# VITA

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**Date and Place of Birth:**

March 8, 1937; Kansas City, Missouri

**Education:**

B.B.A., University of Missouri, Kansas City, 1960

Ph.D., Carnegie-Mellon University, 1965

**Experience:**

Distinguished Professor, University of Colorado, 2005 – present

Chief Executive Officer, Meta-Analytics, Inc., 2014 – present

Chief Technology Officer, OptTek Systems, Inc., 1992 – 2014

Director of Research, Hearin Center for Enterprise Science, 2000 – 2002.

MediaOne and US West Chaired Professor, University of Colorado, 1986 – 2006

Director of Technology Development, Management Robotics, Inc., 1981 – 1992

Head of Research, NASA Center for Space Construction, University of Colorado, 1990 – 1991.

Graduate Faculty of Applied Mathematics (founding member), University of Colorado, 1983 – present.

Director of Research, Center for Applied Artificial Intelligence (founding member), University of Colorado, 1984 – 1990.

Honorary Professor of Mathematics, University of Colorado, Denver, 1988 – present.

John King Chaired Professor and Professor of Management Science, University of Colorado, 1970 – 1986.

Research Director, Analysis, Research and Computation, Inc., 1969 - 1981

Research Fellow | Associate Professor, Operations Research and Computer Science, University of California, Berkeley, 1965 – 1967 | University of Texas, 1967 – 1970.

**Principal Research Areas:**

Mathematical and computer optimization, applied to systems design, artificial intelligence, decision support, machine learning, natural resources and economic planning, large scale networks, dynamic allocation models, industrial and scientific process control.

**Professional Associations:**

The American Association for the Advancement of Science (AAAS); Institute of Electrical and Electronics Engineers (IEEE); Mathematical Programming Society (MPS); Association for Computing Machinery (ACM); Production and Operations Management Society (POMS); Institute of Operations Research and Management Science (INFORMS); Decision Sciences Institute (DSI); Institute of Incorporated Engineers (IIE).

**Distinctions, Awards & Prizes:**

U. S. National Academy of Engineering, Elected Member, 2002.

John Von Neuman Theory Prize, by the *Institute for Operations Research and Management Science*, for distinguished lifetime contributions to the theory of operations research, management science and combinatorial optimization 1998.

The Siwei Chen Award, by the *International Academy of Information Technology and Quantitative Management*, for innovations in quantitative methods and information technology to solve management problems, 2016.

2013 Herbert A. Simon Award for Outstanding Contribution in Information Technology and Decision Making, for "New Optimization Models for Data Mining" by Fred W. Glover and Gary Kochenberger, *International Journal of Information Technology & Decision Making*, Vol. 05, Issue 04, pages 605-609

INFORMS Impact Prize, for contributions that have had a broad and enduring impact on the fields of Operations Research and Management Science (awarded by INFORMS once every two years), 2010

IGI Global, Excellence in Journal Research Award, for Best Peer-Reviewed Article, 2010.

Metaheuristics International Conference in honor of Fred Glover's 70th birthday, Montreal, Canada, 2007

INFORMS Special Recognition Prize for Contributions to Operations Research, in recognition of the impact of contributions on research and industrial applications (the only such special prize awarded by INFORMS), 2004

Networks Journal Honor: creation of the Glover-Klingman Award, given annually for best paper to appear in the Networks journal, 2003

Inaugural INFORMS Fellows Award, by the Institute for Operations Research and Management Science 2002.

Distinguished Operations Research Seminar Award, Lucent Technologies (now Alcatel-Lucent) Operations Research Seminar Series, 1997.

Best Paper Award of the Western Decision Sciences Institute, for research on Management Science and Quantitative Methods, 1994.

National Award for Research Excellence in Operations Research/Computer Science, by the Operations Research Society of America, Computer Science Section, for development and extension of the tabu search metaheuristic, 1994.

National Award for the Best Theoretical/Empirical Research Paper by the Decision Sciences Institute, for models and methods of optimizing system diversity, 1993.

National Award Finalist and Distinguished Paper Citation, Production and Operations Management Society, 1993

ANBAR Citation of Excellence (now Emerald Management Reviews) for outstanding contribution to the literature and body of knowledge of Electronic Intelligence, 1992.

National Prize for Research Excellence, Operations Research Society of America (Now INFORMS), for contributions to the interface between Operations Research and Computer Science, 1989.

Distinguished Research Lecturer Award, Council on Research and Creative Work, University of Colorado, Boulder (the highest award at the University of Colorado) for research integrating artificial intelligence and mathematical optimization, and their application to solving practical problems, 1988.

Informs Computing Society Prize: First Place, Award for best English language paper or group of related papers dealing with the Operations Research/Computer Science interface, for network and netform optimization models and algorithms for solving them, 1987.

National Award for Best Application of Decision Science Theory, Decision Sciences Institute, for applications of artificial intelligence to combinatorial systems, 1985.

Outstanding Achievement Award of the American Institute of Decision Sciences (now DSI), 1984.

National Decision Science Instructional Award of the American Institute of Decision Sciences and Alpha Iota Delta for interactive software for mathematical optimization, 1983.

International Management Science Achievement Award of the Institute of Management Sciences College of Practice, for an integrated production, distribution and inventory planning system, 1979.

North Atlantic Treaty Organization Division of Scientific Affairs Award for research and lecture presentations at NATO Advanced Study Institute (Sogesta) on networks and logistics planning, 1978.

CBA Foundation Award for Applications of Mathematical Procedures to Problems in Industrial Planning, 1978.

National Energy Research Institute Award for research on alternative energy resources and uses,

1976.

International Business Machines Award for Mathematical Programming Research, 1976.

**Honorary Appointments & Professorships**

Honorary Professorship Award, from the China University of Mining and Technology, 2013

Honorary Director, Institute of Management Science & Industrial Engineering, China University of Mining and Technology, 2013

Chaired Research Professor in Computer Science (Chaire d'excellence, Pays de la Loire), Laboratoire d'Etude et de Recherche en Informatique d'Angers (LERIA), 2009

Honorary Doctorate, Glushkov Institute of Cybernetics, National Academy of Sciences of Ukraine, 2006

Honorary Professor, Department of Mathematics and Statistical Sciences, University of Colorado, Denver, 2001

National Advisory Board of the Enterprise Simulation Optimization Laboratory (eSOL), 2000

Founding Research Director of the Hearin Center for Enterprise Science at the University of Mississippi, in Oxford, MS, 1999.

Distinguished University Research Lecturer, University of British Columbia, 1994.

Head of Global Optimization, NASA Center for Space Construction (now within Aerospace Engineering Sciences), University of Colorado, Boulder, 1991.

Research Scholar, Centre Nationale de Recherche (National Research Center), Universite de Grenoble, France, 1991.

Distinguished Visiting Research Professor, Ecole Polytechnique Federale de Lausanne (Swiss Federal Institute of Technology), Switzerland, 1989-1990; 2001-2002.

Visiting Cockrell Family Regents Chaired Professor in Engineering, University of Texas, Austin, 1988-1989.

Distinguished Researcher, US West Advanced Technologies (now Quest Advanced Technologies), 1986-1998.

Distinguished Visiting Researcher, Université de Paris-Nord, 1998.

**Fellowships**

IEEE Life Fellow, for individuals who have distinguished themselves through sustained and lasting contributions to IEEE.

IEEE Fellow, in recognition of contributions to computer based and mathematical optimization, 2013.

International Research Fellow of the International Center for Electronic Commerce, 1997.

Senior Fellow, Center for Management of Operations and Logistics (now Logistics and Supply Chain Optimization), University of Texas, 1996.

Senior Research Fellow of the $IC^2$ Institute, 1987.

First US West Distinguished Fellow, for contributions to mathematical optimization, computer science and artificial intelligence, 1986.

Honorary Fellow, American Association for the Advancement of Science (AAAS), for research in mathematical optimization and computer applications in industry, 1983.

Honorary Fellow, International Honor Society in the Decision Sciences and Information Systems, Alpha Iota Delta, 1983.

Honorary Fellow, Decision Sciences Institute, for contributions to the field of Decision Sciences in mathematical optimization and planning, 1982.

Federal Fellow of the U.S. Defense Communications Agency (now the Defense Information Systems Agency) for communications and satellite systems design, 1972-73.

Research Fellow of the Miller Institute for Basic Research in Science, for research in industrial engineering and operations research, 1965-66.

Ford Foundation Fellow, Carnegie-Mellon University, 1962-65.

**Biographical Listings:**

Who's Who in the World

Who's Who in America

Who's Who in the West

International Who's Who of Contemporary Achievement

Men of Achievement

2000 Outstanding Intellectuals of the 21st Century

Who's Who in Frontier Science and Technology

Who's Who in Computer Education and Research

World Directory of Mathematicians

American Men and Women of Science

Who's Who in American Education

Who's Who and What's Where in Artificial Intelligence

Who's Who in Science and Engineering

**Business and Government Experience:**

Dr. Glover has served on the Board of Directors of four corporations and a nonprofit research institute. He has also served as a consultant for over 70 government agencies and industrial firms. A partial list includes the following:

Analysis, Research and Computation, Incorporated
Battelle Institute
Bethlehem Steel
Boeing Computer Services
Ciba-Geigy Corporation
Citicorp
Exxon Corporation
Firestone
First City National Bank of New York
General Electric Corporation
General Mills
General Motors
General Research Corporation
Halliburton
International Business Machines
Logicon, Incorporated
Mathematica, Incorporated
Phillips Petroleum Company
Reynolds Metal Company
Rockwell International
Sperry-Univac
Terra Chemical Company
Texas Instruments
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Energy
U.S. Department of Transportation

**Past and Present Professional and Educational Activities:**

U.S. National Academy of Science Program for Scientific Exchange - research lecturer and host for

visiting scientists.

Queen Elizabeth II Fellowships and Australian Research Grants Committee.

National Visiting Lecturer in Management Science and Operations Research, sponsored by the Institute of Management Science and the Operations Research Society of America.

National Science Foundation Advisory Panel for the University Research Initiative Program on Computational Combinatorics.

National Science Foundation Advisory Panel for the Study of Optimization Infeasibility Diagnostics.

Advisory Board for New Sky Energy, Inc.

Advisory Board for Annals of Optimization & Data Science

Advisory Board for the Journal of Risk Analysis and Crisis Response

Advisory Committee for the Graduate School of Management of Technology of Hosei University

Advisory Committee for the Data Science & Information Quality Research Center of Xi'an Jiaotong University

Distinguished guest lecturer at international advanced study institutes sponsored variously by NATO, The Bolyai Janos Mathematical Society, NSF, The International Institute of Management, and IBM Scientific Research Centers in Italy, France, Germany and the United States.

