World Congress on Global Optimization
WCGO 2015

Hilton University of Florida Conference Center

February 22th – 25th, 2015
Gainesville, Florida, USA.

Sponsors

Conference Organizer: Panos M. Pardalos
Local Organizers: Ioannis P. Pappas and Jiaxing Pi

Starting times	Sunday 02/22	Monday 02/23	Tuesday 02/24	Wednesday 02/25
7:55		Conference Opening by Panos M. Pardalos		
8:00				
8:45		Session 1	Session 5	Session 9
9:00				
9:45		Coffee break	Coffee break	Coffee break
10:00				
10:45		Session 2	Session 6	Session 10
11:00				
11:45				
12:00		Lunch	Lunch	Lunch
13:00				
13:45		Session 3	Session 7	Session 11
14:00				
14:45		Coffee break	Coffee break	Coffee break
15:00				
15:45				
16:00		Session 4	Session 8	Session 12
16:45	Reception			
17:00				
17:45			Dinner and Prizes	
18:00				
19:00				

Sunday, February 22th

4:00PM-6:00PM Conference Reception

4:00PM-6:00PM Conference Registration

Monday, February 23th

7:00AM-9:00AM Conference Registration

7:45AM-8:00AM Opening remarks by Prof. Panos M. Pardalos

8:00AM-9:45AM Session 1

Yiming Wang, Austin Buchanan, and Sergiy Butenko
On Imposing Connectivity Constraints in Integer Programs
Carlos Nohra and Alexander Mitsos
Global Solution of MPEC for Semi-Infinite Program
Dong Li and Anna Nagurney
Supply Chain Performance Assessment and Supplier and Component Importance Identification in a General Competitive Multitiered Supply Chain Network Model
Ralph Baker Kearfott
The Pending IEEE Standard on Interval Arithmetic: Implications for the Global Optimization Community
Joan Davins-Valldaura, Säid Moussaoui, Guillermo Pita-Gil, and Franck Plestan
ParEGO Extensions for Multi-objective Optimization of Expensive Evaluation Functions

9:45:00AM-10:00AM Coffee Break

10:00AM-12:00PM Session 2

Alla Kammerdiner, Alexander Veremyev, and Eduardo Pasiliao
On Laplacian Spectrum of Parametric Families of Closely Connected Networks
Paul Feliot, Julien Bect, Emmanuel Vazquez
A Bayesian approach to constrained multi-objective optimization
Sanjeet Singh and Nivedita Haldar

Bilevel Portfolio Optimization: A Global Optimization Approach
Yan Zhao
A Cell Genetic Algorithm on GPU for Dependent Task Scheduling for Heterogeneous Computing
Haoxiang Jie, Yizhong Wu, Jianwan Ding, and Liping Chen
An Efficient Multi-Objective PSO algorithm Assisted by Kriging Metamodel for Expensive Black-Box Problems

12:00PM-1:00PM Lunch Break

1:00PM-2:45PM Session 3

Yaohui Li, Yizhong Wu, Jianjun Zhao, and Liping Chen
A Kriging-based Constrained Global Optimization Algorithm for Expensive Black-box Functions with Infeasible Initial Points
Raka Jovanovic, Milan Tuba, and Stefan Voss
Ant Colony Optimization Applied to the Problem of the Maximal Balanced Partitioning of Graphs with Supply and Demand
Tomasz Nabagło and Andrzej Jurkiewicz
Grid-Seed Strategy for Fuzzy Rules Optimization in an Application to Semi-Active Suspension Control System
Tiantian Nie, Shu-Cherng Fang, Zhibin-Deng, and Qi An
On Linear Conic Relaxation of Discrete Quadratic Programming Problems

2:45PM-3:00PM Coffee Break

3:00PM-7:00PM Session 4

Yicheng Xu, Dachuan Xu, Donglei Du, and Chenchen Wu
Local Search Algorithm for Universal Facility Location Problem with Linear Penalties
Josef Kallrath
Packing Ellipsoids into Volume-Minimizing Rectangular Boxes
Akhlad Iqbal
Integral Inequalities of Hermite-Hadamard Type for Functions whose Third Derivative Absolute Values are Preinvex
Somyot Plubtieng
On the Convergence of the Proximal Point Algorithm for Convex Minimization
Yong Hsia, Ruey-Lin Sheu, and Ya-xiang Yuan
On General $p-$Regularized Subproblems for $p > 2$
Michael Hirsch and Hector Ortiz-Pena
Information Workflow Optimization with Bandwidth Constraints
Mengyi Ying and Min Sun
Some Feasibility Sampling Procedures in Interval Methods for Constrained Global Optimization
Rabian Wangkeeree and Jutamas Kerdkaew

Hölder Continuity of Solution Maps of Parametric Ky Fan Inequalities in Metric Linear Spaces
Yin Qian, Wu Yizhong, Wang Boxing, and Chi Yuancheng
IDF Optimization Algorithm Based on Globally Optimized Design Structural Matrix
Erotokritos Skordilis, Georgios K.D. Saharidis, George Liberopoulos, and George Kolomvos
A New Hybrid Solution Approach for a Special Case of VPR ith Time Windows and Specific Requirements for Vehicles and Customers
Anurag Jayswal and Ashish Kumar Prasad
Second Order Fractional Symmetric Duality in Variational Problems over Cone Constraints
Georgios K.D. Saharidis, George Liberopoulos, and Erotokritos Skordilis
Greenroute: A Web Based Platform which helps Individuals and Companies move Commodities with the most Environmental Friendly way

Tuesday, February 24th

8:00AM-9:45AM Session 5

Oleg Prokopyev and Andrew Trapp
On Constraint Aggregation and Value Functions for Two-Stage Stochastic Integer Programs
Maciej Rysz and Pavlo Krokhmal
Two-stage Stochastic Maximum Clique Problem and Extensions
Julius Žilinskas
Hybrid Global Optimization Algorithm for Engineering Structures
Yannis Marinakis, Magdalene Marinaki, and Athanasios Migdalas
A Tree Neighborhood Topology Particle Swarm Optimization Algorithm for the Vehicle Routing Problem with Stochastic Travel and Service Times
Valeriy Kalyagin, Alexander Koldanov, Peter Kaldanov, and Panos Pardalos
Optimal Identification Procedures in Gaussian Graphical Models

9:45AM-10:00AM Coffee Break

10:00AM-11:45AM Session 6

Adolfo R. Escobedo and Erick Moreno-Centeno
Towards Roundoff-Error-Free (REF) Optimization: REF Cholesky and LU Factorizationss
Yishui Wang, Dachuan Xu, Donglei Du, and Chenchen Wu
An Approximation Algorithm for Squared Metric Facility Location Problems with Linear Penalties
Yu-Ching Lee, Jong-Shi Pang, and John E. Mitchell
Global Parameter Selection of the Support Vector Machine Regression with MPCC
Thomas J. Morrisey and Ravi Prasad
Predicting Supply Disruptions
Paweł Ocłoń, Marco Bittelli, Piotr Cisek, Eva Kroener, Marcin Pilarczyk, and Dawid Taler

Thermal Performance Improvement of Underground Power Cables System using the Momentum-Type PSO Method

12:00PM-1:00PM Lunch Break

1:00PM-2:45PM Session 7

Neng Fan
Vulnerability Analysis of Multicommodity Network Flows and its Applications in Network Design
Alexander S. Belenky
Calculating Nash Equilibria in n-Person Games on Polyhedral Sets of Player Strategies in Large-Scale Economic Systems by Linear Programming Techniques
Jared Guilbeau
A Vector Based Parallel Brand and Bound Algorithm
Giovanni Felici, Kumar Parijat Tripathi, Daniela Evengelista, and Mario R. Guarracino
From Locally Significant to Globally Relevant: a Paradigm Shift in the Analysis of Biological High Throughput Experiments

2:45PM-3:00PM Coffee Break

3:00PM-5:00PM Session 8

Fani Boukouvala and Christodoulos A. Floudas
Global Optimization of Constrained Grey-Box Computational Problems
Ignacio E. Grossmann
Relaxations for Convex Nonlinear Generalized Disjunctive Programs and their Application to Nonconvex Optimization
Nikolaos Sahinidis
Recent Advances in the BARON Project

17:00PM-19:00PM Dinner Buffet

Wednesday, February 25$^{\text{th}}$

8:00AM-09:45AM Session 9

Richard Oberdieck and Efstratios N. Pistikopoulos

Parallelization Studies for mp-MIQP Algorithms
Lyudmila Egorova
Mathematical Modeling of the Stock Exchange Behavior with Respect to Individual Traders
Ioannis Demetriou
A Bisection Algorithm for Least Squares Piecewise Monotonic Data Approximation
Mikhail Batsyn, Evgeny Maslov, Alecey Nikolaev, and Pablo San Segundo
An Efficient Approach to the Protein Structure Alignment Problem
Athanasia Karakitsiou and Athanasios. Migdalas
Discrete Bi-Level Facility Models with Competing Customers

9:45AM-10:00AM Coffee Break

10:00AM-11:45AM Session 10

Matthew Norton and Stanislav Uryasev
Maximization of AUC and Buffered AUC in Classification
Eric Newby and Montaz Ali
Methods for Solving Non-Convex MIQPs
Egidio D'Amato, Elia Daniele, and Lina Mallozzi
Two-stage Optimization Approach for a Location-Allocation Problem
Ingrida Steponaviče, Rob J. Hyndman, Kate Smith-Miles, and Laura Villanova
Pareto Optimal Set Identification for Costly Black-box Problems
Yue Sun and Alfredo Garcia
Interactive Model-based Search in Real Time

