g. the results of optimal design of magnetic deflection systems of color TV sets, and of optimal design of pigment mixtures for paint technology are referenced in the book *Global Optimization*, Springer, 1989, written with A. Törn. He was a chairman of Lithuanian part of international project *Computing, Information Services and the Internet*, which was fulfilled in 1996–1997 cooperating with Växjö University (Sweden). He was a Managing Director of TEMPUS project *Modelling of Economics and Business Systems* funded by EU in 1997–2000 with participation of Vytautas Magnus University, Kaunas University of Technology from Lithuania, and Copenhagen University (Denmark), Maastricht University (Netherlands) from EU. He was a partner (with Prof. J. Calvin) in the project *Probabilistic Analysis of Global Optimization Algorithms* funded by National Research Council (USA) under Collaboration in Basic Science and Engineering Program 1998–2000.

A. Žilinskas has published more than 100 papers mainly on statistical global optimization theory, algorithms and applications, 5 monographs and 6 textbooks; the titles of the monographs follow:

- Žilinskas, A.: *Global Optimization: Axiomatic of Statistical Models; Algorithms; Applications*. Mokslas (1986) (in Russian),
- Törn, A., Žilinskas, A.: *Global Optimization*. Springer (1989),
- Šaltenis, V., Žilinskas, A.: *Search for Optimum*. Nauka (1989),
- Zhigljavsky, A., Žilinskas, A.: *Methods of Search for Global Extremum*. Nauka (1991) (in Russian),
- Žilinskas, A. (ed) *System Analysis, Design and Optimization*. Space Technology (1993),

He was a co-editor of the book

- Dzemyda, G., Šaltenis, V., Žilinskas, A. (eds) *Stochastic and Global Optimization*. Kluwer (2002).

Current research interests of A. Žilinskas are statistical theory of global optimization, optimization based modeling and design, analysis of multidimensional data by means of visualization. Research is oriented to develop statistical models of global optimization, implement and investigate the corresponding algorithms, and apply them to practical problems.

This book is dedicated to A. Žilinskas on the occasion of his 60th birthday. The chapters cover research interests of A. Žilinskas. The book is divided into six parts: I. Advanced Models in Optimization Theory; II. Interval Algorithms;

III. Deterministic Optimization Models and Algorithms; IV. Stochastic Algorithms; V. Educational Aspects; and VI. Applications.

Part I consists of two chapters at the forefront of research. Chinchuluun and Pardalos consider optimality conditions and duality for multiobjective programming problems with generalized convexity. Floudas and Kreinovich consider the problem of selecting the best auxiliary function within a given global optimization technique.

Part II consists of four chapters on interval algorithms for global optimization. Kj oller, Kozine, Madsen and Stauning describe interval global optimization and constraint propagation for solving systems of non-linear equations, and combine them to improve performance of global optimization. Kosheleva discusses optimal data compression under interval uncertainty. Pedamallu,  zdamar and Csendes present interval partitioning algorithm for continuous constrained global optimization problems.  zilinskas and Bogle review estimation of ranges of functions combining interval arithmetic and underestimating interval arithmetic.

Part III consists of four chapters on deterministic optimization models and algorithms. Antamoshkin and Masich consider heuristic algorithms for a constrained pseudo-Boolean optimization problem. Sergeev, Khalaf and Kvasov review Lipschitz univariate constrained global optimization algorithms for solving problems with multiextremal non-differentiable constraints. Szab  and Specht review models and algorithms for the packing of equal circles in a square.  altenis presents simulation of wet film evolution for solving Euclidean Steiner problem.

Part IV consists of four chapters on stochastic algorithms for global optimization. Ali presents a probabilistic hybrid differential evolution algorithm. Calvin concerns nonadaptive univariate optimization using Wiener process model assuming that the function values are corrupted by independent Gaussian noise. Hamilton, Savani and Zhigljavsky consider linear and maximum likelihood estimators of the minimum of a function in global random search methods. Molvalioglu, Zabinsky and Kohn presents a multi-particle version of simulated annealing where points in the population interact with each other.

Part V concerns educational aspects of global optimization. Hendrix shows how the concepts of global optimization algorithms may be introduced to students and researchers. Mockus discusses Internet aided distance graduate studies of the course on optimal sequential decisions with several objective functions.

Part VI consists of five chapters on applications of global optimization. Bernatavi ien , Dzemyda, Kurasova, Marcinkevi ius and Medvedev consider visual analysis of multidimensional medical data.  iegis describes applications where global optimization is essential part of mathematical modeling cycle. Fraga and Papageorgiou apply hybrid optimization for the design of optimal water distribution networks. Kaminskas considers practical issues in the implementation of self-tuning control systems. McAllister, Rajgaria and Floudas address global pairwise sequence alignment problem in a mathematically-

detailed, rigorous and generic manner using mixed-integer linear programming.

On behalf of all the contributors of this Festschrift we would like to congratulate Antanas Žilinskas on the occasion of his 60th birthday and to wish him well and continued success in scientific career.

Åbo, Finland
Vilnius, Lithuania
January 2006

Aimo Törn
Julius Žilinskas

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