Distinguished Visiting Research Professor, Ecole Polytechnique Federale de Lausanne (Swiss Federal Institute of Technology).

Founding Research Director of the Hearin Center for Enterprise Science

Chaired numerous sessions, presented invited papers, served as discussant, and conducted tutorials at international, national and regional conferences sponsored by NBS, DOE, DOT, ONR, AFOSR, MORS, TIMS, ORSA, AIDS, DIMACS, COAL, ESA, SIGMAP, DSI, , MIC, DGOR, ECCO, SVOR, AIRO, SIAM, ACM, AIIE, IEEE, IIE, CORS,.APOR, IFORS, EURO, MPS, INFORMS.

Reviewer for: The U.S. National Academy of Sciences, National Science Foundation, Conference Board of the Mathematical Sciences, Air Force Office of Scientific Research, Bolyai Janos Mathematical Society, the Guggenheim Foundation, NATO Division of Scientific Affairs, Sloan Foundation, National Research Council, National Science Foundation EPSCOR Program, Canadian National Research Council, Natural Sciences and Engineering Research Council of Canada, Social Services and Humanities Research Council of Canada, Institut National de Recherche en Informatique et en Automatique (INRIA), Engineering and Physical Sciences Research Council, Center for Advanced Study in the Behavioral Sciences, and Assembly of Mathematical and Physical Science.

Advisory Board of the CORTECS (project to apply Combinatorics and Operations Research in Technology and the Computational Sciences).

Advisory Board of the Center for Decisions under Uncertainty

Advisory Board of the Chinese National Science Foundation (CNSF)

Advisory Board of the Chinese Academy of Sciences (CAS)

Founding council member, Special Interest Group in Artificial Intelligence, Operations Research Society of America.

Founding member of the Center for Applied Artificial Intelligence at the University of Colorado.

Founding member of the Intelligent Systems Group of the University of Colorado.

Founding member of the Graduate Faculty of Applied Mathematics, and member of the Applied Mathematics Steering Committee, of the University of Colorado.

IEEE Life Member, for individuals who have distinguished themselves through sustained and lasting contributions to IEEE.

Co-founded Mathematical Applications for Business Report Series at the University of Texas.

Co-founded the Management Science Research Report Series at the University of Colorado.

Co-founded the Optimization Research Report Series of the Hearin Center for Enterprise Science.

Co-founder and board member of nonprofit research organization, Decision Analysis and Research Institute, Incorporated.

Executive Committee member, Center for Space Construction, School of Engineering, University of Colorado, Boulder.

**Editorial Activities**

First Editor-in-Chief and Co-founder, Journal of Heuristics.

Editor, Handbook for the International Series in Operations Research and Management Science, Kluwer

Editor, Special Issue, European Journal of Operational Research

Area Editor, Heuristic Search and Learning, ORSA Journal on Computing.

Area Editor, Mathematics of Industrial Systems

Area Editor, Journal of Computers in OR

Honorary Editor, International Journal of Applied Metaheuristic Computing

Special Issue Editor, Annals of OR

Associate Editor, Operations Research and Rude Intrusions on the Real World

Editor, Artificial Intelligence and Operations Research, Annals of Operations Research

Co-Editor, Linkages with Artificial Intelligence, Annals of Operations Research, Baltzer Scientific Publishing

Co-Editor, Tabu Search, Annals of Operations Research, Baltzer Scientific Publishing

Co-Editor, Handbook of Metaheuristics, Kluwer

Associate Editor, Management Science.

Associate Editor, Operations Research.

Publications Committee, Operations Research.

Editorial Advisory Board:
- Computers and Operations Research.
- INFORMS Journal on Computing
- Fuzzy Optimization and Decision Making
- Journal of Heuristics
- International Journal of Information Technology and Decision Making
- Encyclopedia of Optimization
- Journal of Risk Analysis and Crisis Response
- Journal of Evolutionary Optimization
- International Journal of Management Science
- International Journal of Mathematical Optimization
- International Monograph Series of the Society of Industrial and Applied Mathematics
- International Journal of Applied Metaheuristic Computing
- Metaheuristics
- Networks
- Journal of Scheduling
- Metaheuristics - Methods and Applications

**Grants and Contracts:**

National Science Foundation -- grant for research in Linear and Discrete Mathematical Programming.

Office of Naval Research -- contract for developing Improved Computational Algorithms for Scheduling and Distribution Systems.

U.S. Department of Agriculture – contract for "Embedded Network Structures in National Forestry Models"

Department of the Navy -- Naval Regional Procurement Office for the project entitled "Development and Computational Design of an Integrated Policy Evaluation and Planning Model for Navy Manpower Utilization."

Office of Naval Research -- contract for "A Study of Integer Programming Solution to Navy

Assignment Problems with Side Constraints."

Department of Transportation -- contract for "Development and Analysis of Shortest Path Algorithms and Computer Codes."

Federal Energy Administration -- contract for "Study of Software Requirements to Support the Project Independence Evaluation System (PIES)."

U.S. Army Research Office -- contract for "Assignment Optimization."

Office of Naval Research -- contract for "Mathematical Programming Optimization."

Department of Transportation -- contract for "Improving Flow Management and Control Via Improving Shortest Path Analysis."

Energy Research Development Agency -- contract for "Advanced Methods for Planning Electrical Energy Distribution Systems."

U.S. Army Research Office -- contract for "Large Scale Algorithms for Mixed Assignment and Combinational Problems."

Department of Transportation -- contract for "Interactive Heuristics for Multicriteria and Allocation Problems."

Bureau of Business Research, University of Colorado -- grant for "Computer Implementation Procedures for LP/Embedded Networks."

Solar Research Energy Institute -- contract for "Computer Software for Generalized Network Energy Problems in Alternative Energy Research."

U.S. Department of Interior -- contract for "System for Allocating Vegetation to Herbivores."

Battelle Laboratories/U.S. Army Research Office -- contract for "Developing a Personnel Readiness Indicator Model."

U.S. Department of Transportation -- contract for "Multicriteria Analysis and Mathematical Optimization of Transportation Planning Systems."

U.S. Army -- contract for "Interdisciplinary Discrete Mathematical Optimization System for National Readiness."

U.S. Naval Support Center -- contract for "Renovation and Logistics Planning."

U.S. Forest Service -- contract for "Network Optimization System for USDA Long-Range Planning of National Forests."

U.S. Department of Interior -- contract for "Computer Modeling Analysis of the USDI World Mineral Supply Model."

Naval Sea Systems Command -- contract for "Model Analysis and Implementation Enhancements for

the Logistics Readiness Program."

U.S. Army -- contract for "Solving Equipment Procurement and Distribution Problems in Support of National Readiness."

Office of Naval Research – contract for "Modeling and Solution Procedures for Diversity Maximization"

Office of Naval Research – contract for "Learning-Based Approaches for Enhancing Optimization Solution Methodologies"

Office of Naval Research – contract for "Effective Solutions of Very Large-Scale Optimization Problems for Personnel Planning and Management"

Office of Naval Research – contract for "Advanced Methods for Stochastic Routing and Scheduling Models in Real-World Applications"

Office of Naval Research – contract for "Optimization Methodologies"

Office of Naval Research – contract for “Layering Strategies for Creating Exploitable Structure in Linear and Integer Programs”

Office of Naval Research – contract for “New Sharpness Properties, Algorithms and Complexity Bounds”

Office of Naval Research – contract for “Intelligent Decision Support System for Combat Readiness”

Colorado Institute of Applied Artificial Intelligence – grant for “Applications of Tabu Search to the Placement Problem in VLSI Design”

Office of Naval Research -- contract for "Mathematical Foundations of Combinatorial Optimization" (Part I of Joint Agency Proposal).

Air Force Office of Scientific Research -- contract for "Mathematical Foundations of Combinatorial Optimization" (Part II of Joint Agency Proposal).

Air Force Office of Scientific Research -- Augmentation award for Science and Technology, U.S. Department of Defense.

Air Force Office of Scientific Research -- contract for "Extended Foundations of Combinatorial Optimization."

Air Force Office of Scientific Research – contract for “Search Methods in Optimization”

Office of Naval Research – contract for “Effective Solutions of Very Large-Scale Optimization Problems”

Office of Naval Research – contract for “Advanced Methods for Stochastic Routing and Scheduling”

Office of Naval Research – contract for “Optimization Methodologies”

Office of Naval Research – contract for "Innovations in Optimization Methodologies"

US Department of Transportation, Bureau of Transportation Statistics – contract for "Disclosure Limitation for Tabular Data"

National Science Foundation Small Business Innovative Research – Phase I Award for "A New Approach for Enhancing Capital Investment Decisions by Optimizing Returns and Risks of Project Portfolios"

Office of Naval Research, Small Business Technology Transfer Research – Phase I & II Awards for "OptForce: New Human Resource Optimization Methods"

Army Research Office, Small Business Technology Transfer Research – Phase I & II Awards for "OptAgent: A Generalized Framework for the Optimization and Analysis of Agent-based Models"

National Science Foundation, Small Business Technology Transfer Research – Phase I & II Awards for "OptDiverse: Innovative Technology to Enhance Workforce Diversity, Capabilities, and Performance

## ACADEMIC AND PROFESSIONAL CREDENTIALS - MAJOR CONTRIBUTIONS

### Computer Based Systems

(i) Headed the development of an integrated production, distribution and inventory planning system for Agrico Chemical Company, utilizing algorithmic advances in solving large scale embedded network problems. This work received an International Achievement Award of The Institute of Management Sciences in 1979 and was acknowledged to save Agrico over forty three million dollars in its first five years (amounting to more than one hundred twenty million dollars today). The original article reporting this work has now been reprinted in seven different volumes on systems design, and the underlying procedures continue in widespread use in supply chain management. The modeling component of this work is being taught at universities around the country, including Columbia, Princeton, Wharton, and the University of Chicago.

(ii) Developed a microcomputer system for scheduling operations and personnel that has successfully handled problems three orders of magnitude larger than any of its class by a decade of prior research. This work was implemented for the major food industry chains of McDonalds and Krogers and is widely cited as a pioneering demonstration of the importance of the computer/scheduling interface. The paper reporting this study received the Best Application of Decision Science Theory Award of the Institute of Decision and Information Sciences.

(iii) Developed formulations and approaches for classification analysis that provide new methods for pattern recognition problems. Widely implemented and tested, this work has been shown capable of solving classification problems that classical models cannot encompass, while yielding superior discrimination power. Recent developments are now using these approaches to train neural networks.