12:00PM-1:00PM Lunch Break

1:00PM-2:45PM Session 11

Aleksandr Mafusalov and Stanislav Uryasev
Convex Optimization Formulations for Buffered Probability of Exceedance Minimization
Arman Boyaci
The Max-Cut Problem In Co-bipartite Chain Graphs
Fuad Alekserov and Denis Tverskoy
Global Optimal Solutions and the Origin of Multicellularity: Differentiation of Types, Energy Constraints, Curvatures of Trade-Off Functions
Jun Pei, Xinbao Liu, Panos M. Pardalos, Wenjuan Fan, Shanlin Yang, and Ling Wang
Application of an Effective Modified Gravitational Search Algorithm for the Coordinated Scheduling Problem in a Two-Stage Supply Chain

2:45PM-3:00PM Coffee Break

3:00PM-7:00PM Session 12

Ling Wang, Lu An, Jiaxing Pi, Panos M. Pardalos, and Minrui Fei
A Diverse Human Learning Optimization Algorithm
Kun Zhao and Stanislav Uryasev
Gradient Calculations for the Buffered Probability of Exceedance
José Viriato Coelho Vargas, Vanessa Kava-Cordeiro, and Juan Carlos Ordonez
The Optimization of Hydrogen Production from Microalgae
Anirban Chaudhuri and Raphael T. Haftka
Profit based Effectiveness of Global Optimization Stopping Criteria
Zehra Melis Teksan and Joseph Geunes
Production Planning with Price-Dependent Supply Capacity
Miro Germuska
General Nonlinear Iterative Variation Method for Problems with Inequalities, Discontinuities and Singularities
Babatunde A. Sawyerr, Ebun P. Fasina, and Oluwafunmilola E. Kesa
Enhanced Differential Evolution with Tabu list (EDET) for Permutation-Based Combinatorial Optimization Problems

On Imposing Connectivity Constraints in Integer Programs

Yiming Wang[1], Austin Buchanan[1], and Sergiy Butenko[1]
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In many clustering and network analysis applications, one searches for a connected subset of vertices that exhibits other desirable properties. To this end, we study the connected subgraph polytope of a graph, which is the convex hull of subsets of vertices that induce a connected subgraph. We perform a thorough polyhedral study, showing how its facets are linked to the facets of the connected components' polytopes, and determine precisely when vertex separator inequalities induce facets. We explore the complexity of generating facet-defining inequalities via lifting, showing that it is hard in general, but is polytime solvable in several special cases.

Global Solution of MPEC for Semi-Infinite-Programs

Carlos Nohra[1] and Alexander Mitsos[1]
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Mathematical programs with equilibrium constraints (MPECs) are interesting in their own right but can also be used to solve related or more general problems, such as mixed-integer nonlinear programs (MINLPs), bilevel programs and semi-infinite programs (SIPs). In the first part of this talk we give a brief comparison of commercial global and local optimizers to examine the effectiveness of formulation and solution method. We demonstrate that global solvers have done tremendous progress in the solution of MPECs. In the second part we consider the use of MPEC inside solution of SIPs, following work of [Mitsos et al SIOPT 2008] and compare it with alternative approaches in particular [Mitsos Optimization 2011].

Supply Chain Performance Assessment and Supplier and Component Importance Identification in a General Competitive Multitiered Supply Chain Network Model

Dong Li[1] and Anna Nagurney[1]
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In this paper, we develop a multitiered competitive supply chain network game theory model, which includes the supplier tier. The firms are differentiated by brands and can produce their own components, as reflected by their capacities, and/or obtain components from one or more suppliers, who also are capacitated. The firms compete in a Cournot-Nash fashion, whereas the suppliers compete a la Bertrand since firms are sensitive to prices. All decision-makers seek to maximize their profits with consumers reflecting their preferences through the demand price functions associated with the demand markets for the firms' products. We construct a supply chain network performance measure, on the full supply chain and individual firm levels, that assesses the efficiency of the supply chain or firm, respectively, and also allows for the identification and ranking of the importance of suppliers as well as the components of suppliers with respect to the full supply chain or individual firm. The framework is illustrated through a series of numerical supply chain network examples.

The Pending IEEE Standard on Interval Arithmetic: Implications for the Global Optimization Community

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The IEEE P-1788 working group on interval arithmetic has completed its work on an interval arithmetic standard. The document will now become a standard pending a final Sponsor Ballot vote and procedural review. Implementations of the pending standard will contain various standard features to facilitate computations relevant to global optimization. This is particularly true when interval arithmetic is used in the box reduction phase of branch and reduce algorithms: The behavior of the basic operations and functions, particularly those involving extended interval arithmetic, is standardized, and hence portable. All possible exceptions, such as empty intersections or evaluations partially in or outside the domain of an operation, are tracked without interrupting the computation. Comparison operators are standardized. A library of standard functions is required. Additionally, the tracking mechanism allows for different contexts. For example, evaluation of a function at an argument only partially in its domain can be handled one way during constraint propagation (i.e. during box reduction), but another way in a computational existence / uniqueness proof. Finally, at all points, the pending standard has been crafted to allow efficient implementations. We give an overview of the features of this pending standard, and will give an update on its status during the talk.

ParEGO Extensions for Multi-objective Optimization of Expensive Evaluation Functions

J. Davins-Valldaura[1], Säid Moussaoui[2], Guillermo Pita-Gil[1], and Franck Plestan[2]
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Multi-objective optimization of expensive evaluations problem arises in several engineering applications, such as for instance automotive system design, where the goal is to find a set of optimal design parameters in a limited global processing time. In some situations a manual parameter setting can be performed while in others an automatic tuning strategy must be adopted in order to handle the problem complexity and to manage processing time. Widely used algorithms for multi-objective optimization are ParEGO (Pareto Efficient Global Optimization) and NSGA-II (Nondominated Sorting Genetic Algorithm). NSGA-II is an evolutionary algorithm that recursively sorts the set of parameter values according to a measurement of Rank and Crowing distance and updates the parameter values using a genetic algorithm. In practice, such algorithm may require a high population size and several population updates, especially in the case of high-dimensional problems and more than two objectives functions. ParEGO algorithm is an extension of the mono-objective global optimization method called EGO. Its use for multi-objective optimization consists in combining linearly all the objectives with several random weights and to maximize the expected improvement (EI) criterion, which is based on a surrogate model obtained by Kriging. In high dimensions, ParEGO algorithm tends to favor parameter values suitable for the reduction of the surrogate model error, rather than finding the non-dominated solutions. The contribution of this article is to propose an extension of the ParEGO algorithm for finding the Pareto Front by introducing a double Kriging strategy allowing to calculate a modified EI criterion that jointly accounts for the objective function approximation error and the probability to find Pareto Front solutions. The main feature of the resulting algorithm is to enhance the convergence speed and thus to reduce the total number of function evaluations; which is of high interest in high-dimensional or expensive evaluations problems. The performances of this new algorithm are compared with the methods ParEGO and NSGA-II on a standard benchmark problem (ZDT functions). Finally, the use of the algorithm in an automotive engineering application is presented : the parameter setting optimization of the controller and the state observer of the auto-steer system in the autonomous car design.

On Laplacian Spectrum of Parametric Families of Closely Connected Networks

Alla Kammerdiner[1], Alexander Veremyev[2], and Eduardo Pasiliao[2]
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Each eigenvalue of graph Laplacian is a solution of a global optimization problem. We derive analytical expressions for the eigenvalues of certain parametric families of networks and discuss the implications for the convergence speed of consensus algorithms.

A Bayesian Approach to Constrained Multi-Objective Optimization

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This paper addresses the problem of derivative-free multi-objective optimization of real-valued functions under multiple inequality constraints. Both the objective and constraint functions are assumed to be smooth, nonlinear, expensive-to-evaluate functions. As a consequence, the number of evaluations that can be used to carry out the optimization is very limited. The method we propose to overcome this difficulty has its roots in both the Bayesian and multi-objective optimization literatures. More specifically, we introduce a new domination rule taking both constraints and objectives into account under a unified multi-objective framework and propose a generalization of the expected improvement sampling criterion adapted to the problem.

Bilevel Portfolio Optimization: A Global Optimization Approach

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This paper proposes a method to solve a Bilevel Portfolio Optimization problem using Global Optimization technique. The problem is nonlinear and bilevel in nature where a brokerage house, as the leader, tries to maximize the total brokerage fee by setting brokerage fees for individual assets. Investor, as the follower, decides the investment in each asset in order to maximize expected return for a fixed level of risk or to minimize risk while maintaining a fixed level of return. Bilevel portfolio optimization problem is transformed into an equivalent single level mathematical programming problem using Karush-Kuhn-Tucker (KKT) conditions. Equivalent problem involves twice differentiable nonlinear functions while the linear independence constraint qualification holds for the follower level constraints. Subsequently, convexification has been done using the relaxation of the feasible region by convex underestimation. Finally, applying a branch and bound framework based on the Deterministic Global Optimization algorithm, αBB, the efficient portfolios have been obtained. Theoretical results have been illustrated with the help of numerical examples.

A Cell Genetic Algorithm on GPU for Dependent Task Scheduling for Heterogeneous Computing

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Dependent task scheduling in heterogeneous system is a NP-complete problem. Due to the dependent constraints among tasks, chromosomes generated by random processes are possibly invalid. Extra computation must be paid for distinguishing, and then repairing or regenerating them. Thus the conventional algorithms are relatively slow for solving large instance problems. Many recent studies accelerate the solving process by reduced searching spaces or limited chromosome operations. However, the global optimal solution is possibly eliminated. In this paper, we have introduced a cell genetic algorithm. The population are represented by cells in grid. The reproduction are made by neighbor cells. A new mutation operation is presented, which is a key process for finding the global optimal solution. All processes, including reproduction, natural selection, crossover and mutation are designed in parallel and accelerated by GPU. The method is supposed to have excellent performance in solving large instance problems.

