Numerica

A Modeling Language for Global Optimization

Pascal Van Hentenryck, Laurent Michel, and Yves Deville

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Cheng Seong Khor

Numerica A Modeling Language For Global Optimization:

   Numerica Pascal Van Hentenryck,Laurent Michel,Yves Deville,1997 Many science and engineering applications require the user to find solutions to systems of nonlinear constraints or to optimize a nonlinear function subject to nonlinear constraints The field of global optimization is the study of methods to find all solutions to systems of nonlinear constraints and all global optima to optimization problems Numerica is modeling language for global optimization that makes it possible to state nonlinear problems in a form close to the statements traditionally found in textbooks and scientific papers The constraint solving algorithm of Numerica is based on a combination of traditional numerical methods such as interval and local methods and constraint satisfaction techniques This comprehensive presentation of Numerica describes its design functions and implementation It also discusses how to use Numerica effectively to solve practical problems and reports a number of experimental results A commercial implementation of Numerica is available from ILOG under the name ILOG Numerica   Modeling Languages in Mathematical Optimization Josef Kallrath,2013-12-01 This volume presents a unique combination of modeling and solving real world optimization problems It is the only book which treats systematically the major modeling languages and systems used to solve mathematical optimization problems and it also provides a useful overview and orientation of today s modeling languages in mathematical optimization It demonstrates the strengths and characteristic features of such languages and provides a bridge for researchers practitioners and students into a new world solving real optimization problems with the most advances modeling systems   **Global Optimization and Constraint Satisfaction** Christian Bliek,Arnold Neumaier,2003-11-05 This book constitutes the thoroughly refereed post proceedings of the First International Workshop on Global Constraints Optimization and Costraint Satisfaction COCOS 2002 held in Valbonne Sophia Antipolis France in October 2002 The 15 revised full papers presented together with 2 invited papers were carefully selected during two rounds of reviewing and improvement The papers address current issues in global optimization mathematical programming and constraint programming they are grouped in topical sections on optimization constraint satisfaction and benchmarking   Global Optimization Using Interval Analysis Eldon Hansen,G. William Walster,2003-12-19 Employing a closed set theoretic foundation for interval computations Global Optimization Using Interval Analysis simplifies algorithm construction and increases generality of interval arithmetic This Second Edition contains an up to date discussion of interval methods for solving systems of nonlinear equations and global optimization problems It expands and improves various aspects of its forerunner and features significant new discussions such as those on the use of consistency methods to enhance algorithm performance Provided algorithms are guaranteed to find and bound all solutions to these problems despite bounded errors in data in approximations and from use of rounded arithmetic   *Frontiers in Global Optimization* Christodoulos A. Floudas,Panos M. Pardalos,2013-12-01 Global Optimization has emerged as one of the most exciting new areas of mathematical programming Global optimization has received a wide attraction from many fields in the past few

years due to the success of new algorithms for addressing previously intractable problems from diverse areas such as computational chemistry and biology biomedicine structural optimization computer sciences operations research economics and engineering design and control This book contains refereed invited papers submitted at the 4th international confer ence on Frontiers in Global Optimization held at Santorini Greece during June 8 12 2003 Santorini is one of the few sites of Greece with wild beauty created by the explosion of a volcano which is in the middle of the gulf of the island The mystic landscape with its numerous mult extrema was an inspiring location particularly for researchers working on global optimization The three previous conferences on Recent Advances in Global Opti mization State of the Art in Global Optimization and Optimization in Computational Chemistry and Molecular Biology Local and Global approaches took place at Princeton University in 1991 1995 and 1999 respectively The papers in this volume focus on de terministic methods for global optimization stochastic methods for global optimization distributed computing methods in global optimization and applications of global optimiza tion in several branches of applied science and engineering computer science computational chemistry structural biology and bio informatics   Global Optimization and Constraint Satisfaction Christophe Jermann,2005-05-24 This book constitutes the throughly refereed post proceedings of the Second International Workshop on Global Optimization and Constraint Satisfaction COCOS 2003 held in Lausanne Switzerland in Nowember 2003 The 13 revised full papers presented were carefully selected and went through two rounds of reviewing and improvement The papers are devoted to theoretical algorithmic and application oriented issues in global constrained optimization and constraint satisfaction they are organized in topical sections on constraint satisfaction problems global optimization and applications   IJCAI-97 International Joint Conferences on Artificial Intelligence,1997   Model-Based Optimization for Petroleum Refinery Configuration Design Cheng Seong Khor,2024-01-03 Model Based Optimization for Petroleum Refinery Configuration Design An accessible easy to read introduction to the methods of mixed integer optimization with practical applications real world operational data and case studies Interest in model based approaches for optimizing the design of petroleum refineries has increased throughout the industry in recent years Mathematical optimization based on mixed integer programming has brought about the superstructure optimization method for synthesizing petroleum refinery configurations from multiple topological alternatives Model Based Optimization for Petroleum Refinery Configuration Design presents a detailed introduction to the use of mathematical optimization to solve both linear and nonlinear problems in the refining industry The book opens with an overview of petroleum refining processes basic concepts in mathematical programming and applications of mathematical programming for refinery optimization Subsequent chapters address superstructure representations of topological alternatives mathematical formulation solution strategies and various modeling frameworks Practical case studies demonstrate refinery configuration design refinery retrofitting and real world issues and considerations Presents linear nonlinear and mixed integer programming approaches applicable to both new and existing