(iv) Developed a series of expert analysis and network computer solution procedures for production planning and distribution systems for GM Research Laboratories. This work provided

fundamental breakthroughs in machine scheduling that have been incorporated into manufacturing of plastic molded parts throughout the industry.

(v) Applied artificial intelligence learning techniques to develop job shop scheduling and sequencing procedures based on the innovation of parametric and probabilistic machine learning rules now implemented in the steel industry. Applied to test beds assembled by Carnegie-Mellon University and Purdue University, these procedures were demonstrated to yield schedules whose quality surpassed those of the previous research in the field.

(vi) Headed the development of an interactive microcomputer and graphics system for space planning and facilities layout design. This system produced more than a hundredfold improvement in efficiency over previous procedures for these problems and is being routinely used by space planning companies such as Dalton, Dalton, Newport and Marshall Erdwin around the country. This work was also selected for citation in a survey of outstanding applications of microcomputer graphics systems in 1985.

(vii) Developed an expert planning system to determine optimal lot-sizing and machine loading for multiple products used in multi-level planning of manufacturing operations. This work was implemented for a major U.S. manufacturing company and reported in a collection of published articles in Interfaces and AIEE Transactions on improved computer-based planning systems.

(viii) Co-developed the managerial robot concept and its prototype embodiment in a system that replaces a human manager in the performance of tasks requiring intellectual and planning skills. This concept has been widely adopted by other researchers and has been incorporated into courses taught at Stanford, Carnegie-Mellon University and the University of Texas.

(ix) Developed a modeling and computer solution system for determining optimal mining and ore extraction sequences for W. R. Grace, Inc. The model encompasses an expert system component incorporating zero-one optimization to make decisions concerning depth and location of mining activities and has been implemented in the field since 1983.

(x) Co-developed a large-scale model and solution system for introducing new products and determining product distribution in the oil industry. This work solved large scale nonlinear and mixed integer programming problems that were previously unsolvable and appeared as the lead article in a volume dedicated to computer methods for industrial applications.

**Energy and Resources Planning**

(i) Developed an energy and resources planning system for scheduling and coordinating the allocation of water at dams, reservoirs, and channels to maintain optimal levels and flows for hydroelectric and agricultural needs, based on embedding a network optimization within a large-scale simulation of interactions between system components based on rainfall forecasts and expected water releases from upstream sources. This system spun off a company called Aqua Logic (now absorbed into Oracle) and has also been implemented into systems by government agencies in India, Sweden, Germany and Poland for analyzing flows in river basins for scheduling, forecasting and analyzing policy.

(ii) Developed a system for analyzing trade-offs among alternative energy sources and uses for the Solar Energy Research Institute, joining multiple scenario generation and embedded generalized network optimization to analyze exchanges between petrochemical and biomass based fuels. The model and solution procedure of this system won an award from the National Renewable Energy

Laboratory (NREL) for the analysis of energy issues, and was subsequently been expanded to a large-scale national model featured as a special invited paper in *Energy Models and Studies*. A further expanded international version of the model including a broader simulation component is currently being investigated in association with the Center for Brazilian and American Affairs and the Energy and Environmental Security Initiative.

(iii) Developed a system for the U.S. Department of Agriculture for large scale forest planning operations over an eighty-year planning horizon. By combining long-range simulations with embedded network optimization, the system integrates the determination of economically feasible investment levels with the determination of policies for harvesting, transporting, clearing and re-planting of different types of timber to assure adequate supply and reserves for future needs.

(iv) Developed a model formulation and solution methodology for scheduling nuclear refueling operations to coordinate use of electrical energy with hydroelectric and chemical energy sources for the Tennessee Valley Authority. This work succeeded in generating schedules that improved on the schedules found by the best previous methods by over ten million dollars.

(v) Co-developed a procedure for optimally locating and sizing electrical power substations for the U.S. Department of Energy (ERDA), determining the most effective way to expand and contract electrical power facilities to meet the changing energy demands resulting from growth and population shifts.

**Network Optimization**

Pioneered the development, implementation, testing and commercialization of specialized solution methods for such network problem classes as maximum flow, shortest path, assignment, transportation, capacitated transshipment, generalized network and linear programming/embedded networks problems. This research has involved the development of new mathematical algorithms, computer science data structures, computer implementation techniques, and computational testing techniques. The breakthroughs from this work have resulted in the use of these procedures by over fifty government agencies and Fortune 500 companies.

(i) Jointly conducted theoretical and computational studies of minimum cost flow networks that have provided the most efficient network techniques available. These studies also have provided the fastest methods for solving large-scale networks for nearly two decades, as reconfirmed by independent tests against leading alternative software in 2004.

(ii) Developed the first efficient methods for solving networks with millions of variables. This development has allowed the U.S. Military to substantially improve its human resource planning and assignment activities. It has also allowed the U.S. Treasury to solve problems containing over 60,000,000 variables, to obtain merged micro-data files for evaluating the fiscal impact of taxation, welfare and social security policy.

(iii) Co-developed highly efficient algorithms for solving multicriteria network flow problems. The U.S. Army conducted an extensive study showing that these algorithms made it possible to solve optimally multicriteria personnel assignment problems with 8,000 people and over a million eligible job assignments in less than 15 minutes. Since the 1980s, these algorithms have been used extensively by the Army Military Personnel Center in the reassignment of enlisted personnel.

(iv) Jointly developed the first efficient EAPI data structures for storing and updating a set of disjointed quasi trees. The EAPI data structure provides the key for developing the most

efficient generalized network algorithms. The EAPI data structures are used in all major generalized network algorithms today.

(v) Co-developed refinements of the primal simplex algorithm for generalized networks and the first fully debugged and generally usable generalized network code. For more than a decade this code has been the most efficient code available for generalized networks. This code made it possible for the U.S. Government to develop a nationwide natural gas distribution model for evaluating national regulatory policies. The Congressional records indicate that this code was 50 times more efficient that any other code for these problems.

(vi) Jointly conducted a computational evaluation of maximum flow algorithms and developed the most efficient polynomially bounded primal algorithm for this class of problems.

(vii) Conducted with associates the first in-depth evaluation of network algorithms for micro-computers.

(viii) Co-developed new algorithms and data structures for linear programming/ embedded network problems which have motivated researchers worldwide to study this class of problems.

(ix) Co-developed efficient data structures and algorithms for solving shortest path problems and conducted extensive computational evaluation of shortest path algorithms. The U.S. Department of Transportation credits these developments with expanding the analytical capabilities of local, state, and Federal transportation planners.

(x) Developed a new family of polynomially bounded shortest path algorithms which subsumes and strictly enlarges the class of previously known polynomially bounded shortest path algorithms.

**Combinatorial Optimization**

(i) Developed group theoretic results providing characterizations of nested facets -- the strongest possible inequality structures for asymptotic integer programs. These characterizations made it possible to generate numbers of facets that exponentially dominated those obtained by previous results. Moreover, these nesting results gave the first theorems and algorithms for the widely used integer programming strategy now referred to as "lifting" facets.

(ii) Developed results for aggregating and disaggregating diophantine equations, extending classic contributions of number theory and combinatorics by providing tighter parameter conditions and improved coefficient growth rates. This work is conjectured to yield the smallest possible coefficients for a broad class of equations. The latest general results have also produced the best method for solving unbounded variable knapsack problems.

(iii) Developed a dual algorithm for generalized upper bounded knapsack problems that established the best theoretical bound known for these problems.

(iv) Developed and characterized the most general form of strongly convergent algorithms for linear optimization over constraint sets involving dyadic matrices. Proved that no other strongly convergent algorithms could dominate this class.

(v) Introduced the surrogate constraint strategies for integer programming which have led to highly effective solution procedures for many important problem classes, including quadratic

optimization, generalized assignment, graph theory and satisfiability problems. This work has also led to surrogate and surrogate-Lagrangian duality theory for mathematical programming, providing smaller duality gaps than the generalized Lagrangian and Fenchel duality theories. It also enables these and other previous standard dualities to be encompassed in a single framework.

(vi) Characterized the complete set of linear inequalities that are necessary and sufficient to determine the lower integer hull for integer points contained in a convex polytope, via the polyhedral annexation framework and theorems. Such a characterization underlies one of the basic formulations of the area known as disjunctive programming.

(vii) Developed the class of algorithms for Cardinality Constrained Matroid Optimization Problems, yielding the most efficient known methods for these problems.

(viii) Co-developed methods for the Matroid Intersection Problem that yielded a new best mathematical complexity bound for this problem.

(ix) Co-developed the *netform* modeling technique which allows zero-one integer programming problems to be formulated as integer network problems. This technique has led to improved formulation and solution approaches for a wide range of optimization problems. By this approach, the Tennessee Valley Authority obtained a solution to its nuclear power plant refueling problems which is ten million dollars better than previous solutions.

(x) Co-developed efficient solution procedures for facility location and capacity allocation problems. These procedures have been able to solve problems with more than 10,000 discrete variables in a matter of seconds.

(xi) Co-developed the class of methods called *layering methods* for combinatorial optimization. These methods have been embodied in an integer decomposition algorithm which has been successfully utilized by several agencies to solve problems which were heretofore unsolvable by any known method. Companies have credited this algorithm with solving problems in less than 10 minutes that they had spent over 25 man years trying to solve. The paper establishing the theoretical basis of these layering methods also received the National Award for Research Excellence by the Computer Science Society of INFORMS.

**Human Resource and National Planning**

(i) Developed personnel planning models and solution approaches for human resource planning and career path planning. These models and algorithms are used monthly by the U.S. Army to make operational decisions and have successfully solved the largest personnel problem ever undertaken. Due to the success of these approaches, the military services in 1982 issued a request for proposals totaling over 300 person-years of effort which required the use of these models.

(ii) Developed the modeling and solution of a problem for the U.S. Department of the Treasury and the National Bureau of Standards to determine categories, levels, and eligibility status for welfare payments, social security insurance payments and tax assessments. Economic and social implications are analyzed by a model structure an order of magnitude larger than any comparable model previously considered in government or industry.

(iii) Co-developed specialized methods and computer solution routines for the Department of

Transportation. These new methods were tested on multiple transportation structures and proved superior to all methods previously developed for these problems.

(iv) Jointly developed formal planning models to assist multinational firms in adapting to a rapidly changing environment and developed a model for the U.S. Treasury to assist policy makers in identifying changes which would encourage multinational firms to locate their headquarters in the United States.