An Efficient Multi-Objective PSO Algorithm Assisted by Kriging Metamodel for Expensive Black-Box Problems

Haoxiang Jie[1], Yizhong Wu[1], Jianwan Ding[1], and Liping Chen[1]
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The huge computational overhead is the main challenge in the application of community based optimization methods, such as multi-objective Particle Swarm Optimization and multi-objective genetic algorithm, to deal with the multi-objective optimization involving costly simulations. And the metamodel technique can effectively approximate the expensive black-box analysis model to reduce the computational cost, which has been widely used into many engineering problems especially the single-objective optimizations. So this paper presents a so-called KMOPSO method, in which Kriging metamodel approximate technique is embedded within the crowding distance based Particle Swarm Optimization (MOPSO_CD) algorithm, to solve multi-objective optimization problems involving expensive black-box functions. In the searching process, the KMOPSO constructs Kriging metamodel for each expensive objective function adaptively, and then the non-dominated solutions of the metamodels are utilized to assist the update of particle population. To reduce the computational cost, the generalized expected improvements of each particle predicted by metamodels are presented to determine which particles need to perform actual function evaluations. The proposed method is tested on six benchmark functions and compared with the original crowding distance based multi-objective Particle Swarm Optimization algorithm. The tests results show that the application of Kriging metamodel improves the search ability and reduces the computational cost of conventional MOPSO_CD. Additionally, the KMOPSO method is applied to the optimal design of a cycloid gear pump and achieves desirable results.

A Kriging-based Constrained Global Optimization Algorithm for Expensive Black-box Functions with Infeasible Initial Points

Yaohui Li[1], Yizhong Wu[1], Jianjun Zhao[1], and Liping Chen[1]
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In many engineering optimization problems, the objective and constraint functions which come from computational and analytical models are often expensive and black-box. In this case, it necessary for optimization process to use sampling data to fit surrogate models so as to reduce the number of objective and constraint evaluations as soon as possible. In addition, it is sometimes difficult for the constrained optimization problem based on surrogate models to find a feasible point, which is the premise of further searching a global optimal feasible solution. For this purpose, a new Kriging-based Constrained Global Optimization (KCGO) algorithm is proposed. Unlike previous Kriging-based methods, this algorithm can dispose black-box constrained optimization problem even if initial sampling points are all infeasible. There are two pivotal phases in KCGO algorithm. Main task of the first phase is how to find a feasible point when there is no any feasible data in initial sample. The feasible point will be found by minimizing the sum of predicted constraint functions. It is noted that the phase will be ignored if there is one or several feasible points in initial sample. Aim of the second phase is how to obtain a better feasible point under the circumstances of fewer expensive function evaluations. Finishing this objective is not easy because it is difficult for researchers to find an appropriate ISC (infill sampling criterion) in order to efficiently balance the local and global search behavior. Therefore, a new ISC based on the predicted function value and standard deviation of Kriging is introduced in this paper to determine the next optimal sampling point. Finally, test results on several mathematical problems and three design problems illustrate feasibility, stability and effectiveness of the proposed method in optimization process.

Ant Colony Optimization Applied to the Problem of the Maximal Balanced Partitioning of Graphs with Supply and Demand

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In the recent years there has been a growing interest for the problem of the minimal partitioning of graphs with supply and demand, due to its close connection to electrical distribution systems, especially in the context of smartgrids. This classical graph problem has shown to be closely related to the optimization of self-adequacy of interconnected microgrids. It is defined for an undirected graph $G(V, E)$ with a set of vertices V and a set of edges E .V is split into two disjunct sets V_s and V_d. Each $u \in V_s$is called a supply vertex, and it has a corresponding positive integer value $sup(u)$. A vertex $v \in V_d$ is called a demand vertex and has a corresponding positive integer value $dem(v)$. The goal is to partition the graph into several connected subgraphs in a way that each of them has a single supply vertex and the total sum of demands in it, is less or equal to the available supply. Or in other words, each demand vertex can receive "power" from only one supply vertex through the edges of G.The goal is to maximize the fulfillment of demands, or more precisely to maximize the sum $\sum_{s\in\Pi}\sum_{v\in S} dem(v)$, where Π is the set of subgraphs which represents the partitioning. It has previously been shown that this problem is NP-Complete even in case of its restricted to a star shaped graph with a single supply node in the center. Although this graph problem is suitable for a rough representation of certain aspects of electrical systems, it has been adapted and extended for specific applications. Some important examples are the inclusion of a maximal capacity to edges of the graph, and making the supplies in the graph parameter dependent. The original problem and the mentioned extensions include the constraint of allowing only a single supply vertex in a subgraph, which significantly narrows the potential of application of this model. In this work we propose a new version of the problem in which instead of the uniqueness of the supply vertices, we include a maximal allowed total supply. The second constraint is a limit in the number of subgraphs in the partitioning. For the proposed problem we first develop a heuristic based greedy algorithm, which is an adaptation of the approach used on the original problem in article. With the goal of acquiring high quality solutions, an ant colony optimization (ACO) algorithm is developed as an extension of the previously developed greedy algorithm. The ACO algorithm is further improved using the previously developed pheromone correction procedure. To evaluate the proposed algorithm we have generated problem instances for general graphs and trees with a wide range of pairs (s, d), where s/d represents the number of supply/demand vertices. The optimal solution for each problem instance is known due to the method of generation. The generated benchmark data sets are made available online. Our computational experiments show that the proposed ACO algorithm produces partitionings having a small error when compared to the optimal solutions.

Grid-seed Strategy for Fuzzy Rules Optimization in an Application to Semi-Active Suspension Control System.

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This paper presents an optimization strategy based on the genetic algorithm and applied to optimization process of a fuzzy logic controller. This idea was undertaken by Park et al. In the strategy, not only member functions shapes, but also rules connecting these member functions are optimized. This solution was proposed by Foran as an optimization approach, which let transform linguistic dependencies to self-organizing rules. A mechanism applied to this problem solution is based on so called grid-seed strategy. It transforms appropriate genes to fuzzy linguistic rules, then fuzzy member functions are described by other genes, which together are connected in the single individual. Optimization process was conducted on the simple semi-active quarter car model, in which, the damping coefficient of sprung mass suspension is changeable. This kind of optimized controller solution was also verified on the semi-active quarter-car model, which was also taken into consideration by Ahmadian et al. It was compared to classic solution of sky-hook strategy implemented in fuzzy logic controller, described by Kanarachos et al. An aim function for the optimization process was the smallest momentary value of the sprung mass vertical acceleration. This aim function let improve the drive comfort and may be realized on semi-active suspension based on magneto-rheological fluid dampers described by Alexandridis et al. Tests were conducted for sinusoidal road excitation with frequencies from 1 to 10 Hz, as also for step excitation, which represents driving onto curb with high velocity. These frequencies were chosen, because the area of highest sensitivity of the human body to the effects of vibration is between 4 and 8 Hz, what was mentioned by Hrovat. The solution of semi-active suspension control system was also tested for driving safety improvement. As indicator of driving safety level, a contact force between road wheel and the road was used. Results were also compared with results of solution using the classic sky-hook strategy implemented in fuzzy logic controller. This model was verified also on multi-body model constructed in MSC.ADAMS program, which was put forward also by Kubela et al. During researches also others solution of control system for active and semi-active suspension was analyzed. These solutions were described in works of Rączka et al. and Sibielak et al.

On Linear Conic Relaxation of Discrete Quadratic Programming Problems

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A special RLT-based linear conic relaxation is proposed for discrete quadratic programming (DQP). We show that the proposed relaxation is tighter than the SDP relaxation. Moreover, when the proposed relaxation problem has an optimal solution with rank one or two, optimal solutions to the original DQP problem can be explicitly generated. This rank-two property is further extended to binary quadratic optimization problems and linearly constrained DQP problems. Numerical results indicate that the proposed relaxation is capable of providing high-quality and robust lower bounds for DQP.

Local Search Algorithm for Universal Facility Location Problem with Linear Penalties

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The universal facility location problem is a generalized formulation which contains several variants of facility location problems including uncapacitated facility location problem and ca- pacitated location problem (both hard capacities and soft ones) as its special cases. In the universal facility location problem, we are given a set of demand points and a set of facilities. We wish to assign the demands to facilities in such a way that the sum of service and facility costs is minimized. The service cost is proportional to the distance each unit of the demand has to travel to its assigned facility, whereas the facility cost of each facility i depends on the amount z of demand assigned to that facility and is given by a cost function fi(z). In this paper, we consider an indeed general case of universal facility location problem, universal facility location problem with linear penalties. In this problem, we can refuse to supply services to some demand points, but instead we should pay penalty costs which is a linear function with respect to the demands. We present a local search algorithm along with analysis for the approximation ratio on this problem.

Packing Ellipsoids into Volume-Minimizing Rectangular Boxes

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A set of ellipsoids, with given semi-axes, is to be packed into a rectangular box, while minimizing its volume. The box is subject to lower and upper bounds of its widths, lengths and height; the ellipsoids are free of any orientation restrictions. We present a closed mathematical programming formulations for this ellipsoid packing problem. The key ideas in the developed non-convex NLP model is to use a purely algebraic approach to represent rotated and shifted ellipsoids, to consider the elements of the rotation matrix as variables and to use separating planes to ensure the ellipsoids do not overlap with each other. For small number of ellipsoids we compute feasible points which are globally optimal subject to the finite arithmetic of the global solvers available in GAMS.

Integral Inequalities of Hermite-Hadamard Type for Functions whose Third Derivative Absolute Values are Preinvex

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In this paper, we establish some new integral inequalities of Hermite-Hadamard's type for functions whose third derivative absolute values are preinvex. Applications to some special means are also considered.

On the Convergence of the Proximal Point Algorithm for Convex Minimization

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In this talk, a proximal spliting method for treating points to be minimizer of the sum of a convex continuous Frechet differentiable function f and a convex function g is investigated. Weak and strong convergence theorems are established in the framework of Hilbert spaces. Moreover, we also used this method for proved weak and strong convergent theorems to find zero points of the sum of two monotone operators is investigated.