petroleum refineries Highlights the benefits of model based solutions to refinery configuration design problems Features detailed case studies of the development and implementation of optimization models Discusses economic considerations of heavy oil processing including cash flow analysis of refinery costs and return on capital Includes numerical examples based on real world operational data and various commercial technologies Model Based Optimization for Petroleum Refinery Configuration Design is an invaluable resource for researchers chemical engineers process and energy engineers other refining professionals and advanced chemical engineering students   *Relaxation and Decomposition Methods for Mixed Integer Nonlinear Programming* Ivo Nowak,2006-03-28

Nonlinearoptimizationproblemscontainingbothcontinuousanddiscretevariables are called mixed integer nonlinear programs MINLP Such problems arise in many elds such as process industry engineering design communications and nance There is currently a huge gap between MINLP and mixed integer linear programming MIP solvertechnology With a modernstate of the artMIP solver itispossibletosolvemodelswithmillionsofvariablesandconstraints whereasthe dimensionofsolvableMINLPsisoftenlimitedbyanumberthatissmallerbythree or four orders of magnitude It is theoretically possible to approximate a general MINLP by a MIP with arbitrary precision However good MIP approximations are usually much larger than the original problem Moreover the approximation of nonlinear functions by piecewise linear functions can be di cult and ti consuming In this book relaxation and decomposition methods for solving nonconvex structured MINLPs are proposed In particular a generic branch cut and price BCP framework for MINLP is presented BCP is the underlying concept in almost all modern MIP solvers Providing a powerful decomposition framework for both sequential and parallel solvers it made the success of the current MIP technology possible So far generic BCP frameworks have been developed only for MIP for example COIN BCP IBM 2003 andABACUS OREAS GmbH 1999 In order to generalize MIP BCP to MINLP BCP the following points have to be taken into account A given sparse MINLP is reformulated as a block separable program with linear coupling constraints The block structure makes it possible to generate Lagrangian cuts and to apply Lagrangian heuristics In order to facilitate the generation of polyhedral relaxations nonlinear c vex relaxations are constructed The MINLP separation and pricing subproblems for generating cuts and columns are solved with specialized MINLP solvers

Essays and Surveys in Global Optimization Charles Audet,Pierre Hansen,Giles Savard,2005-04-20 Global optimization aims at solving the most general problems of deterministic mathematical programming to find the global optimum of a nonlinear nonconvex multivariate function of continuous and or integer variables subject to constraints which may be themselves nonlinear and nonconvex In addition once the solutions are found proof of its optimality is also expected from this methodology Therefore with these difficulties in mind global optimization is becoming an increasingly powerful and important methodology Essays and Surveys in Global Optimization is the most recent examination of its mathematical capability power and wide ranging solutions to many fields in the applied sciences   *Encyclopedia of Optimization*