(v) Co-developed models and solution models for the Urban Mass Transit Authority of the Department of Transportation. The solution methods have proved capable of handling problems with thousands of junctions and hundreds of thousands of interconnections and demonstrated greater efficiency for the UMTA/DOT problems than any methods produced by two decades of prior research.

**Simulation – Learning and Embedded Optimization**

(i) Co-developed probabilistic and parametric methods for the Office of Naval Research to combine local decision rules for job shop scheduling. Simulations to determine make span distributions for different local rules were augmented with procedures to learn and automatically modify probabilities and parameter settings to yield combined decision rules. The outcome produced new (composite) decision rules that were superior to previously existing rules and laid a foundation for subsequent strategies to combine decision elements that have become incorporated in the evolutionary scatter search metaheuristic.

(ii) Developed a procedure for scheduling and coordinating the allocation of water at dams, reservoirs, and channels to maintain optimal levels and flows for hydroelectric and agricultural needs, based on embedding a network optimization within a large-scale simulation of interactions between system components based on rainfall forecasts and expected water releases from upstream sources. This procedure has been implemented by government agencies in the United States, India, Sweden, Germany and Poland. The underlying software has also been incorporated into systems for analyzing flows in U.S. river basins for scheduling, forecasting and analyzing policy.

(iii) Developed a system for analyzing trade-offs among alternative energy sources and uses for the Solar Energy Research Institute, joining multiple scenario generation and embedded generalized network optimization to analyze exchanges between petrochemical and biomass based fuels. The model and solution procedure of this system won an award from the National Renewable Energy Laboratory for the analysis of energy issues, and was subsequently been expanded to a large-scale national model published as a special invited paper in *Energy Models and Studies*. A further expanded international version of the model including a broader simulation component is currently being investigated in association with the Center for Brazilian and American Affairs and the Energy and Environmental Security Initiative.

(iv) Developed a system for the U.S. Department of Agriculture for large-scale forest planning operations over an eighty-year planning horizon. By combining long-range simulations with embedded network optimization, the system integrates the determination of economically feasible investment levels with the determination of policies for harvesting, transporting, clearing and re-planting of different types of timber to assure adequate supply and reserves.

(v) Headed the development of models and solution methods for plant layout design for

General Motors Research Laboratories. This work linked simulation and embedded optimization phases to determine the subdivision of plant space and relative locations of assembly lines to inventories, in order to enable efficient fabrication of final products. GM credited this research with saving thousands of hours in engineering design, and with developing improved plant layout procedures that reduced both operating expense and capital costs of building to yield ongoing financial savings of millions of dollars annually.

(vi) Integrated simulation, network optimization and rule based systems for IBM in a project through the Center for Applied Artificial Intelligence of the University of Colorado to determine timing, routing and carriers for shipping orders to customers. The success of this project demonstrated the ability of simulation processes to work effectively in combination with rule-based systems as well as with network optimization.

(vii) Coordinated the development and implementation of simulation models as Head of Research for the NASA Center for Space Construction, to monitor the design and assembly of space stations. Assembly, rendezvous and docking activities were analyzed by means of Monte Carlo simulations and used in NASA planning operations.

(viii) Co-designed and implemented an employee scheduling system joined with simulation, in association with Management Robotics, Inc. (MRI) and Kroger, as a basis for building useful labor standards utilizing queuing lengths as a critical input. The component developed for MRI was subsequently extended and marketed to the retail food industry, and then to additional parts of the retail industry by Tomax, Inc.

**Simulation Optimization**

(i) Pioneered the integration of simulation methods with metaheuristic search procedures based on tabu search and scatter search. This work provided effective methods for linking simulation and optimization by using adaptive memory and population-based methods to exploit the power and flexibility of simulation as a modeling tool. Collaborations on these objectives with James Kelly and Manuel Laguna have led to the creation of OptTek Systems (www.opttek.com), a software provider and consulting company whose OptQuest software has been licensed to over 90,000 users.

(ii) Co-developed the financial analysis and capital investment software embodied in the OptFolio software for linking simulation and optimization. This software is being used by oil companies, through the intermediary of Landmark Graphics (a Halliburton company), to determine capital investments over multi-year horizons to determine the allocation of funds to different options for exploring, extracting and distributing oil. Integrated into the TERAS PPM solution software, the technology is widely used for applications in the energy and petroleum field.

(iii) Headed the design and planning of software for a massive simulation study for the United States Strategic Command (USSTRATCOM), in a joint project under the charge of OptTek Systems and Lockheed-Martin Corporation. The study is a 10 year project, currently underway, to generate and analyze USSTRATCOM scenarios for future planning of staffing and structure alternatives. A major Business Activity Management component, with important consequences for the industrial sector, addresses the challenge of forecasting potential bottlenecks, and responding with effective strategies for dealing with them.

(iv) Jointly conducted a Business Process Management (BPM) study using simulation optimization to analyze the operation of emergency rooms (ERs) in a hospital. The goal was to identify the most effective routing policies and the best use of personnel, hospital space and resources to produce a configuration that minimizes total asset cost (including the staff's hourly wages and the fixed cost of each ER used). This study produced significant improvements in both asset costs and in patient cycle time, and its design is now embedded in a model and software system implemented by OptTek Systems and SIMPROCESS.

(v) Developed a new method for approximating the implicit objective function contours produced by a simulation optimization application. This method, called the LEVER method, was funded for development by the National Science Foundation, and embodied in software that achieved a 10 fold improvement in the efficiency of searching for an optimal or near optimal solution by simulation optimization. Extensions of the LEVER method currently underway have applications to data mining, pattern analysis and machine learning.

**Heuristics and Metaheuristics for Optimization**

(i) Introduced the *tabu search* approach for nonlinear and combinatorial optimization. Tabu search, which is based on designing and exploiting adaptive memory structures to determine effective trajectories through complex search spaces, has become the focus of many sessions and tutorials at national and international meetings of INFORMS, the Mathematical Programming Society, the International Federation of Operations Research and many other leading societies. The method is widely used in applications due to its ability to handle problems that involve complicating restrictions and goals that are not easily represented by classical optimization models. A Google search on "tabu search" yields over a million results.

(ii) Developed and co-developed tabu search implementations for optimization problems in scheduling, routing, production planning, graph partitioning, telecommunications network design, financial planning under uncertainty, clustering, facility location, multilevel assignment, space planning and a variety of other areas. The foundation papers underlying this work received a National Award for Research Excellence from the Computer Science Society of INFORMS. This work was also cited as one of the cornerstones for the receipt of the John Von Neumann Theory Prize.

(iii) Developed the evolutionary method called *scatter search* that integrates heuristics with population-based processes for combining solutions in Euclidean space. These designs are now recognized to yield, as special cases, fundamental "crossover" mechanisms that were introduced into the genetic algorithm literature approximately a decade later (including uniform crossover, Bernoulli crossover and arithmetic crossover). Additional components of scatter search, and its *path relinking* generalization that replaces Euclidean space by neighborhood space, have provided effective new methods for nonlinear optimization and for integrating optimization with simulation.

(iv) Introduced the *star path* framework for exploiting scatter search in the context of zero-one integer programming. The theorems underlying this framework provide a mechanism for mapping the space of zero-one feasible solutions into a collapsed space

that is contained within the intersection of a valid cutting plane and the cone spanned by a linear programming vertex. The resulting approach gives a means for solving zero-one optimization problems by linking cutting planes and search methods.

(v) Developed the class of procedures called ejection chain methods for generating complex moves in search space from simple components. Theorems for these methods show that by means of certain "reference structures" it is possible to implicitly design compound neighborhoods containing exponentially large numbers of solutions, but whose best member can be identified in low order polynomial time. Heuristic refinements have additionally been demonstrated to give high quality solutions in linear time. Ejection chain implementations guided by tabu search memory structures have produced the best known results for solving vehicle routing problems, generalized assignment problems, and combinatorial applications involving traveling salesman problems attended by complicating constraints.

(vi) Co-developed the target analysis learning framework for improving the effectiveness of heuristic and exact solution methods. Target analysis has been used to generate improved decision rules in search methods and in branch and bound procedures applied to problems of nuclear refueling, machine scheduling and telecommunication design. Recently it has been applied in conjunction with a global sensitivity analysis to yield 90% improvements in solution efficiency for solving problems of determining optimal investments in financial planning.

(vii) Developed the memory construct known as critical event memory, which is providing new advances for solving discrete optimization problems. In accompaniment with standard memory structures of tabu search, critical event memory has produced the best currently available heuristics for solving multidimensional knapsack problems and binary quadratic programming problems. These methods strongly dominate previous methods, and yield increasingly better solutions as the size and complexity of the problems grow.

## INVITED SPEAKER

(Partial Listing of engagements since 1990)

Invited presentation titled, "Fundamentals of Optimal Search," Joint US/USSR Seminar on Advances in Optimization," Washington, D.C., January 8-12, 1990.

Invited presentation titled, "Tabu Search Applications in Engineering," Industrial Engineering/Operations Research Seminar, University of California, Berkeley, March 12, 1990.

Invited presentation titled, "Combinatorial Optimization and Search Algorithms," Operations Research Colloquia, Stanford University, March 14, 1990.

Invited presentation titled, "Tabu Search for Discrete Optimization," Office of Naval Research Computational Combinatorics Seminar, Lafayette, Indiana, April 19, 1990.

Invited Plenary Tutorial, "Artificial Intelligence and Management Science with New Linkages for Simulation" Joint National TIMS/ORSA Meetings, Las Vegas, May 7-9, 1990.

Two invited presentations titled "A Pseudo-Polynomial Primal Method for Network Optimization" and "Tabu Search for Combinatorial Programming Problems," International Federation of Operations Research Meetings, Athens, Greece, June 1990.

Chaired the special invited session titled "Combinatorial Complexity: the P = NP Question," International Federation of Operations Research Meetings, Athens, Greece, June 1990.

Invited presentation titled "Target Analysis for Marrying Simulation and Optimization in Decision Planning," FAW Institute, University of Ulm, Germany, July 1990.

Invited presentation titled "Heuristic Search and Integer Programming," Institute for Advanced Studies, Vienna, Austria, July 1990.

Invited presentation titled "Tabu Search for Discrete Optimization" at the DGOR/SVOR International Conference on Operations Research, Vienna, Austria, August 1990.

Chaired session titled "Discrete Optimization and Complexity Theory" at the DGOR/SVOR International Conference on Operations Research, Vienna, Austria, August 1990.

Invited presentation titled "Recent Developments and Applications of Tabu Search," International "Viewpoints on Optimization" Meeting of the Mathematical Programming Society, Grimentz, Switzerland, September 1990.