On General $p-$regularized Subproblems for $p > 2$

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The p-regularized subproblem (p-RS) is a regularization technique in computing a Newton-like step for unconstrained optimization. The idea is to globally minimizes a local quadratic approximation of the objective function while incorporating with a weighted regularization term $\frac{\sigma}{p}\|x\|^p$. The global solution of the p-regularized subproblem for $p = 3$, also known as the cubic regularization, has been characterized in literature. Now we resolve both the global and the local non-global minimizers of (p-RS) for $p > 2$ with necessary and sufficient optimality conditions. Moreover, we prove that the (p-RS) for $p > 2$ can have at most one local non-global minimizer, which generates a parallel result for the trust region subproblem due to Martínez. When (p-RS) with $p = 4$ is subject to additional linear inequality constraints, we show that the problem is in general NP-hard. However, if the number of linear constraints is fixed as a constant, it can be solved in polynomial time.

Information Workflow Optimization with Bandwidth Constraints

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Workflow management systems allow for visibility, control, and automation of some of the business processes. Recently, nonbusiness domains have taken an interest in the management of workflows. In this research we have developed a rigorous mathematical programming formulation of the information workflow optimization problem, incorporating bandwidth constraints. Multiple heuristics have been developed to solve this problem, and results will be presented.

Some Feasibility Sampling Procedures in Interval Methods for Constrained Global Optimization

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Four feasibility sampling procedures are developed as add-on acceleration strategies in interval methods for finding optimal solutions of global optimization problem over a bounded interval domain subject to one or two additional linear constraints. The main feature of all four procedures is their abilities to test any subdomain's feasibility and to actually locate a feasible point if the feasible set within the subdomain is nonempty. This add-on feature can significantly lower upper bounds of the best objective function value in any interval method and improve its convergence and effectiveness. The feasibility of our selected samples will be proved, and numerical results will be provided to demonstrate the effectiveness and difference of these four procedures.

Hölder Inequalities of Solution Maps of Parametric Ky Fan Inequalities in Metric Linear Spaces

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The famous Ky Fan inequality was published in 1972 (see Fan 1972), where the existence of a solution was proved for a class of bifunctions, which were later called Ky Fan functions in the literature. Then, the result was shown to be equivalent to fundamental theorems on fixed points and equilibrium points, like the theorems of Brouwer, Schauder, Kakutani and Theorem 3.2.1 on equilibrium points in Aubin and Frankowska (1990). In Blum and Oettli (1994), the authors called a Ky Fan inequality an equilibrium problem and considered it as a generalization of constrained minimization / optimization problems and variational inequalities. Many authors have studied this model of an equilibrium problem (i.e., the Ky Fan inequality), which was shown to encompass most of optimization-related problems such as complementarity problems, fixed-point and coincidence-point problems, Nash equilibria, traffic network equilibria, etc. However, this model is not consistent with equilibria in physics and engineering, though describes well equilibria in economics and related areas. In this talk, we would like to call this model a Ky Fan inequality to emphasize the original work of Ky Fan. In this talk, we study the parametric Ky Fan inequalities in metric linear spaces. We first give the concept of strongly quasiconvex maps. Next, new sufficient conditions for Hölder continuity of solution mas are established. Many examples are provided to illustrate the essentialness of the imposed assumptions and advantages of the results over existing ones.

IDF optimization algorithm based on globally optimized design structural matrix

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Single-level MDO algorithms like individual discipline feasible (IDF) prove to be efficient in solving medium size MDO problems with small percent of local design variables. With the number of coupling variables increasing, the resulting problem for IDF algorithm might be too complex to be solved efficiently, as additional design variables and compatibility consistent equality constraints must be added. The problem size could be reduced by selecting part of coupling variables as additional design variables. In terms of design structure matrix (DSM), feedback variables in the lower triangle are usually selected as additional design variables, and Genetic Algorithm is further introduced to reduce the feedback coupling loops. Traditional methods, which minimize the number of feedback coupling loops, rather than the number of feedback coupling variables, might not minimize the resulting problem size; and solving with Genetic Algorithm might be time-consuming, or might not search a global optimum. This paper proposes a sequencing approach of disciplines based on globally optimized DSM to select coupling variables for IDF. In the approach, each off-diagonal element of DSM is denoted with a coupling variable set indicating one discipline dependence on another, and an optimal sequence problem is formulated to minimize the number of feedback coupling variables in the lower triangle by reordering the sequence of diagonal elements. Based on Cantor Expansion the permutation of diagonal disciplines are mapped to an integer, and the optimal sequence problem is transformed into an unconstraint integer programming problem, which is solved through using improved DIRECT algorithm. As the maximum integer represented in a specified computer system is limited, a permutation with large number of elements can be mapped to an integer array. Details for mapping between permutation and an integer array and DIRECT algorithm implementation for integer programming are presented, and the effectiveness of the approach is validated with some optimized DSM test cases. A MDO problem with 20 disciplines is also implemented to demonstrate the performance of IDF based on optimized DSM. The optimization process, using IDF, IDF based on initial DSM and IDF based on optimized DSM, is respectively performed in MATLAB environment starting from multiple initial points. Analyses with eight different relaxation tolerances for compatibility consistent constraints are investigated, and total function evaluation counts and relative error of objective value are recorded. The comparative data indicate that optimization using IDF based on optimized DSM uses the fewest function evaluations, meanwhile the relative error of objective value remains at a low level.

A New Hybrid Solution Approach for a Special Case of VPR with Time Windows and Specific Requirements for Vehicles and Customers

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In this presentation, we describe a new hybrid solution approach for the capacitated Vehicle Routing Problem with Time Windows. This new approach is the combination of various mixed-integer linear problem approaches, modified and augmented in a way that will best satisfy the specific requirements of the problem. The case study under question contains a number of customers, scattered through the map, and each customer being subject to a pair of requirements. It also contains a fleet of vehicle with various characteristics that also are subject to a pair of requirements, similar to the ones of the customers. The pairs of requirements of each customer and vehicle are categorized as follows: "True/True", "True/False", "False/True" and "False/False" and the most fundamental constraint we come across is that not all vehicles can accommodate all customers. For example, a vehicle that has a pair of requirements as "True/False" can accommodate a "True/False" or a "False/False" customer, but it cannot accommodate a "True/True" customer. Furthermore, each vehicle is bound to a certain priority and another aspect of the algorithm is the immobilization of vehicles with the highest priority possible. The algorithm has three distinct levels, each one interconnected with the other. The first level of the algorithm calls for the capacitated clustering of the nodes representing the customers in order to obtain convex clusters, leading to a better geographical distribution of the customers. This will prohibit vehicles that accommodate customers in a certain cluster, to try to accommodate customers to another, thus reducing the computational size of the problem. The second level assigns as few vehicles as possible at each cluster in order to accommodate all customers in them, without violating the capacity constraints of each vehicle and the previously mentioned requirement constraint. The third and last level calls for the creation of the optimal paths for each vehicle through the customers that are assigned to it. For that purpose, the Environmental Travelling Salesman Problem is utilized, which defines the routes with the least fuel consumption possible. This approach solves the asymmetric non-Euclidean Traveling Salesman Problem by blending cutting planes and the 2-OPT algorithm, thus reducing the computational time in order to be solved.

Second Order Fractional Symmetric Duality in Variational Problems over Cone Constraints

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In the present paper, we introduce a pair of second order fractional symmetric variational programs over cone constraints and derive weak, strong and converse duality theorems under second order $\mathcal{F}$-convexity assumptions. To show the existence of introduced class of functions, we have constructed an example. Moreover, self duality theorem is also discussed. Our results extend some of the very recent results in literature.

Greenroute: A Web Based Platform which helps Individuals and Companies move Commodities with the most Environmental Friendly way

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The objective of the proposed research is to develop a Decision Support System (DSS) for a web based platform which will help individuals and companies move commodities in the most environmental friendly way, minimizing environmental externalities (e.g. CO2 emissions) and transportation costs. The developed platform which is the final outcome of an FP7 European research project, referred to as "GreenRoute" project. For the purpose of the green vehicle routing problem, a new modelling approach is presented. This modelling approach is based on the idea of the Environmental Externality Score concept referred to as EES. EES is a measure that calculates the percentage of increase or decrease of the underlying environmental externalities compared to the nominal conditions. Each arc of the given network that we apply the algorithm, would have an individual EES based on the arc's characteristics. By multiplying the EES with the values provided by any emission calculation model, we obtain the result into fuel consumption in liters per kilometer travelled. The instantaneous environmental externalities score function EES related to fuel consumption, is the ratio of instantaneous fuel consumption to fuel consumption at nominal conditions. The above is expressed through the following formula: $\frac{FC}{\overline{FC}}$ where FC stands for fuel consumption and $\overline{FC}$ for fuel consumption at nominal conditions. The web-platform is already running and can be found at www.greenyourroute.com.

On Constraint Aggregation and Value Functions for Two-Stage Stochastic Integer Programs

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We consider a class of two-stage stochastic integer programs and their equivalent reformulation that uses the integer programming value functions in both stages. One class of solution methods in the literature is based on the idea of pre-computing and storing exact value functions, and then exploiting this information within a global branch-and-bound framework. Such methods are known to be very sensitive to the magnitude of feasible right-hand side values. In this talk we discuss a simple constraint-aggregation based approach that potentially alleviates this limitation. This talk is based on a joint work with Andrew C. Trapp (Worcester Polytechnic Institute).

Two-Stage Stochastic Maximum Clique Problem and Extensions

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We consider the problem of determining the largest "robust" structure in a stochastic graph, where edges may randomly fail or "appear". The "robustness" of a complete subgraph is defined as its repairability after observable random changes to the graph's topology. A two-stage stochastic programming model is formulated, and a graph-based branch-and-bound algorithm is proposed. Numerical experiments illustrate computational effectiveness of the proposed method on the example of the two-stage stochastic maximum clique problem.