Christodoulos A. Floudas,Panos M. Pardalos,2008-09-04 The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research the richness of ideas and the breadth of applications that has come from this field The second edition builds on the success of the former edition with more than 150 completely new entries designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced Particularly heavy attention resulted in health science and transportation with entries such as Algorithms for Genomics Optimization and Radiotherapy Treatment Design and Crew Scheduling **Applied Interval Analysis** Luc Jaulin,Michel Kieffer,Olivier Didrit,Eric Walter,2012-12-06 At the core of many engineering problems is the solution of sets of equa tions and inequalities and the optimization of cost functions Unfortunately except in special cases such as when a set of equations is linear in its un knowns or when a convex cost function has to be minimized under convex constraints the results obtained by conventional numerical methods are only local and cannot be guaranteed This means for example that the actual global minimum of a cost function may not be reached or that some global minimizers of this cost function may escape detection By contrast interval analysis makes it possible to obtain guaranteed approximations of the set of all the actual solutions of the problem being considered This together with the lack of books presenting interval techniques in such a way that they could become part of any engineering numerical tool kit motivated the writing of this book The adventure started in 1991 with the preparation by Luc Jaulin of his PhD thesis under Eric Walter s supervision It continued with their joint supervision of Olivier Didrit s and Michel Kieffer s PhD theses More than two years ago when we presented our book project to Springer we naively thought that redaction would be a simple matter given what had already been achieved Building Decision Support Systems Mark Wallace,2020-04-23 This book introduces readers to the principles of intelligent decision support systems IDSS and how to build them with MiniZinc a free open source constraint programming language Managing an IDSS project requires an understanding of the system s design and behaviour The book enables readers to appreciate what combinatorial optimisation problems are and how modelling a problem provides the basis for solving it It also presents the main algorithms for tackling decision support problems discusses their strengths and weaknesses and explores ways of achieving the necessary scalability when problems become big Moreover to support the learning process it allows readers to try out the ideas described in the text on model applications and puzzles The book highlights the potential benefits of deploying an IDSS It enables users to recognise the key risks involved and identify which techniques can be applied to minimise them and to understand the decision support technology sufficiently in order to manage or monitor an IDSS project It also helps readers distinguish between good sense and mere jargon when dealing with anyone involved in an IDSS project from sales personnel to software implementers As such it especially appeals to graduate students and advanced professionals who need to learn how to build an IDSS and to tackle the problems on the way **Modelling, Simulation and Control of the Dyeing Process** R. Shamey,X. Zhao,2014-08-14 With increased environmental awareness and rising costs

manufacturers are investing in real time monitoring and control of dyeing to increase its efficiency and quality This book reviews ways of automating the dyeing process as well as ways of understanding key processes in dyeing including dye transport in fluid systems This understanding is then used to create models to simulate the dyeing process which can then be used to develop appropriate measurement and control systems Control of variables such as temperature pH conductivity and dye concentration can then be used to ensure a more consistent and cost effective dyeing process Reviews the dyeing process and dye house automation and the factors that affect dyeing quality and common difficulties in the process Explains the principles underlying the dyeing process and provides a thorough understanding of the mathematical models that can be used to approximate it Discusses techniques for monitoring dyebaths and controlling the dyeing process **Handbook of Constraint Programming** Francesca Rossi,Peter van Beek,Toby Walsh,2006-08-18 Constraint programming is a powerful paradigm for solving combinatorial search problems that draws on a wide range of techniques from artificial intelligence computer science databases programming languages and operations research Constraint programming is currently applied with success to many domains such as scheduling planning vehicle routing configuration networks and bioinformatics The aim of this handbook is to capture the full breadth and depth of the constraint programming field and to be encyclopedic in its scope and coverage While there are several excellent books on constraint programming such books necessarily focus on the main notions and techniques and cannot cover also extensions applications and languages The handbook gives a reasonably complete coverage of all these lines of work based on constraint programming so that a reader can have a rather precise idea of the whole field and its potential Of course each line of work is dealt with in a survey like style where some details may be neglected in favor of coverage However the extensive bibliography of each chapter will help the interested readers to find suitable sources for the missing details Each chapter of the handbook is intended to be a self contained survey of a topic and is written by one or more authors who are leading researchers in the area The intended audience of the handbook is researchers graduate students higher year undergraduates and practitioners who wish to learn about the state of the art in constraint programming No prior knowledge about the field is necessary to be able to read the chapters and gather useful knowledge Researchers from other fields should find in this handbook an effective way to learn about constraint programming and to possibly use some of the constraint programming concepts and techniques in their work thus providing a means for a fruitful cross fertilization among different research areas The handbook is organized in two parts The first part covers the basic foundations of constraint programming including the history the notion of constraint propagation basic search methods global constraints tractability and computational complexity and important issues in modeling a problem as a constraint problem The second part covers constraint languages and solver several useful extensions to the basic framework such as interval constraints structured domains and distributed CSPs and successful application areas for constraint programming Covers the whole field of constraint programming Survey style chapters Five chapters on