Invited presentation titled "Parallelism and the Tabu Search Framework for Combinatorial Optimization," Computer Science Department, Swiss Federal Institute of Technology, Lausanne, September 1990.

Invited presentation titled, "Tabu Search Heuristics and Applications," International LIPN "Optimization Days," Paris, France, September 1990.

Four invited presentations on "Operations Research and Artificial Intelligence Methods or Optimization Problems," Mathematics Department, Swiss Federal Institute of Technology, Lausanne, September 1990.

Invited presentation titled "Optimization Methods in Scheduling and Production Planning," Joint Seminar sponsored by the University of Basel and Cibba-Geiggy Corporation, November 1990.

Presented the invited paper titled, "Bandwidth Packing:  A Tabu Search Approach", First Workshop on combinatorial Optimization in Science and Technology, RUTOR, April 2-6, 1991.

Chaired session titled, "Heuristic Procedures for Combinatorial Optimization Problems", First Workshop on Combinatorial Optimization in Science and Technology, RUTOR, April 2-6, 1991.

Presented the invited paper titled, "Advances in Tabu Search for Nonlinear and Parametric Optimization", TIMS/ORSA Joint National Meeting, May 12-15, 1991.

Presented the invited paper titled, "Multilevel Tabu Search," TIMS/ORSA Joint National Meeting, May 12-15, 1991.

Contributed presentation, "Solving Facility Layout Problems Using Diversification Search", TIMS/ORSA Joint National Meeting, May 12-15, 1991. (with Jim Kelly and Manuel Laguna)

Contributed presentation, "Automating the Development of Heuristic Search Methods with Target Analysis", TIMS/ORSA Joint National Meeting, May 12-15, 1991. (with John Knox)

Invited presentation titled, "Tabu Search Applications and Innovations", IMAG Laboratories, Grenoble, July 12, 1991.

Invited Plenary presentation titled, "Operations Research and Artificial Intelligence Applied to Optimizing Simulation", International EURO XI Meetings, Aachen, Germany, July 16, 1991.

Chaired plenary presentation titled, "OR and Expert Systems," International EURO XI Meeting, Aachen, Germany, July 16-19, 1991.

Chaired the invited, "Klingman Memorial Session on Mathematical Optimization", International Mathematical Programming Society Meetings, Amsterdam, The Netherlands, August 5-9, 1991.

Chaired session titled, "Tabu Search Methods and Applications", International Mathematical Programming Society Meetings, Amsterdam, The Netherlands, August 5-9, 1991.

Invited plenary presentation titled, "Tabu Search Innovations and Implications for Flexible Modeling via Simulation", International IMAG Franco-Japanese Meetings, Grenoble, France, August 12-15, 1991.

Invited plenary presentation titled, "Artificial Intelligence Methodologies for Optimization and Simulation-Based Models", International AFCET Franco-Suisse Meetings, Paris, France, September 11-13, 1991.

Chaired session titled, "Simulated Annealing Models and Processes", International AFCET Franco-Suisse Meetings, Paris, France, September 11-13, 1991.

Invited Presentation titled, "New Developments in Tabu Search and Principle of Proximate Optimality", AFOSR Seminar on Mathematical Foundations of Optimization, Denver, Colorado, October 4, 1991.

Invited Presentation titled, "Tabu Search and Nonlinear Optimization", AFOSR Meeting on Optimization in Chemistry, Edward AFB, California, October 21-23, 1991.

Invited panelist, ORSA Computer Science Technical Section titled, "Model Management and Operations Research", Joint National ORSA/TIMS Meeting, Anaheim, California, November 3-6, 1991.

Contributed presentation titled, "Automating the Development of Heuristic Search Methods with Target Analysis", Joint National ORSA/TIMS Meeting, Anaheim, California, November 3-6, 1991.

Chairman of Invited session titled, "Heuristic Search Methods and Applications", Joint National ORSA/TIMS Meeting, Anaheim, California, November 3-6, 1991.

Invited Presentation titled, "Heuristic Search Methods and Applications", Joint National ORSA/TIMS Meeting, Anaheim, California, November 3-6, 1991.

Invited seminar, "Mathematical Optimization and Artificial Intelligence," Applied Mathematics Seminar Series, University of Colorado, Boulder, March, 1992 (with M. Laguna and J. Kelly.)

Invited Tutorial Session, "Artificial Intelligence and Optimization: A New Foundation for Exploiting Simulation" ORSA/TIMS Joint National Meeting, Orlando, Florida, April 26-29, 1992 (with M. Laguna and J. Kelly.)

Invited presentation, "Ghost Image Processes for Optimization by Neural Networks," ORSA/TIMS Joint National Meeting, Orlando, Florida, April 26-29, 1992.

Chaired invited session, "Neural Networks in Optimization," ORSA/TIMS Joint National Meeting, Orlando, Florida, April 26-29, 1992.

Special invited plenary session, "Genetic Algorithms and Tabu Search; Hybrids for Optimization," National Foundation of Genetic Algorithms Meeting, Vail Colorado, July 26-29, 1992 (with M. Laguna and J. Kelly.)

Invited plenary talk, "Ejection Chains for TSP Optimization, International Symposium on Graph Theory and Combinatorics," Grimentz, Switzerland, August 23-28, 1992.

Chaired the invited session titled "Combinatorial Optimization and Scheduling Systems" at the Intelligent Scheduling Systems Symposium of ORSA/TIMS, San Francisco, CA., November 1, 1992.

Chaired the invited session "Combinatorial Search: New Advances" at the Joint National Meeting of the Operations Research Society and the Institute of Management Science, San Francisco, CA., November 2-4, 1992.

Co-presented the invited talk "Scheduling with Tabu Search and Ejection Chain Strategies," at the Joint National Meeting of the Operations Research Society and the Institute of Management Science, San Francisco, CA., November 2-4, 1992 (with W. Barnes).

Presented the invited talk "The Combinatorial Leverage Principle for More Powerful Heuristics," at the Joint National Meeting of the Operations Research Society and the Institute of Management Science, San Francisco, CA., November 2-4, 1992.

Co-presented the invited talk "Update on Tabu Search in Scheduling," at the Joint National Meeting of the Operations Research Society and the Institute of Management Science, San Francisco, CA., November 2-4, 1992 (with J. Kelly and M. Laguna).

Presented the invited paper "An Overview of Tabu Search Approaches to Exploiting Simulation," at the Intelligent Scheduling Systems Symposium of ORSA/TIMS, San Francisco, CA., November 1, 1992 (with M. Laguna).

Co-authored the invited presentation "Telecommunications Planning by Optimization and AI-Related Search," at the Joint National Meeting of the Operations Research Society and the Institute of Management Science, San Francisco, CA., November 2-4, 1992 (with J. Ryan).

Presented the invited paper "New Results for Aggregating Integer-Valued Equations," Symposium on Applied Mathematical Programming and Modeling, Budapest, Hungry, January 1993.

Presented the Keynote Talk "Heuristic Advances in Optimization Integrating Tabu Search, Ejection Chains and Neural Networks," Symposium on Applied Mathematical Programming and Modeling, Budapest, Hungry, January 1993.

Organized and chaired the cluster "OR and Artificial Intelligence," Symposium on Applied Mathematical Programming and Modeling, Budapest, Hungry, January 1993.

Chaired the invited session, "Tabu Search and Meta-Hybrids for Optimization," Joint National Meeting of the Institute of Management Sciences and the Operations Research Society of America, Chicago, Illinois, May 1993.

Co-presented the invited talk "Expanded Optimization and Search Framework for Neural Networks," (with J. Kelly). Joint National Meeting of the Institute of Management Sciences and the Operations Research Society of America, Chicago, Illinois, May 1993.

Co-presented the invited talk "Optimization and Recursive Partition: Machine Discovery of Quality Improvement," (with T. Cox). Joint National Meeting of the Institute of Management Sciences and the Operations Research Society of America, Chicago, Illinois, May 1993.

Co-presented the invited talk "New Column Generating Approach for Nonlinear Regression," (with R. Barr). Joint National Meeting of the Institute of Management Sciences and the Operations Research Society of America, Chicago, Illinois, May 1993.

Co-presented the invited talk "Implicit Model Representations Using Tabu Search," (with J. Kelly and M. Laguna), Integration of Modeling, Optimization and Analysis Roundtable, Denver, CO, May, 1993.

Organized and headed the "Heuristic Methods in Optimization" cluster of sessions for the XIII World Conference on Operations Research, Lisbon, Portugal, July 1993.

Co-presented an invited plenary tutorial titled "AI-Related Heuristics and Applications" (with M. Laguna) at the XIII World Conference on Operations Research, Lisbon, Portugal, July 1993.

Chaired the invited session titled "Metaheuristics in Optimization," at the XIII World Conference on Operations Research, Lisbon, Portugal, July 1993.

Co-presented the opening plenary session titled "Overview of Metaheuristics and Recent Advances for Simulation-Based Optimization," (with J. Kelly) at the National Meeting of the Operations Research Society of Italy, Capri, Italy, September 1993.

Chaired the invited plenary session titled "Advances in Methods for Distribution and Routing," at the National Meeting of the Operation Research Society of Italy, Capri, Italy, September 1993.

Organized and introduced the opening plenary session titled "The Vital Link," (by R. McCormick, US West CEO) at the Joint National Meeting of the Institute of Management Science and the Operations Research Society of America, October 1993.

Chaired the invited session titled "New Methods and Models for Integer Programming," at the Joint

National Meeting of the Institute of Management Science and the Operations Research Society of America, October 1993.

Presented the invited paper titled "Solving Zero-One Integer Programming Problems by Cone-to-Vertex Projections and Directional Rounding, at the Joint National Meeting of the Institute of Management Science and the Operations Research Society of America, October 1993.

Co-authored the invited presentation titled "A Recursive Polynomial Algorithm for LP-Based Discrimination," (with R. Barr) at the Joint National Meeting of the Institute of Management Science and the Operations Research Society of America, October 1993.

Chaired the invited session titled "Artificial Intelligence and Operations Research for Real World Optimization," at the Joint National Meeting of the Institute of Management Science and the Operations Research Society of America, October 1993.

Presented the invited paper titled "Extended Scatter Search: Genetic Models and Beyond," at the Joint National Meeting of the Institute of Management Science and the Operations Research Society of America, October 1993.

Presented the invited talk titled "Beyond the Genetic Metaphor: Scatter Search and Alternatives to Genetic Algorithms," Mathematical Optimization Seminar, University of Colorado-Denver, November 1993.

Co-authored the invited Tutorial Session titled "Computational Methods for Optimizing Diversity," (with C. Kuo and K. Dhir) National Meeting of the Decision Sciences Institute, Washington, D. C., November 1993.