Hybrid Global Optimization Algorithm for Engineering Structures

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In this talk we discuss hybrid global optimization algorithm based on global Lipschitz optimization and convex programming for partial optimization problems. Several versions of Lipschitz optimization algorithms without the Lipschitz constant are proposed recently. Such algorithms are suited to black box optimization problems where analytical expression of the objective function is not known. Problems for engineering structures can be modeled by various optimization problems. Some such problems are convex but quite restricted, for example only suited for topology but not shape optimization at the same time. Therefore in this talk we discuss decomposition of the optimization problems in order part of the variables are involved in convex optimization problems while the other take part in the global black box optimization problem where the value of the objective function is found solving smaller convex optimization problems and therefore its explicit analytical expression is not known. Such a hybrid optimization requires that the formulations of partial problems were quickly solvable (it is necessary to solve a large number of such problems) but on the same time model the full problem good enough so that the global search was faster. We provide some results of experimental investigation of the hybrid algorithm comparing to global Lipschitz optimization and metaheuristic algorithms.

A Tree Neighborhood Topology Particle Swarm Optimization Algorithm for the Vehicle Routing Problem with Stochastic Travel and Service Times

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In recent years, a number of different Vehicle Routing Problems (VRP) with stochastic variables have been studied and an excessive number of results have been published. Typically, stochastic variables are associated with the customers or/and their demands, and/or time windows. In this talk, the stochasticity concerns the travel times between two customers and the service times needed upon arrival to the customer. This variant of the problem is inspired from real life circumstances, as in many cases the travel time between two customers can not be determined exactly due to fluctuations in the conditions of the traffic network. The problem is solved using a Tree Neighborhood Topology Particle Swarm Optimization (TNTPSO) algorithm. In this algorithm, a new neighborhood topology for the particles is used, where instead of a global topology, a local one is utilized based on a tree structure of the swarm. This structure provides a layered swarm where each member reacts only with its successors in the tree. The root at the top of the tree corresponds to the global best particle. Depending on the quality of the associated solutions, the particles move up or down in the tree. The particles on top levels of the tree have more influence on the swarm as they react with more particles from lower levels. We evaluate several different tree structures, and compare the best of them to previously published PSO implementations with global and local neighborhood topologies shown efficient for other types of VRP. The reported computational comparisons are performed on a number of benchmark instances.

Optimal Identification Procedures in Gaussian Graphical Models

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Gaussian graphical models attract an important attention last decades. The main object in these models is a graph that one can associate with dependence structure of vector of random variables. From the other hand, a Gaussian graphical model can be represented as a complex network generated by a random vector. Different structures (subgraphs) of this network were considered in applications, and in particular in market network analysis. In the paper [Tumminello et al. 2005], the authors consider minimum spanning tree and planar maximally filtered graph as a market network structures. This approach allows to detect some hierarchical structures connecting clusters of stocks. Different approach was taken by [Boginski et al.2005] where the market graph was introduced. Market graph is obtained from the complete weighted graph by deleting all edges with weight inferior to a given threshold. In the present paper we consider the problem of identification of network structure in Gaussian graphical models in the framework of the theory of multiple decision statistical procedures. This point of view is novel and seems to be promising in the analysis of Gaussian graphical models. First results in this direction were obtained by [Koldanov et al. 2013]. We give an appropriate definition of optimality and discuss some optimal multiple decision statistical procedures for identification of network structures.

Towards Roundoff-Error-Free (REF) Optimization: REF Cholesky and LU Factorizations

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LU and Cholesky factorizations play a central role in solving linear programs and several other classes of mathematical programs. In many documented cases, the roundoff errors accrued during the construction and implementation of these factorizations lead to the misclassification of feasible problems as infeasible and vice versa (Dhiflaoui et al. 2003). Hence, reducing these roundoff errors or eliminating them altogether is imperative to guarantee the correctness of the solutions provided by optimization solvers. In order to achieve this goal without having to utilize rational arithmetic, we introduce two roundoff-error-free factorizations that require storing the same number of elements and performing a similar number of operations as the traditional LU and Cholesky factorizations. Additionally, we present supplementary roundoff-error-free forward and backward substitution algorithms, thereby providing a complete tool set for solving systems of linear equations exactly and efficiently. An important property of the featured factorizations and substitution algorithms is that their individual coefficients' word-length - the number of digits required for expression - is bounded polynomially. Unlike the rational-arithmetic methods used in practice to solve linear systems exactly, however, the algorithms herein presented do not require gcd calculations to bound the word-length. We also derive various other related theoretical results.

An Approximation Algorithm for Squared Metric Facility Location Problems with Linear Penalties

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We consider the Squared Metric Facility Location Problem with Linear Penalties (SM- FLPLP), a new variant of Facility Location Problem, which combines the Squared Metric Facility Location Problem (SMFLP) and the Metric Facility Location Problem with Linear Penalties (MFLPLP). We applied the LP-rounding algorithm for the MFLPLP provided by Li et al. (2014) to the SMFLPLP, and proved that the approximation ratio is 2.04952, which is near to the lower bound 2.04011. Moreover, we show that the bi-factor approximation ratio curve of our algorithm is given by (γ_f, γ_c), where γ_f is the ratio for facility cost and γ_c is the ratio for connection and penalty cost; and hence, when the facility factor $\gamma_f > 2$, the curve is close to the lower bound $(\gamma_f, 1 + 8e^{-\gamma_f})$.

Global Parameter Selection of the Support Vector Machine Regression with MPCC

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Parameter selection remains the most critical issue for the effective use of a Support Vector Machine (SVM) model of classification or regression. The training-and-validation procedure is commonly used to select the best parameters among a pool of the finite candidates collected from the grid partitions of the parameter space without a guaranteed global optimality. A series of recent research proposed a bi-level mathematical program, formulating the parameter training in the lower level problem and the parameter validation in the upper level problem, to attain a global optimum certificate for the parameters. Consequently, the models of the SVM Regression are simultaneously obtained with a pair of the global optimal parameters in the continuous parameter space, without needing to select the parameters in a separate procedure. By equivalently reformulating the bi-level model into a mathematical program with complementarity constraints (MPCC), we are allowed to derive a Rectangle Search algorithm to attack this non-smooth and non-convex program. The solution produced by the Rectangle Search algorithm is proved mathematically optimum. Abundant numerical experiments and the comparisons with other algorithms are presented. Based on the size of training data points and the numbers of features, an input instance can be categorized into one of the four difficulty levels. Numerical evidences show that the convergent time of the instances within each level is proportional to the size of data. Then, we will compare the performance of the SVM Regression models using globally optimized solution against that using cross-validated local parameters on several different data sets.

Predicting Supply Disruptions

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Supply disruptions are events that affect a buyer's decision in their use of limited resources. The Pharmaceutical industry is an example of an industry with such buyers. These buyers replenish perishable, highly liquid products on a continual basis. If there is enough lead time and the confidence level of the prediction is satisfactory then funds can be reprioritized to accommodate this predicted behavior. An algorithm is presented that can be used by a wholesaler to predict dispersal disruptions from multiple distributors. A method to train and test of this algorithm are given. The multiple distributors are segmented based on the diversity of their inventory. A client use case is presented where it is seen that the algorithm is robust and it is seen that the algorithm's short term memory is about as effective as its longer term memory, though their conclusions may differ. A brief discussion follows that shows the success of this model. Comparison is made to a logistic regression model designed for the same use case and comparison is made to chance.

Thermal Performance Improvement of Underground Power Cables System using the Momentum-Type PSO Method

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Since underground power cables operate at the maximum possible conductor current, heat dissipation from the conductor to the surrounding soil plays a crucial role in evaluating the performance of buried cable systems. The current carrying capacity mostly depends on the conductor temperature. When it is too high, the cable can overheat. The paper presents the thermal performance optimization of underground power cables system. The analyzed system consists of three underground power cables situated in a flat formation (in-line) arrangement in a multilayered soil. To avoid the extensive mechanical loads, caused e.g. by vibrations when locating cables beneath the ground, the cables are situated in HDPE casing pipes, filled with the sand-bentonite mixture. The primary aim of completed simulation is to achieve the optimal temperature of the cable core, specified by the producer. Moreover, the cross-sectional area of thermal backfill layer, used to protect cables from overheating ought to be minimized due to the significant material costs. When compared to the mother ground, the Fluidized Thermal Backfill (FTB), used in this case, improves the heat dissipation process from cable to the external surrounding. The experimental tests were performed to determine the thermal conductivity of a mother ground and FTB backfill. Furthermore, the geological measurements were carried out to determine the porosity and humidity of soil layers. The presented computations are used to design an electricity transmission line in one of the 600MW polish power plants. The temperature distribution in soil, cable and FTB layer is determined using the Finite Element Method (FEM). The FEM code, developed in MATLAB is employed for this purpose. The two- dimensional heat conduction problem is solved for nodal temperatures. The computations consider the temperature dependent cable ampacity and thermal properties of ground and FTB backfill. Thus, the heat conduction problem can be regarded as non-linear. The momentum-type PSO optimization solver with dynamic penalty function was used to minimize the FTB backfill cross-sectional area while not exceeding the allowable temperature of cable operation. The computational results are compared with IEC standards for Poland. Different parameters of momentum-type PSO algorithm were studied (swarm size, values of β and α parameters). The performed optimization procedure allowed to obtain a converged solution after relatively small number of iterations.

Vulnerability Analysis of Multicommodity Network Flows and its Applications in Network Design

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In this paper, we will use vulnerability analysis for multi-commodity network flow. Based on this analysis, we present network design models for defensing the network with respect to uncertain component failures. Our numerical experiments are based on several power grids, water networks, railway networks, etc.