applications **Scientific Computing, Validated Numerics, Interval Methods** Walter Krämer,Jürgen Wolff von Gudenberg,2013-04-17 Scan 2000 the GAMM IMACS International Symposium on Scientific Computing Computer Arithmetic and Validated Numerics and Interval 2000 the International Conference on Interval Methods in Science and Engineering were jointly held in Karlsruhe September 19 22 2000 The joint conference continued the series of 7 previous Scan symposia under the joint sponsorship of GAMM and IMACS These conferences have traditionally covered the numerical and algorithmic aspects of scientific computing with a strong emphasis on validation and verification of computed results as well as on arithmetic programming and algorithmic tools for this purpose The conference further continued the series of 4 former Interval conferences focusing on interval methods and their application in science and engineering The objectives are to propagate current applications and research as well as to promote a greater understanding and increased awareness of the subject matters The symposium was held in Karlsruhe the European cradle of interval arithmetic and self validating numerics and attracted 193 researchers from 33 countries 12 invited and 153 contributed talks were given But not only the quantity was overwhelming we were deeply impressed by the emerging maturity of our discipline There were many talks discussing a wide variety of serious applications stretching all parts of mathematical modelling New efficient publicly available or even commercial tools were proposed or presented and also foundations of the theory of intervals and reliable computations were considerably strengthened **Applied Wavelet Analysis with S-PLUS** Andrew Bruce,Hong-Ye Gao,1996-06-20 Using a visual data analysis approach wavelet concepts are explained in a way that is intuitive and easy to understand Furthermore in addition to wavelets a whole range of related signal processing techniques such as wavelet packets local cosine analysis and matching pursuits are covered and applications of wavelet analysis are illustrated including nonparametric function estimation digital image compression and time frequency signal analysis This book and software package is intended for a broad range of data analysts scientists and engineers While most textbooks on the subject presuppose advanced training in mathematics this book merely requires that readers be familiar with calculus and linear algebra at the undergraduate level

Artificial Intelligence and Symbolic Computation Bruno Buchberger,John A. Campbell,2004-09-10 This book constitutes the refereed proceedings of the 7th International Conference on Artificial Intelligence and Symbolic Computation AISC 2004 held in Linz Austria in September 2004 The 17 revised full papers and 4 revised short papers presented together with 4 invited papers were carefully reviewed and selected for inclusion in the book The papers are devoted to all current aspects in the area of symbolic computing and AI mathematical foundations implementations and applications in industry and academia

Principles and Practice of Constraint Programming - CP98 Michael Maher,Jean-Francois Puget,2003-05-20 Constraints have emerged as the basis of a representational and computational paradigm that draws from many disciplines and can be brought to bear on many problem domains This volume contains papers dealing with all aspects of c puting with constraints In particular there are several papers on applications of constraints re ecting the practical usefulness of

constraint programming The papers were presented at the 1998 International Conference on Principles and Practice of Constraint Programming CP 98 held in Pisa Italy 26 30 tober 1998 It is the fourth in this series of conferences following conferences in Cassis France Cambridge USA and Schloss Hagenberg Austria We received 115 high quality submissions In addition 7 abstracts submissions were not followed by a full paper hence were not counted as submissions The program committee selected 29 high quality papers after thorough refereeing by at least 3 experts and further discussion by committee members We thank the referees and the program committee for the time and e ort spent in reviewing the papers The program committee invited three speakers Joxan Ja ar Peter Jeavons Patrick Prosser Their papers are in this volume

Principles and Practice of Constraint Programming - CP 2010 David Cohen,2010-08-30 The 16th annual International Conference on the Principles and Practice of Constraint Programming CP 2010 was held in St Andrews Scotland during September 6 10 2010 We would like to thank our sponsors for their generous support of this event This conference is concerned with all aspects of computing with constraints including theory algorithms applications environments languages modelsand systems We received a wide variety of submissions each of which was reviewed by at least three referees Referees were chosen for each submission by an initial bidding process where Program Committee members chose papers from their area of interest The range of expertise represented by the large Program C mittee meant that almost all submissions were reviewed by subject experts on the Program Committee or by colleagues chosen by members of the Program Committee for their particular expertise Papers weresolicitedeither as long 15 page or short 8 page submissions Short paper submissions were refereed to exactly the same high standards as long paper submissions but naturally were expected to contain a smaller quantity of new material Thus there is no disti tion in these proceedings between short and long papers I used the excellent EasyChair conference management system to support this process of reviewing and for the collation and organization of these proceedings Submissions were made either to the applications track or to the research track Therewere101 23short researchtracksubmissionsofwhich36 8short wereaccepted whichisa36% 35%ofshort acceptancerate Applicationstrack submissions received special consideration and the acceptance rate was sign cantly higher than for the research track

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