Presented the invited talk titled "Tutorial on Tabu Search – With Threshold, Genetic and Neural Network Hybrids," Computer Science Colloquium, December 1993.

Presented invited Keynote Tutorial Session titled "Tabu Search and Neural Network Hybrids for Optimizing within a Simulation Framework," International Computer Science and Operations Research Meetings, Williamsburg, VA, January 5-7, 1994.

Chaired invited session on "Search Methods for Scheduling." International computer Science and Operations Research Meetings, Williamsburg, VA, January 5-7, 1994.

Chaired invited session on "Heuristics and Learning." Joint National Meeting of the Institute of Management Science and the Operations Research Society of America. Boston, MA, April 24-27, 1994.

Presented invited talk titled "Ejection Chains and Tabu Search." Joint National Meeting of the Institute of Management Science and the Operations Research Society of America. Boston, MA, April 24-27, 1994.

Invited Keynote Tutorial Presentation titled "Tabu Search for Practical Applications." 15th Triennial International Symposium on Mathematical Programming. Ann Arbor, Michigan, August 15-20, 1994.

Invited presentation titled "Metaheuristics in Artificial Intelligence and Operations Research." Air Force Office of Scientific Research Special Colloquium. Hawk Inn, Vermont,

October 4-9, 1994.

Invited presentation titled "Robust Optimization in Long Range Planning." Air Force Office of Scientific Special Colloquium. Hawk Inn, Vermont, October 4-9, 1994.

Invited presentation titled "Tabu Search and its Real World Applications." University of British Columbia Seminar Series on Science and Technology in Commerce. University of British Columbia Seminar, November 7, 1994.

Invited presentation titled "New Advances in Search and Optimization." Computer Science and Mathematics Colloquium. Simon Frasier University, Vancouver, B.C., December 11, 1994.

Invited Lead Speaker for presentation titled "Uses of Tabu Search in Telecommunications." 3rd International Conference on Telecommunication Systems, Modeling and Analysis, Nashville, Tennessee, March 16-19, 1995.

Chaired invited session titled "Developments in Tabu Search & Its Applications." INFORMS College on Artificial Intelligence, Los Angeles, California, April 23-26, 1995.

Invited presentation titled "Integrating Tabu Search & Cutting Planes for Integer Programming." INFORMS College on Artificial Intelligence, Los Angeles, California, April 23-26, 1995.

Chaired invited session titled "Advances in Integer Programming Theory & Practice." INFORMS College on Artificial Intelligence, Los Angeles, California, April 23-26, 1995.

Invited presentation titled "Tabu Search: Methods and Applications." INFORMS Workshop on Enterprise Modeling and Knowledge Management, College on Artificial Intelligence, April 23, 1995 (with James Kelly and Manuel Laguna).

Invited presentation titled "Tabu Search." International Conference on State of the Art in Global Optimization: Computational Methods and Applications, Princeton University, April 28-30, 1995.

Invited presentation titled "Tabu Search, Scatter Search and Simulation" International Conference on Optimization: Techniques and Applications, Chengdu University of Science and Technology, Chengdu, China, June 5-8, 1995.

Invited presentation titled "Tutorial on Heuristic-Based Optimization within Simulation." TIMS XXXIII International Conference, Singapore, June 25, 1995 (with Manuel Laguna).

Invited presentation titled "Graph Partitioning by Tabu Search: Deterministic and Probabilistic Strategies." TIMS XXXIII International Conference, Singapore, June 25-28, 1995 (with Fan Tseng).

Chaired invited session titled "Tabu Search." TIMS XXXIII International Conference, Singapore, June 25-28, 1995 (with Manuel Laguna).

Presented keynote address at the Metaheuristics International Conference, Breckenridge, Colorado, July 22-26, 1995.

General Chairman and Organizer for Metaheuristics International Conference, Breckenridge, Colorado, July 22-26, 1995.

General Chairman of Cluster titled "Heuristic Programming," (20 sessions), INFORMS, New Orleans, October 29-November 1, 1995.

Invited tutorial presentation titled "Tabu Search & Its Real World Application in Simulation and Optimization." INFORMS, New Orleans, October 29-November 1, 1995 (with James Kelly and Manuel Laguna).

Invited presentation titled "Solving Netform-Based IP Models with B&B and Tabu Search." INFORMS, New Orleans, October 29-November 1, 1995 (with Helmut Mausser).

Invited presentation titled "Optimal Network Design for Telecommunications Planning." INFORMS, New Orleans, October 29-November 1, 1995 (with Xiaorong Sun and Helmut Mausser).

Invited presentation titled "New Ways to Exploit Structure in Resource-Constrained Project Scheduling." INFORMS, New Orleans, October 29-November 1, 1995 (with Helmut Mausser and Steve Lawrence).

Co-presenter of invited paper titled "Solving Stochastic Financial Problems by a GRG/Tabu Search Method." INFORMS, New Orleans, October 29-November 1, 1995 (with Michael Tapia and John Mulvey).

Invited presentation titled "LP-Based Recursive Partitioning for High-Speed Machine Learning and Pattern Recognition." INFORMS, New Orleans, October 29-November 1, 1995 (with Richard S. Barr).

Chaired invited session titled "Tabu Search Methods." International Federation of Operations Research (IFORS) meeting, Vancouver, July 8-12, 1996.

Chaired invited session titled "Real World Telecommunication and Project Scheduling Models." International Federation of Operations Research, Vancouver, July 8-12, 1996.

Co-presenter of invited paper titled "Tabu Search.and Scatter Search for Wedding Simulation and Optimization" International Federation of Operations Research, Vancouver, July 8-12, 1996.

Presented invited paper titled "Improved Constructive Multistart Strategies for the Quadratic Assignment Problem." International Federation of Operations Research, Vancouver, July 8-12, 1996.

Co-presenter of invited paper titled "Probabilistic Tabu Search Heuristic for Telecommunications Network Design." International Federation of Operations Research, Vancouver, July 8-12, 1996.

Presented Plenary Session titled: "New Advances in Metaheuristics," the Metaheuristics International Meeting (MIC-II), Sophia-Antipolis, France, July 24-28, 1997.

Chaired Invited Session titled: "Metaheuristics in Scheduling and Logistics," the Metaheuristics International Meeting (MIC-II), Sophia-Antipolis, France, July 24-28, 1997.

Presented invited Tutorial titled: "Tabu Search and Evolutionary Methods for Optimization of Simulation-Based Models," Asia-Pacific Operations Research Society Meeting, World Congress Centre, Melbourne, Australia, November 30-December 4, 1997.

Chaired invited session titled: "Innovations for Optimization," Asia-Pacific Operations Research Society Meeting, World Congress Centre, Melbourne, Australia, November 30-December 4, 1997.

Presented invited paper titled: "An ATM Routing for Telecommunication Network," INFORMS, San Diego, California, May 4-7, 1997.

Chaired invited session titled: "Meta-Heuristics for Solving Integer, Nonlinear & Stochastic Problems," INFORMS, San Diego, California, May 4-7, 1997.

Presented invited paper titled: "Solving a Dynamic Routing Communications Network Design Problem Using Tabu Search, INFORMS. San Diego, California, May 4-7, 1997.

Presented invited Tutorial titled: "Tabu Search for Nonlinear, Stochastic and Simulation-Based Optimization," INFORMS. San Diego, California, May 4-7, 1997.

Presented invited paper titled: "Searching for Optimal Algorithm Parameters," INFORMS. San Diego, California, May 4-7, 1997.

Presented invited paper titled: "Cut Search and Star Path Methods for Integer Programming," INFORMS, Joint International Meeting, Barcelona, Spain, July 14-17, 1997.

Co-Presented invited tutorial at the DIMACS Workshop on New Advances in Simulation and Optimization, Rutgers, NJ, May 1999.

Co-presented invited tutorial titled: "Binary Quadratic Optimization" at the International Meeting Discrete Optimization '99, at the Rutgers Center of Operations Research (RUTCOR), July 25-29, 1999.

Co-presented invited tutorial titled: "Improved Methods for Complex Stochastic and Nonlinear Optimization Using Simulation-Based Models," IFORS'99, 15$^{th}$ World Conference on Operational Research, Beijing, China, August 16-20, 1999.

Co-presented invited tutorials titled: "New Advances for Integrating Simulation and Optimization," at the National Meeting of the Institute of Operations Research and Management Science (INFORMS), Philadelphia, Philadelphia, November 7-10, 1999.

Co-presented invited tutorial: "New Advances for Combining Simulation and Optimization," at the annual Winter Simulation Conference (WSC '99), Phoenix, Arizona, December 5-7, 1999.

Co-presented invited talk titled "Scatter Search to Generate, and Chunking to Evaluate, Diverse Solutions," at the 7th INFORMS Computing Society Conference, Cancun, Mexico, January 5-7, 2000.

Co-presented invited talk on "Adaptive Memory and Scatter Search for Simulation Optimization," at the XVII EURO Conference, Budapest, Hungary, July 16-19, 2000.

Co-presented invited talk titled "One-pass Algorithms for Very Large Binary Quadratic Programs," at the 17th European Conference on Operations Research, Budapest, Hungary, July 16-19, 2000.

Co-presented invited talk, The DIMACS TSP Challenge: Preliminary Results, 17th International Symposium on Mathematical Programming (ISMP2000), Georgia Institute of Technology, August 7-11, 2000.

Co-presented invited talk titled "The Comparison of Parallel Programming Techniques Applied to the Maximum Clique Problem," at the 17th International Symposium on Mathematical Programming, Atlanta, Georgia, August 7-11, 2000.

Co-presented invited tutorial titled "Recent Advances in Tabu Search and Evolutionary Scatter Search in Simulation-Based Optimization," at the IEEE International Conference on Systems, Man, and Cybernetics, San Diego, California, 2000.

Co-presented invited talk titled "Using Explicit Memory in Restart Methods," at the INFORMS 2000 Meeting, San Antonio, Texas, November 5-8, 2000.

Co-presented invited talk titled "Integrating Simulation and Optimization through Metaheuristics," INFORMS Meeting, San Antonio, Texas, November 5-8, 2000.

Co-presenter and Panelist, "Integrating Optimization and Simulation: Research and Practice," at the Winter Simulation Conference, Orlando, Florida, December 2000.

Co-Organized the International Conference "Adaptive Memory and Evolution: Tabu Search and Scatter Search," sponsored by NSF, ESRI and the Hearin Center for Enterprise Science, Oxford, MS, USA, March 8-10, 2001.