Calculating Nash Equilibria in n-person Games on Polyhedral Sets of Player Strategies in Large-Scale Economic Systems by Linear Programming Techniques

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Two n-person games ($n > 3$) on polyhedral sets of player strategies in which Nash equilibria determine optimal player strategies are considered. In the first game, a part of the equilibria vectors determine an optimal scale of using both renewable sources of energy and electricity storing systems in regional electrical grids with fossil-fuel, wind, and solar electricity generators, each competing for the grid customers in establishing direct long-term contracts for supplying them with electricity. In the second game, players compete in a marketplace of cargo transportation services by offering their prices for rendering the services. Transportation companies competing for cargoes to be moved either within a region or among several regions and offering their tariffs for moving these cargoes are the players, each playing against the "market demand" for moving the cargoes. Each competing transportation company has a limited capacity for moving cargoes of all particular types. These capacities can be described by a compatible system of linear constraints of a balance kind, and constraints of the same kind exist for the transportation tariffs. Particularly, each transportation company has its own estimate of the "desirable" tariffs for each type of the cargo for which a demand for moving this cargo exists in the marketplace. Linear constraints of the balance kind also describe the demand for moving all the types of cargo that are available in the marketplace, making the above game the one in which the sets of player strategies are polyhedra, and the payoff function of each player is a sum of a bilinear and a linear function of vector variables. Verifiable sufficient conditions for Nash equilibria in both games, which allow one to find these equilibria by solving a finite number of linear programming problems, are proposed, and the use of these conditions is illustrated by model examples.

A Vector Based Parallel Brand and Bound Algorithm

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Global optimization problems sometimes attain their extrema on infinite subsets of the search space, forcing mathematically rigorous programs to require large amounts of data to describe these sets. This makes these programs natural candidates for parallel computing. In this paper we give a brief overview of parallel computing methods, exploit their availability by constructing a fully distributed implementation of a mathematically rigorous vector parallel branch and bound algorithm using MATLAB's SPMD architecture and interval arithmetic, and compare its performance to a serial branch and bound algorithm.

From Locally Significant to Globally Relevant: a Paradigm Shift in the Analysis of Biological High Throughput Experiments

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The analysis of high throughput gene expression patients/controls experiments is based on the determination of differentially expressed genes, using standard statistical tests. Once a panel of genes is determined, it is used to detect biological enriched pathways, containing a statistically significant number of genes whose expression levels are altered between patients and controls. Usually the set of determined pathways contains elements that are clearly not related to the biological condition under study. This is due to the fact that the statistical significance is not connected with causality, and therefore the detected pathways are above a certain threshold only because they contain a sufficient number of altered genes. In this talk we provide examples of such situations, propose a novel methodology based on mathematical programming, and show the results of numerical experiments.

Global Optimization of Constrained Grey-Box Computational Problems

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Grey-box global optimization refers to problems for which derivatives of the objective function and/or constraints of the original model are not directly employed for obtaining the global optimum. In typical applications of grey-box optimization, derivative information is either: (1) available but deceptive; (2) prohibitively expensive; or (3) partially to completely unavailable. Optimization without derivatives has been characterized as one of the most "challenging and open problems in science and engineering, which has a vast number of potential practical applications" (Conn et al., 2009). For example, derivative-free methods enable the optimization of costly simulation models developed to represent industrial processes with a high level of detail, coupling multiple physical, chemical, and mechanical phenomena across different scales. In addition, the independency of grey-box methods from derivatives allows the optimization of problems with embedded numerical noise, discontinuities and multiple local optima (Conn et al., 2009; Forrester et al., 2008; Martelli and Amaldi, 2014). Constrained grey-box methods have a vast pool of application areas ranging from expensive finite-element or partial-differential equation systems and flowsheet optimization to mechanical engineering design, molecular design, material screening, geosciences, supply chain optimization and pharmaceutical product development, to name a few (Boukouvala et al., 2014). Despite the increasing interest in derivative-free optimization, there is scarcity of global optimization approaches for multidimensional general constrained grey-box problems. Specifically, existing theoretical and algorithmic developments in grey-box optimization employ local optimization concepts and are predominantly developed for box-constrained problems or constrained problems with explicitly known constraints (Rios and Sahinidis, 2013). In this work, the problem of constrained grey-box optimization is formulated as a compilation of deterministic global optimization sub-problems stemming from sampling selection, parameter estimation and global optimization of surrogate formulations. We present a novel AlgoRithm for Global Optimization of coNstrAined grey-box compUTational problems (ARGONAUT), which is developed to solve constrained grey-box optimization problems with a large number of input variables and constraints. The algorithm can address box constraints, known inequality and equality constraints, and unknown inequality and equality constraints. The objective function of the grey-box problem, as well as the set of unknown constraints are approximated by surrogate functions. The algorithm involves variable selection techniques, which aim to exploit the sparsity of the model with regards to the objective function and the set of unknown constraints. Subsequently, surrogate function selection for the objective and each of the unknown constraints is performed using parameter estimation and validation con-

cepts, which are formulated as non-linear optimization problems solved to global optimality using deterministic global optimization solver ANTIGONE (Misener and Floudas, 2014). ARGONAUT also includes a rigorous formulation for the selection of samples used for parameter estimation, using a Mixed Integer Linear formulation developed to select an optimal subset of samples based on both their input space locations as well as their objective and constraint function values (Li and Floudas, 2014). The proposed algorithm is an iterative framework, which identifies new sampling locations during each iteration based on the global optimization of the grey-box formulation which is comprised of all of the known constraints and surrogate approximations of the unknown objective and constraints. Finally, a domain refinement procedure is embedded within ARGONAUT, which allows for the enhanced exploration of promising subspaces of the input domain. The capacity of ARGONAUT is shown through a large set of problems from known standard libraries for constrained global optimization. The performance of ARGONAUT is also compared with commercially available derivative-free optimization software.

Relaxations for Convex Nonlinear Generalized Disjunctive Programs and their Application to Nonconvex Optimization

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This talk deals with the theory of reformulations and numerical solution of generalized disjunctive programming (GDP) problems, which are expressed in terms of Boolean and continuous variables, and involve algebraic constraints, disjunctions and propositional logic statements. We describe a hierarchy of relaxations to generate alternative MINLP formulations for convex nonlinear GDP problems. Next, we consider the solution of nonconvex GDPs that involve bilinear, concave and linear fractional terms. To solve these problems with a spatial branch and bound method, convex GDP relaxations are obtained by using suitable convex under- and over-estimating functions that are tightened through the hierarchy of relaxations for convex GDP problems. We report computational results.

Recent Advances in the BARON Project

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Since the early 1990s, the BARON project has entailed the development of global optimization algorithms, range reduction techniques, and novel lower bounding methodologies. This talk presents recent advances in the BARON project that address (a) problems with integer variables and (b) infeasible formulations. New methodological developments to handle problems with integer variables include automatic constraint classification, preprocessing, probing, active constraint management, branching, cutting planes, and a portfolio of relaxations that involves dynamic selection of linear, integer and nonlinear relaxations in different parts of the search tree. For infeasible nonlinear or mixed-integer nonlinear programs, we propose the combination of constraint programming with constraint filtering techniques to rapidly determine sets of infeasible constraints that cannot be reduced. Extensive computational results are presented on a variety of test problems, including problems submitted to BARON over the NEOS server in 2012 and 2013.

Parallelization studies for mp-MIQP algorithms

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In recent years, multiparametric programming has become a widespread tool in applications such as model-predictive control, (Bemporad et al., 2002; Pistikopoulos, 2007; Faísca et al., 2008) scheduling (Li et al., 2007; Wittmann and Pistikopoulos, 2013; Kopanos and Pistikopoulos, 2014; Diangelakis et al., 2014) and bilevel programming (Faísca et al., 2007; Domínguez and Pistikopoulos, 2009). However, one of the main drawbacks of multiparametric programming is its potentially high offline computational burden. As a result, in the case of multiparametric mixed-integer quadratic programming (mp-MIQP) only small sized problems can be solved in reasonable time. In this work, we present a general approach towards the parallelization of algorithms for the solution of general mp-MIQP problems. First, the structural similarities among different mp-MIQP algorithms (Dua et al., 2002; Borrelli et al., 2003; Oberdieck et al,, 2014; Axehill et al., 2014; Oberdieck and Pistikopoulos, 2014) are described, featuring an initialization step as well as an iterative procedure comprised of an integer handling, a mp-QP solution and a comparison procedure step. At each iterative procedure, these steps are applied to a list of independent subproblems. Thus, a domain decomposition parallelization strategy is applied, where this list of subproblems is distributed evenly onto different machines and solved in parallel. In the particular case of decomposition-type (Dua et al., 2002; Oberdieck and Pistikopoulos, 2014) and branch-and bound (Oberdieck et al., 2014; Axehill et al., 2014; Oberdieck and Pistikopoulos, 2014) type algorithms, new subproblems might be generated based on the solution of the subproblems, thereby allowing for parallelization options. As this involves trade-offs among the parallelization overhead, the tightness of the upper bound and the workload distribution, the number of iterations performed on a machine is considered as a tuning parameter. Several computational results are presented, illustrating the different features and trade-offs.

Mathematical Modeling of the Stock Exchange Behavior with Respect to Individual Traders

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We proposed an approach to developing software for quantitatively analyzing the behavior of a stock exchange with respect to three groups of individual traders-ordinary traders, followers, and "black swan seekers". A trader is considered ordinary if she can predict the direction of every move of securities price. A trader is considered a follower if she can recognize a leader (a successful trader) or several leaders to follow their moves with a one-day lag. Finally, a trader is considered a "black swan seeker" if she can recognize the approaching of a financial crisis or any rare event capable of causing a crash in the stock exchange but predict ordinary event with lower probability. We formulate problems of forming an optimal portfolio of the securities aiming to achieve each particular goal of a trader from each group as stochastic programming problem. A part of the data for calculating parameters in these problems is assigned exogenously, whereas the rest of the data is calculated by means of the above-mentioned software with the use of the publicly available statistics on the stock exchange operations. The software is designed for the purpose of forming and testing hypotheses on regularities describing the behavior of traders from the three groups and that of the stock exchange and for analyzing results of solving stochastic programming problems by means of standard software packages. The software structure, along with results of the experiments run for the three types of individual traders based upon the data on the dynamics of various securities in 2001-2010, is presented. Model results of using the software for the above three groups of individual traders are reported to help understand the difference between the behavior of a stock exchange with respect to individual traders.

A Bisection Algorithm for Least Squares Piecewise Monotonic Data Approximation

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Piecewise monotonic approximation makes the least sum of squares change to n, say, noisy measurements of a univariate function so that the first divided differences of the smoothed data have at most $k-1$ sign changes, where k is a prescribed positive integer. The smoothed data form a n-vector with k monotonic sections in its components, increasing and decreasing, but the turning points are unknowns of the optimization calculation. A fast algorithm is developed that allows $log_2 n$ levels of bisection of the data to obtain a turning point, a process that is repeated $k-1$ time to derive an optimal fit with $k-1$ turning points. A global minimum is found in $O(n^2 + knlog_2 n)$ computer operations, which is extremely little work compared with the $O(n^k)$ number of local minima of this combinatorial optimization problem. The numerical results suggest that the method can be used when n is very large, because the techniques that achieve the mentioned complexity in theory, do provide much shorter computation times in practice. The method may have many applications. For example, it is highly suitable in estimating turning points (peaks) of a function from some measurements of its values which are distorted by random errors. Peak finding is a subject of continuous interest in spectroscopy, chromatography and signal processing, for instance. Further, this method can be used in medical applications in order to reduce the noise in magnetic resonance imaging and computed tomography as well as to achieve shorter processing times, when the treatment of malignant tumors by radiation may require multiple serial examinations for the same patient.

An Efficient Approach to the Protein Structure Alignment Problem

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The Protein Structure Alignment Problem (PSAP) consists in finding the best alignment of two proteins defined by their primary structures. It finds the most similar substructure of two proteins. This problem is polynomially reducible to the Maximum Clique Problem (MCP) for the protein alignment graph. In this paper we present an efficient algorithm for the PSAP based on our recent ILS & MCS algorithm (Batsyn et al., 2014) for the MCP. To reduce the alignment problem to the MCP we follow the DAST method in- troduced by Malod-Dognin et al. (2010). Our main contributions include: applying the ILS heuristic to obtain a lower bound and make preprocessing of an alignment graph to reduce its size; efficient implementation of the algorithm for large but sparse alignment graphs including memory preallocation and bit representation of adjacency matrix. The computational results are provided for the popular Skolnick test set of 40 proteins and show that the suggested algorithm is more efficient than one of the fastest PSAP solvers-the ACF algorithm by Malod-Dognin et al. (2010).

Discrete Bi-level Facility Models with Competing Customers

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The research work dealing with the bi-level formulation of location problems is limited only to the competition among the locators, that is it is supposed that either both the locator and the allocator are the same or the customer (i.e., the user as a whole) knows the optimality criterion of the locator and agrees passively with it. Customers preferences as well as externalities (such as road congestion, facility congestion, emissions etc) caused by the location decisions are either ignored or controlled by incorporating constraints in order to ensure the achievement of a predetermined target. However, this approach treats customers as irresolute beings. Thus, if, for example, the customers travel to the facilities to obtain the offered service, then there is no compulsion or intensive for them to attend the designated facility. This means that, once the facilities are open, what the locator wishes the customers to do may not coincide with their own wish and behavior. We suppose that the customers are involved in a Nash game in order to ensure what they conceive as the best level of services for themselves. In order to take into consideration the effects of such competition in the facilities location decisions we propose a bi-level programming approach to the problem.

Maximization of AUC and Buffered AUC in Classification

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This paper proposes an alternative to the Area Under the Receiver Operating Characteristic Curve (AUC) performance metric called Buffered AUC (bAUC). We show that bAUC is an intuitive counterpart to AUC. In addition, we show that bAUC is much easier to handle in optimization frameworks than AUC, specifically reducing to convex and linear programming. We use these friendly optimization properties to introduce the bAUC Efficiency Frontier, a concept that serves to partially resolve the "incoherency" that arises when misclassification costs need be considered. We conclude that bAUC avoids many of the numerically troublesome issues encountered by AUC and integrates much more smoothly into the general framework of model selection and evaluation.

Methods for Solving Non-Convex MIQPs

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We develop a method for solving non-convex MIQPs whose Hessians have a specific structure. The method developed involves preprocessing. Specifically we consider the case where the principal leading submatrix corresponding to the continuous variables is singular. The method is based on a linear transformation. The problem is solved using a Branch and Bound algorithm. The linear is chosen in such a way that more efficient lower bounding problems can be obtained at the nodes of the Branch and Bound tree. Results are presented showing the effectiveness of the method.

Two-stage Optimization Approach for a Location-allocation Problem

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A two-stage optimization model is studied to find the optimal location of new facilities and the optimal partition of the consumers (location-allocation problem). The social planner minimizes the social costs, i.e. the fixed costs plus the waiting time costs, taking into account that the citizens are partitioned in the region according to minimizing the capacity costs plus the distribution costs in the service regions. By using optimal transport tools we present existence results of solutions to the location-allocation problem, together with a genetic algorithm procedure to solve the problem numerically.

Pareto Optimal Set Identification for Costly Black-box Problems

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Multi-objective optimization problems in real-world usually involve costly black-box functions where analytical expression is unavailable. Such problems as a rule require either an underlying numerical model or expensive experiments to be conducted. Usually, the number of function evaluations is limited by available resources. Therefore, the small number of function evaluations yielding a good approximation of the Pareto optimal set has been a crucial issue. To this aim, EPIC method combined with a local search is proposed to get a balance between the exploration and exploitation. It is compared with state-of the-art methods on a set of benchmark problems used in the multiobjective optimization literature.

Interactive Model-based Search in Real Time

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We revisit the interactive model-based approach to global optimization proposed in Wang and Garcia (2014). In that design, multiple threads implementing in parallel a model-based search method interact through a simple acceptance-rejection rule preventing duplication of search efforts. Assuming that at each iteration each thread successfully identifies a locally optimal solution, it was shown that that the rate of convergence increases exponentially in the number of threads. In practice, however, the computational time required to identify a locally optimal solution varies greatly. Hence, when the acceptance-rejection rule is implemented, any given thread may fail to identify a locally optimal solution. In this paper we consider a real-time implementation of the interactive model-based approach. The acceptance-rejection rule is modified to account for the possibility that several threads failing to identify a locally optimal solution. The modified rule alternates between enforcing diverse search (to prevent duplication) and reallocation of computational effort (to speed up the identification of local optima). As in Wang and Garcia (2013), we are able to show that the rate of convergence increases in the number of threads. We report the results from extensive numerical experiments which are consistent with the theoretical analysis of performance.

Convex Optimization Formulations for Buffered Probability of Exceedance Minimization

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Paper considers a new probabilistic characteristic called Buffered Probability of Exceedance (bPOE). This characteristic is an extension of so-called Buffered Probability of Failure. We provide efficient calculation formulas for bPOE. Also, we prove that bPOE is a quasi-convex function of random variable w.r.t. the regular addition operation and a concave function w.r.t. the mixture operation; it is a monotonic function of random variable. bPOE is a strictly decreasing function of the parameter on the interval between the mathematical expectation and the essential supremum. Multiplicative inverse of the bPOE is a convex function of parameter, and a piecewise-linear function in the case of discretely distributed random variable. Minimization of the bPOE is reduced to a convex program for a convex feasible region and to LP for a polyhedral feasible region. A family of bPOE minimization problems and family of the corresponding CVaR minimization problems share the same frontier of optimal solutions and optimal values.

The Max-Cut Problem In Co-bipartite Chain Graphs

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A graph is co-bipartite chain graph if and only if it is co-bipartite and for each clique the neighborhoods of the vertices in that clique can be ordered linearly with respect to inclusion. Motivated by one of our recent studies, we consider Max-Cut Problem in co-bipartite chain graphs. The Max-Cut Problem is NP-hard even in co-bipartite graphs. However we present a polynomial-time dynamic programming algorithm to solve Max-Cut in this special graph class. We also show that there is an explicit formula to solve the problem if we further assume that the graph is twin-free.

Global Optimal Solutions and the Origin of Multicellularity: Differentiation of Types, Energy Constraints, Curvatures of Trade-Off Functions.

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A fundamental issue discussed in evolutionary biology is the transition from unicellular to multicellular organisms. Developing non-robust models provided in [Michod, R.E. et al. 2006] and models from [Aleskerov F.T. et al. 2014] we attempt to get robust models investigated how differentiation of types and energy constraints influence on the optimal behavior of colonies with different size (so, different initial costs of reproduction). Constructed models show that each large - sized colony with high initial costs of reproduction tends to full specialization, no matter are all cells in this colony identical or are there cells with different types in this colony. Moreover, in this model (as distinct from [Michod, R.E. et al. 2006]) not exactly the half of cells from the colony should specialize in, for example, soma. The level of type's diversity determines the number of cells specialized in soma. In small - sized colonies with low initial costs of reproduction, when type's diversity is week, an unspecialized state may bring colony some benefits. However, these benefits may be only local and in optimum in the colony some cells would be specialized, others - unspecialized. The amount of specialized cells in small - sized colony depends on the level of type's diversity in this colony. Adding energy constraint, we may receive robust models even in convex case. In optimum, the colony with different types of cells and energy restriction may be indifferent between some optimal patterns of states. Arbitrary chosen cell may be soma or germ in some states or may be unspecialized in other. Moreover, in each optimal state levels of fecundity and viability of each cell lie in limited ranges. This result reflects the fact that some cell in the colony may lose the potential ability to achieve, for example, high level of fecundity, but does not lose the possibility to perform a reproductive function at all. It means that provided model can describe organisms, which represents the intermediate between unspecialized colonies and full-specialized multicellular organisms. Also, constructed full optimization model with different type of cells and energy restrictions reveals an important property: a colony of cells in some cases may reallocate (without any loses in fitness of the colony) fecundity and viability between cells in response to corresponding displacement of different external irritants. Extended version of this work you can find in [Tverskoy D.N., 2014].