Co-Director, the DIMACS TSP Challenge, 2001, hosted by Rutgers University.

Invited Cluster Chair, "Applications & Extensions of Metaheuristics," National INFORMS 2001 Meeting, Miami, Florida, USA, 4-7 Nov. '01.

Invited Session Chair, "Network Optimization," Annual International Event of the European Chapter on Combinatorial Optimization, ECCO XIV, Bonn, Germany, 31 May - 2 June, '01.

Invited Session Chair, "Adaptive Memory Programming and New Evolutionary Models (I)," National IEEE Systems, Man and Cybernetics 2001 Meeting, Tucson, Arizona, 7-10 October, '01.

Invited Session Chair, "Adaptive Memory Programming and New Evolutionary Models (II)," National IEEE Systems, Man and Cybernetics 2001 Meeting, Tucson, Arizona, 7-10 October, '01.

Invited Plenary presentation, "New Methods and Computational Results for Combinatorial Problems with Simulation Components," European Chapter on Combinatorial Optimization, ECCO XIV, Bonn, Germany, 31 May - 2 June, 2001 (with M. Laguna).

Invited Plenary Presentation, MIC' 2001: 4th Metaheutistics International Conference, Porto, Portugal, July 2001 (with G. Kochenberger and C. Rego), "Advances in Metaheuristics for Classical and Real World Problems"

Invited Presentation, ECCO XIV, European Chapter on Combinatorial Optimization. March 31 to June 2, 2001. (with A. Lokketangen), "On the tradeoff between randomization and search guidance".

Invited Presentation, Adaptive Memory and Evolution: Tabu Search and Scatter Search, at the Hearin Center for Enterprize Science, Oxford, Mississippi, 8-10 March '01. (with A. Lokketangen), "Search Guidance for Satisfiability Problems".

Invited Presentation, The Canadian Operational Research Society (CORS) Quebec city (Canada), May 6-9, 2001, (with M. Toulouse and K. Thulasiraman), "The Energy Function of Cooperative Multi-level Graph Partitioning Algorithms"

Invited Presentation, Memory and Evolution: Tabu Search and Scatter Search Conference, March 8-10, 2001 (with M. Toulouse and K. Thulasiraman, "Dynamics of Multilevel Cooperative Search Algorithms"

Invited Presentation, MIC' 2001: 4th Metaheutistics International Conference, Porto, Portugal, July 2001, (with C. Rego and D. Gamboa, "Analysis on the Implementation of Efficient Heuristic Algorithms for the Traveling Salesman Problem"

Invited presentation, Max Planck - Poland Symposium on Bioinformatics, Berlin, Germany, October 22-23, 2001, (with J. Blazewicz), "New Approaches to DNA Sequencing Using Metaheuristic Analysis"

Invited presentation, IEEE Systems, Man and Cybernetics 2001, Tucson, Arizona, 7-10 October, '01, (with M. Yagiura and T. Ibaraki) "An Effective Metaheuristic Agorithm for the Generalized Assignment Problem"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. (with A. Lokketangen), "Surrogate Constraint Guidance versus Randomization in Local Search Methods for the Satisfiability Problem"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. (with R. Barr and B. Hickman), "Information Engineering with Optimization and Simulation-Based Alternatives to Classic Multivarate Statistical Models"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. (with W. Adams and R. Forrester), "Comparisons & Enhancement Strategies for Linearizing Mixed 0-1 Quadratic Programs"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. (with A. Lokketangen) "Surrogate Constraint Guidance for Boolean Optimization Problems"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. "New Methods & Results for Synthesizing Simulation and Optimization"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. (with G. Kochenberger and B. Alidaee), "New Heuristic Approaches to Graph Optimization & Related Problems"

Invited presentation, INFORMS 2001, Miami, Florida, USA, 4-7 Nov. '01. (with C. Rego), "Filter and Fan Methods for Combinatorial Optimization"

Invited presentation, Winter Simulation Conference, WSC 2001, Washington, D.C., 9-12 Dec., '01, (with J. Kelly and J. April) "New Advances in Optimizing over Uncertainty by Combining Simulation and Optimization"

Invited panel presentation, Winter Simulation Conference, WSC 2001, Washington, D.C., 9-12 Dec., '01, (with J. Kelly), "Future of Simulation Optimization"

Invited Principal Talk, 15th Cumberland Conference in Combinatorics, Graph Theory and Computing, Oxford, MS, May 16-18, 2002. (wih G. Kochenberger), "A Royal Road to Combinatorial Optimization - The 0-1 Quadratic Programming Problem"

Invited paper,MAS V- Military Personnel Research, sponsored by INFORMS, NPRST and ONR, June 3-5, 2002 (with K. Womer, and G. Kochenberger), "Innovations in Optimization Methodologies"

Invited paper, MAS V- Military Personnel Research, sponsored by INFORMS, NPRST and ONR, June 3-5, 2002 (with M. Amini and G. Kochenberger), "New Advances in Discrete Generalized Networks"

Invited featured paper, INFORMS Conference on OR/MS Practice: Analyzing and Enhancing the Extended Enterprise, May 19-21, 2002, Montreal Canada (with J. Kelly), "Innovations in Metaheuristics and Applications to Simulation Optimization"

Invited Panel, INFORMS Conference on OR/MS Practice: Analyzing and Enhancing the Extended Enterprise, May 19-21, 2002, Montreal,Canada, ,"The OR Entrepreneur"

Invited paper, International Symposium on Combinatorial Optimization (CO'02) Paris, April 8-10 (with Said Hanafi), "Convergent Tabu Search for Optimal Partitioning"

Invited Presentation, Very Large-Scale Neighborhood Search Algorithms; Session (with C. Rego and A. Punnen), "Advances in Ejection Chain Methods for the Traveling Salesman Problem"

Invited Presentation, INFORMS 2002, San Diego, CA. (with M. Amini and G. Kochenberger) Invited Presentation, "Discrete Optimization via Netforms and Dynamic B&B," INFORMS 2002, San Diego, CA. (with M. Amini and G. Kochenberger)

Invited Presentation, " New Prospects and Developments for Joining Optimization with Simulation," IFORS 2002, Edinburgh, UK, July 8-12, 2002.

Invited Presentation, "An Evolutionary Metaheuristic for Unconstrained Binary Quadratic Programming," IFORS 2002, Edinburgh, UK, July 8-12, 2002 (with C. Rego, M. Amini and B. Alidaee)

Invited Presentation, "Foundation-Penalty Cuts for Mixed Integer Optimization," Tri-Regional University Seminar, University of Bologna, Italy, October 24, 2002.

Invited Presentation, “Latest Advances in Adaptive Memory Programming,” ROADEF Meeting, Avignon, France, February 2003.

Invited Seminar "Second Generation Applications of Tabu Search and Scatter Search in Simulation Optimization,” EPFL, Swiss Federal Institute of Technology, March 2003.

Invited Plenary Presentation titled "Metaheuristic Agent Based Processes with Applications to Nonlinear, Stochastic and Simulation-Based Models,” (with G. Kochenberger), International MIC 2003 conference, Kyoto, Japan, August 2003.

Invited Presentation titled "An Adaptive Surrogate Constraint Algorithm for the Set Covering Problem" (with Jie Zhang and Cesar Rego), INFORMS conference, Advances on Metaheuristics for Combinatorial Optimization, Atlanta, Georgia, October 2003.

Invited Paper titled "Improved Solution Approaches for Boolean Optimization,” (with Arne Lokketangen), INFORMS conference, Advances on Metaheuristics for Combinatorial Optimization, Atlanta, Georgia, October 2003

Chaired Session Titled "Metaheuristics -- Unified Frameworks and New Advances" in the Mathematical Programming cluster of the international Joints CORS/INFORMS meeting, Banff, Canada, May 2004.

Chaired session titled "New Methods for Discrete Nonlinear and Satisfiability Problems," in the INFORMS Computing Society (ICS) Cluster of the international Joints CORS/INFORMS meeting, Banff, Canada, May 2004.

Chair of a special cluster on the topic of SCIENCE & OR at the national INFORMS meeting, Denver, October 24-27, 2004.

Organizing Committee: The 2nd Multidisciplinary International Conference on Scheduling : Theory and Applications (MISTA 2005), 18th - 21st July 2005, New York, USA

Invited Presentation titled "A Unified Modeling and Solution Framework for Partitioning and Related Problems," Fred Glover and Gary Kochenberger, for the conference "Multiscale Optimization Methods and Applications," University of Florida, February 26 - 28, 2004.

Invited presentation titled "The Unconstrained Quadratic Binary Program: A Unified Modeling and Solution Framework for Combinatorial Optimization," with Gary Kochenberger, at the International Joint CORS/INFORMS meeting, Banff, Canada, May 2004.

Invited presentation titled "A Candidate List Strategy with a Simple Diversification Device," with Gilles Trombettoni and Bertrand Neveu, at the International Joint CORS/INFORMS meeting, Banff, Canada, May 2004.

Invited paper titled "Evaluating Alternative Roles and New Product Technologies in Uncertain Domain Environments," for the 11TH International Product Development Management Conference, EIASM - The European Institute for Advanced Studies in Management (with R. Farina), Dublin, Ireland, June 20-22, 2004

Invited Paper titled: "New Advances on Solving the Protein Folding Problem," at the Denver INFORMS 2004 National Meeting, October 24-27, 2004 (with C. Rego and H. Li).

Invited Tutorial presentation titled: "Simulation Optimization," at the Denver INFORMS 2004 National Meeting, October 24-27, 2004 (with J. April and J. Kelly).

Computational Biology Poster Presentation titled “New Advances on Solving the Protein Folding Problem,” Butcher Symposium on Genetics and Biotechnology, November 11, 2004

Invited paper ”Simulation Optimization for Business Process Trends,” Winter Simulation Conference WSC '04, Washington, D.C., December 5-8, 2004 (with J. April, J. Kelly and M. Laguna)

Invited paper titled "Improved Clustering of Microarray Data," (with G. Kochenberger, B. Alidaee and H. Wang), Conference on Systems Analysis, Data Mining and Optimization in Biomedicine, Gainesville, FL , Feb 2005.

Invited paper titled "Tree Search Neighborhoods for the Protein Folding Problem in the HP Lattice Model," (with H. Li and C. Rego), Chemistry and Chemical Engineering, Mississippi Academy of Sciences (MAS) Annual Meeting, Oxford Convention Center; Oxford, MS, February 16-18, 2005.

Invited paper titled "Advances in Data Mining via Quadratic Programming," (with G. Kochenberger) Conference on Systems Analysis, Data Mining and Optimization in Biomedicine, Gainesville, FL , Feb 2005.

Opening Plenary Presentation, titled "New Developments for Metatheuristics in Science and Industry," 6th Metaheuristics International Conference MIC2005 , Vienna, August 22-26, 2005

Invited presentation titled "Attractive Nonlinear Models: Calling into Question the Tenet of Linearity for Combinatorial Problems," (with G. Kochenberger, B. Alidaee, and H. Wang), 6th Metaheuristics International Conference MIC2005 , Vienna, August 22-26, 2005.

Invited paper titled "Clustering via Clique Partitioning," (with G. Kochenberger), National INFORMS Meeting, San Francisco, November 13-16, 2005.

Invited paper titled "Parallelization and Diversification Strategies for the Quadratic Assignment Problem," (with T. James and C. Rego), National INFORMS Meeting, San Francisco, November 13-16, 2005.

Invited paper titled “Advances in Mixed Integer Formulations for Pattern Analysis,” Conference on Data Mining, Systems Analysis and Optimization in Neuroscience," University of Florida, Gainesville, FL, February 15-17 2006.

Invited Keynote Presentation: "New Optimization Models for Data Mining," Xiangshan Sciences Forum on Frontier Studies on Data Technology and Knowledge Economy, Meeting of the Chinese Academy of Sciences, Beijing, China May 21-25, 2006 (with G. Kochenberger)

Invited Presentation: "Simulating Disruptions in Supply Chains," International Conference on National Security, Natural Disasters, Logistics and Transportation, University of Rhode Island, September 25-26, 2006 (with T. Schmitt, K. Stecke, and S. Kumar)

Invited Presentation: "Attractive Nonlinear Models for Combinatorial Optimization," EURO XXI European Conference on Operational Research, Reykjavik, Iceland, July 2-5, 2006 (with G. Kochenberger)

Invited Presentation: "An Ejection Chain Algorithm for the Quadratic Assignment Problem," EURO XXI European Conference on Operational Research, Reykjavik, Iceland, July 2-5, 2006 (with C. Rego and T. James)

Invited Presentation: "A Primal-Dual RAMP Algorithm for Very Large Set Covering Problems," EURO XXI European Conference on Operational Research, Reykjavik, Iceland, July 2-5, 2006 (with J. Ablanedo and C. Rego)

Invited Presentation: "New Optimization Models for Data Mining," International Conference on Applied Optimization and Metaheuristic Innovations, Yalta, Ukraine, July 19-21, 2006 (with M. Better and G. Kochenberger)

Invited Presentation: "Innovations in Mathematical Methods for Pattern Analysis," Institute of Cybernetics, Ukrainian Academy of Sciences, July 25, 2006

Invited Presentation: "A Novel Approach to Classification in Financial Applications," INFORMS Workshop on Artificial Intelligence and Data Mining, INFORMS National Meeting, Pittsburgh, PA, November 2006 (with M. Better and G. Kochenberger)

Invited Presentation: "Multi-Start Tabu Search and Diversification Strategies for the Quadratic Assignment Problem," INFORMS National Meeting, Pittsburgh, PA, November 2006 (with T. James and C. Rego).

Invited Presentation: "Evaluating the Performance of Multi-Stage Supply Chains under Disruptions and Random Customer Demand," INFORMS National Meeting, Pittsburgh, PA, November 2006 (with Sanjay Kumar, Thomas G. Schmitt and Kathryn E. Stecke)

Invited Presentation: "New Data Mining Models and Applications," Chinese Academy of Sciences, Beijing, China, May 2007 (with G. Kochenberger).

Invited Presentation: "Simulation and Optimization in Industry, Science and Government," Inaugural Meeting of the Enterprise Simulation and Optimization Laboratory, University of Memphis, Memphis, Tennessee June 2007.

Invited Presentation: "Innovations and Practical Advances in Metaheuristics," Metaheuristics International Meeting (MIC2007), Montreal, Canada, October 2007.

Invited Presentation: "Models and Applications of Simulation Optimization," INFORMS Workshop on Applied Optimization, INFORMS National Meeting, Seattle, Washington, November 2007 (with G. Kochenberger).

Invited Presentation: "Adaptive Search Methods for Ordering Decisions in Multi-stage Supply Chains," 19th Annual Conference of the Production and Operations Management Society, La Jolla, California, May 2008 (with S. Kumar, K. Stecke and T. Schmidt)

Invited Presentation: "Global Optimization Methods," Colloquium on Applied Mathematics, University of Paris XXII, Paris, France, October 2008

Invited Presentation: "Simulation Optimization and Agent Based Models," U.S. Army Research Office, Raleigh, N.C., November 2008 (with B. Thengvall)

Invited Presentation: "Nonlinear Quadratic Optimization and Zero-One Programming," Laboratoire d/Etude et de Recherche en Informatique d'Angers (LERIA), Universite d'Angers, Angers, France December 2008.

Invited Presentation: "New Methods for Binary Quadratic Optimization," *International Meeting of the European Operational Research Society, EURO 2009*, Bonn, Germany, July 2009.

Invited Presentation: "Neighborhood Structures and Improved Strategies for their Exploitation," *Metaheuristic International Meeting, MIC 2009*, Hamburg, Germany, July 2009.

Invited Presentation: "Optimization and Analysis of Agent-based Models," *77th MORS Symposium*, Fort Leavenworth, Kansas, August 2009 (with B. Thengvall)

Invited Presentation: "A Framework for the Optimization and Analysis of Agent-based Models," *Winter Simulation Conference*, Austin, Texas, December 2009 (with B. Thengvall)

Conference Co-Chair: *Special Conference On Methods and Applications of Metaheuristics*, School of Business, Sun Yat-Sen University, Guangzhou, Guangdong, China, December 2009

Invited Keynote Presentation: "Simulation Optimization: New Advances for Real World Optimization," *Special Conference On Methods and Applications of Metaheuristics*, School of Business, Sun Yat-Sen University, Guangzhou, Guangdong, China, December 2009 (with G. Kochenberger).

Invited Presentation: "Solving Large max cut problems using tabu search," *INFORMS National Meeting*, Austin, Texas, November 2010 (with G. Kochenberger).

Invited Presentation: "Impacts of Tabu Search and its Offspring," *INFORMS National Meeting*, Austin, Texas, November 2010.

Program Committee: *Metaheuristics International Meeting*, MIC2011, Udine, Italy, July 2011.

Chaired Session Titled "Metaheuristics for Quadratic Binary Programs," *Metaheuristics International Meeting*, MIC2011, Udine, Italy, July 2011.

Invited Presentation: "Cardinality constrained quadratic binary programming," *Metaheuristics International Meeting*, MIC2011, Udine, Italy, July 2011 (with G. Kochenberger and J. K. Hao)

Invited Presentation: "Adaptive Memory Projection Method for Binary Combinatorial Optimization," *Metaheuristics International Meeting*, MIC2011, Udine, Italy, July 2011 (with P. Greistorfer)

Invited session co-chair, "Advances in Simulation and Optimization, *Production and Operations*

*Management Society (POMS)* National meeting, Denver, June 2013

Invited Presentation, "Innovations in Applications of Optimization to Technology and Industry," *Institute of Management Science & Engineering Review*, China University of Mining and Technology, Xuzhou, China, August 2013.

Steering Committee, *Metaheuristics International Conference*, Singapore, August 2013

Keynote speaker and Best Paper award committee, *Metaheuristics International Conference*, Singapore, August 2013

Invited Chair of Session Stream, "Meta-Analytics: A Marriage of Metaheuristics and Analytics," *20th Conference of the International Federation of Operational Research Societies (IFORS),* Barcelona, Spain., July 2014.

Invited Presentation, "Advances in Specialized Zero-One Optimization," *20th Conference of the International Federation of Operational Research Societies (IFORS)*, Barcelona, Spain., July 2014.

Steering committee, *Metaheuristics International Conference (MIC2015),* Agadir, Morocco, June 2015

Keynote speaker, "Innovations in Supply Chain Management," *Metaheuristics International Conference (MIC2015),* Agadir, Morocco, June 2015.

Invited Presentation, "Advances in Meta-Analytics," *Chinese Academy of Engineering Conference on Engineering Management*, Beijing, China, August 2016.

Invited Keynote Presentation, "Meta-Analytics for Real World Optimization," *Institute of Technology and Quantitative Management Conference,* Asan,, Korea, August 2016.

Invited Presentation, "Multi-Wave Algorithms for Metaheuristic Optimization," *University of Valenciennes Optimization Colloquium,* October, 2016.

Invited presentation "Wealth Management Systems for individual investors," School of Engineering and Applied Science, Princeton University, Apr 25 – 28, 2017 (with John Mulvey).

Invited presentation, "Robo Advisors and Stochastic Optimization," School of Engineering and Applied Science, Princeton University, Apr 25 – 28, 2017 (with John Mulvey).

International Advisory Committee of the *12th International Conference on Green, Pervasive and Cloud Computing* (GPC-2017), Cetara, Amalfi Coast, Italy, May 2017.

Invited Research Collaboration "Combinatorial and Multiwave Optimization," University of Valenciennes June 16-30, 2017 (with Said Hanafi)

Steering committee, *Metaheuristics International Conference (MIC2017),* Barcelona, Spain, July 2017.

Invited Chair of Session Stream, Tabu Search, *Metaheuristics International Conference (MIC2017),* Barcelona, Spain, July 2017.

Invited Presentation: "Quantum Bridge Analytics in Combinatorial Optimization," 12th Metaheuristics International Conference, MIC2017, Barcelona, Spain, July 4-7, 2017

Invited Presentation: "Quantum Bridge Analytics and QUBO Solutions," Los Alamos National Laboratory, Nov 25-28, 2018 (with Gary Kochenberger)

Invited Presentation: "Metaheuristics for Optimization," NEU (Northeastern University), Shenyang, China, December 8-13, 2018 (with G. Kochenberger).

Invited Presentation: "Quantum Bridge Analytics," Tianfu Institute, Chengdu, China, Feb 7-13, 2019.

Invited Plenary Presentation: "QUBO Models in Optimization, Machine Learning and Quantum Computing,", ECCO XXXII International Meeting, Malta, May 30 - June 1, 2019 (with G. Kochenberger).

Invited Presentation: "Quadratic Unconstrained Binary Optimization." 30th European Conference on Operational Research, (EURO 30 th), Dublin, Ireland, June 23-26, 2019 (with G. Kochenberger).

Invited Presentation: "Quantum Bridge and Simulation Optimization," MIC - Metaheuristics International Conference, Cartagena, Colombia, SA, July 28-31, 2019 (with Marco Better).