Application of an Effective Modified Gravitational Search Algorithm for the Coordinated Scheduling Problem in a Two-Stage Supply Chain

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The emerging technology of Internet of Things (IoT) has caught much attention of both theoretical research and production application in product lifecycle management (PLM). The introduction of IoT can dramatically improve business process efficiency and promote organizational performance according to related studies. Contradicting with these advantages, nevertheless, firms tend to hesitate in IoT investment decisions and thus post great challenges for IoT application progress. Among the reasons, investment nature of long cycle, high cost and great risk is critically important. Besides, "organizational factors" are also non-ignorable: successful applications of new information technology are frequently accompanied by change in organizational structure, adjustment in organizational function and development in organizational culture. Based on a binomial framework and the risk-free arbitrage principle, we proposed a two-stage real options model referring to optimal IoT investment decisions from internal pilot program to PLM application. Both uncertainties of future returns and changes in program value are considered in our stochastic model. Coordinating and promoting role of organizational factors in project implementation is also investigated. This paper demonstrates the internal causes and significances of organizational change for IoT development program, which is theoretically meaningful for explanation of real options approach in organizational area.

A Diverse Human Learning Optimization Algorithm

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A large number of meta-heuristics inspired by biological systems, such as Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), the Artificial Bee Colony Algorithm (ABCA), and the Artificial Fish Swarm Algorithm (AFSA), have been proposed and successfully applied to solve various complicated problems. These algorithms have received increasing attention for their easy implementation and excellent performance, and researches have been presenting new algorithms to solve problems more efficiently and effectively. Previous works have demonstrated that the well-known No Free Lunch theorem is invalid on some problems, which means that some algorithms can be better than others on these problems. Considering that human being is the smartest creature in the earth, it is reasonable to presume that the meta-heuristic inspired by human learning mechanisms may have better performance on the problems in our daily life than PSO, ACO and other meta-heuristics which are inspired by other creatures. Motived by this idea, recently we presented a simple human learning optimization (HLO) algorithm which is developed based on a simplified human learning model and the experimental results demonstrated that HLO is better than PSO, Harmony Search, Fruit Fly Optimization Algorithm and Differential Evolution. However, all individuals are assumed to have the same cognitive and learning ability in the standard HLO which is not true as individual differences are almost everywhere due to the influence of the gene, environment and many other factors. Actually, in real life many human characteristics are distributed as the Gaussian curves. For example, Richard J. Herrnstein presented in his famous book "The bell curve" that IQ scores follows Gaussian distribution, and James R. Flynn pointed out that with the development of society and technology, cognitive and learning competence of human beings had developed and IQ test scores had significantly increased and would continue to rise. Inspired by this fact, this paper proposed a novel Diverse Human Learning Optimization (DHLO) algorithm in which the control parameter of the algorithm is Gaussian-distributed and dynamic adjusted. On the one hand, as is known to all, meta-heuristics including HLO are sensitive to the parameters while it is very challenging to set the optimal parameters for meta-heuristics because it is problem-dependent. Thus, the introduction of the Gaussian distribution and dynamic adjusting in DHLO can cover the range of optimal values of parameters and gradually converge to the best value, which enhances the robustness and search ability of the algorithm. On the other hand, the Gaussian distribution of the parameters causes the individual difference which helps DHLO keep the diversity of the population and avoid the premature. And thus, the performance of DHLO is significantly improved.

Gradient Calculations for the Buffered Probability of Exceedance

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By definition, buffered probability of exceedance (bPOE) is an inverse function of Conditional Value-at-Risk (CVaR). Since bPOE bounds the Probability of Exceedance (POE) from above, it can be used in optimization problems as a surrogate for POE. This paper suggests new gradient formulas for bPOE under various assumptions, for both continuous and discrete random values.

The Optimization of Hydrogen Production from Microalgae

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Microalgae derived hydrogen has been considered one possible environmentally correct alternative to supply a so called hydrogen economy. However, H2 production has been demonstrated only at the laboratory scale, and the yield of H2 from any of the tested processes is still low for commercial application. Therefore, the optimization of design and operating parameters for maximum H2 production is a possible direction to address the issue of increasing biohydrogen production rate. For that, in this work, a general transient mathematical model for managing microalgae derived hydrogen production, with temperature dependence of the cultivation medium is developed. The model allows for the determination of the resulting mass fractions distribution. A Michaelis-Menten type expression is proposed for modeling the rate of hydrogen production with dependence on genetic modification of the microalgae species. Strategies including increasing the number of gene copies, increase or decrease gene expression (up- or down-regulation) are proposed by cloning the DNA of interest in vectors which are meant to be inserted in microalgae, followed by selection of transformants through selective media. As a result, a mathematical correlation, with dependence on the process variables, is proposed to calculate the resulting effect on H2 production rate after genetically modifying the microalgae species. The so called indirect biophotolysis (periodic cycle with aerobic-microalgae biomass production and anaerobic-H2 production stages) process was used. Therefore, a singular opportunity was identified to optimize the aerobic to anaerobic stages time ratio of the cycle for maximum H2 production, i.e., the process rhythm, which happens to be a recurrent phenomenon in the evolution of different living systems. The potential for an optimum process rhythm is identified through the process asymptotic behavior and scale analysis. A system thermodynamic optimization is then conducted through the model equations to find more accurately the optimal system operating rhythm for maximum hydrogen production, and how wild and genetically modified species compare to each other.

Profit based Effectiveness of Global Optimization Stopping Criteria

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Stopping criteria for global optimization algorithms are generally based on convergence to global optimum. However, when we have an expensive or time consuming objective function, the cost of the optimization (including the cost of delays in time to market) reduces the profit from improvements in the objective function, and it may not be profitable to proceed till convergence. This led us to devise a worth-based stopping criteria that justify continuing with the optimization only if the next cycle is likely to yield a minimum specified improvement that is larger than the cost of the optimization. We propose to measure the effectiveness of these stopping criteria and other stopping criteria based on the ratio of net profit from the executed cycles to the maximum achievable net profit. Net profit refers to the difference between the improvement achieved in each cycle and the cost of investment of resources to carry out the objective function evaluation for that cycle. The stopping criteria will be tested on several benchmark global optimization problems. It is possible to calculate the ideal case maximum net profit for the analytic test problems we use in this work by running the optimization algorithm long enough and checking the maximum net profit possible. We will also compare the terminating cycle indicated by the worth-based stopping criteria to the ideal stopping cycle predicted by maximum net profit achieved. It will reveal whether we lose performance mostly because we stop too soon or because we stop too late. The net profit based stopping effectiveness indicators are presented for worth-based stopping criterion for surrogate (or metamodel) based optimization algorithms, which are a popular choice for dealing with expensive objective functions. In this work we will use two variants of the surrogate-based Efficient Global Optimization (EGO) algorithm: (i) using expected improvement (EGO-EI), (ii) using probability of improvement with adaptive target setting (EGO-AT).

Production Planning with Price-Dependent Supply Capacity

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We consider a producer who procures an input component for production by offering a price to suppliers. The available supply quantity for the production input depends on the price the producer offers, and this supply level constrains production output. The producer seeks a time-phased production and supply-pricing plan that minimizes the cost incurred while meeting a set of demands over a finite horizon consisting of a discrete number of time periods. We consider several variants within this problem class, including cases in which the producer incurs fixed costs for production and/or procurement. We model the problem as a finite-horizon, discrete-time production and component-supply-pricing planning problem with non-stationary costs, demands, and component supply levels. This leads to a class of two-level lot-sizing problems with objective functions that are neither concave nor convex. Although the most general version of the problem is NP-Hard, we provide polynomial-time algorithms for practical special cases.

General Nonlinear Iterative Variation Method for Problems with Inequalities, Discontinuities and Singularities

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This work presents a variation method that uses iteration to improve the accuracy of Lagrange multipliers λ and hence the accuracy of the solution. It can cope with Lagrangians involving arbitrary high powers. Numerical means are used to evaluate integrals and to solve equations. This allows any variational inequality constraint to be converted into an equality constraint, using the integral of the absolute value of the function involved. The method may be used for Lagrangians with any powers, negative and fractional, since they can be approximated by quasi-linearization using 3rd and higher powers to achieve required accuracy. This should be of interest to fractional calculus or variations, since it was recently shown that fractional derivatives with $0 < \alpha < 1$ can be converted into an expression involving fractional powers α of the integration variable. The method is demonstrated by finding the spherical spinning top of given mass, given height and convex profile, with the minimum moment of inertia. This involves 4th power of the radius $r(z)$ and the inequality constraint that $r(z)$ must be convex, which results in a singularity at zero.

Enhanced Differential Evolution with Tabu list (EDET) for Permutation-Based Combinatorial Optimization Problems

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In this paper, a new differential evolution termed Enhanced Differential Evolution with Tabu list (EDET) is proposed. EDET is an improved version of the Enhanced Differential Evolution (EDE) algorithm developed specifically for solving permutation-based combinatorial optimization problems. The improvement was achieved by incorporating a tabu list to enhance the quality of solutions and ensure faster convergence. EDE has been successfully used to solve different class of permutation-based combinatorial optimization problems. Numerical experiments were carried out to compare the performances of EDET and EDE on benchmark problems selected from QAP library, TSPLIB, and OR-library. The results obtained shows that EDET performed better than EDE.