Book of Abstracts

(Ouro Preto, 2-4 October 2017)

Contents

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Andréa Cynthia Santos. A Variable Neighborhood Search for solving a distribution problem in post-disaster relief

Several problems in the response phase of major disasters rely on optimization models for strategical, tactical and operational decisions. Some emerging ones cover network accessibility, work-troops scheduling, facility location, covering and distribution. This study is dedicated to post-disaster operations for distribution of supplies from big hubs to depots close to the population, in order to anticipate the so-call last mile distribution. The problem focused here was modeled in a collaborative project with partners of the international Charter Space and Major Disaster. It corresponds to a Vehicle Routing Problem (VRP) with additional constraints. Heuristics, a local search and a Variable Neighbourhood Search (VNS) have been developed. The VNS is able to solve large scale graphs with thousands of vertices and edges. Computational experiments were performed using realistic instances from past earthquakes and theoretical instances from the literature. For the former, the algorithm is scalable and efficient, proving some insights for the decision-making process. For the latter, results indicate the method is competitive with the best known algorithms from the literature, obtaining better results for some instances.

Leandro Mundim and Thiago Queiroz. Using a variable neighborhood search for solving a bi-objective identical parallel machine scheduling problem

We develop a variable neighborhood search heuristic and a mixed integer programming model for the identical parallel machine scheduling problem with sequence dependent setup time. For this problem, we consider minimizing two objectives, which are the makespan and the flow time. The heuristic proposed has a constructive procedure to build initial solutions, five neighborhood structures, and a local search based on the variable neighborhood descent. Computational experiments indicate that the heuristic is very fast and can return better solutions than the model since it found 90% of the best solutions. It also outperformed all solutions computed with the longest processing time and shortest processing time rules, both commonly adopted for scheduling problems.

Lucas Esperancini Moreira E Moreira and Franklina Maria Bragion Toledo. Vehicle Routing Problem with Boarder Costs

Courier companies in Brazil may need to attend clients in different states throughout the country. One complicating factor is related to tax audits. Such audits occur every time a vehicle crosses a border between two states since it has to stop to be checked. The total route time of the vehicles inspected during their trips is increased. In this study, a fixed increasing time was considered every time a vehicle crossed borders. We proposed an Iterated Local Search method and a simple Variable Neighbourhood Search method. In the ILS, we used the very common 2-opt neighbourhood and a deterministic perturbation while, in the VNS, we used only two neighbourhoods: 2-opt and 1-0 exchange. For both methods, the initial solution was obtained using the Clarke and Wright algorithm. We adapted the distances of the vehicle routing problem instances proposed in the literature, which ranged from 100 to 1000 customers, to evaluate our methods. Tests were divided into phases. In the first, we solved instances without additional costs, i.e., as a classic CVRP. In the second, we analysed instances with fixed increasing times to cross borders. The VNS method outperformed the ILS in both phases in average 0.6% and 1,1%, respectively.

Rodolfo Pereira Araujo, Eyder Rios, Igor Machado Coelho, Leandro A. J. Marzulo and Maria Clicia Castro. A novel List-Constrained Randomized VND approach in GPU for the Traveling Thief Problem

The Traveling Thief Problem (TTP) is a multi-component combinatorial optimiza-tion problem that combines two well-known problems in the literature: the TravelingSalesman Problem (TSP) and the Knapsack Problem (KP). This paper proposes anovel list-constrained local search process inspired in Variable Neighborhood Descent (VND) for multiple neighborhood structures, combined with a metaheuristicGreedy Randomized Adaptive Search Procedure (GRASP). The local search imple-mentation was made in a Graphics Processing Unit (GPU) architecture in order toexplore the massive number of computing cores to simultaneously explore neighborsolutions, while the GRASP was implemented exploring the natural parallelism ofa multi-core CPU. The computational results were compared to state-of-the-art re-sults in literature and indicate promising

research directions for the design of novelsearch algorithms in high performance architectures

Iago A. Carvalho, Thiago Noronha, Christophe Duhamel and Luiz Vieira. A MILP-based VND for the min-max regret Shortest Path Tree Problem with interval costs

The min-max regret Shortest Path Tree problem (RSPT) is a NP-Hard Robust Optimization counterpart of the Shortest Path Tree problem, where arcs costs are modeled as intervals of possible values. This problem arises from the uncertainty in link quality the routing protocols for IPv6 Low Wireless Personal Area Networks have to handle. In this paper, we propose a Variable Neighborhood Descent (VND) heuristic based on a Mixed Integer Linear Programming formulation. An exact algorithm based on the same formulation is used to assess the quality of this heuristic. Computational experiments show that VND has an average optimality gap of 0.91%, being smaller that with the best heuristic in literature for RSPT.

Micheli Knechtel, Philippe Michelon, Serigne Gueye and Luis Satoru. VNS Multi-start Approach for Generic Generalized Block-modeling

Block-modeling is framework to describe a social network as a small structure. We propose here a VNS Multi-start metaheuristic for tackling the Generic Generalized Block-modeling. The Generic Generalized Blockmodeling is the first and most complete model approach: it allows to analyze networks without any a priory knowledge about them. The other models require to know the size of the partition (i.e. the number of sub-sets that the partition will contain) and a pre-definition of the ideal models.

Pablo Luiz Araujo Munhoz, Pedro Henrique Gonzalez, Uéverton Dos Santos Souza, Luis Satoru Ochi, Philippe Michelon and Lúcia Maria De A Drummond. General Variable Neighborhood Search for the Data Mule Scheduling Problem

A usual way to collect data in a Wireless Sensor Network (WSN) is by the support of a special agent, called data mule, that moves among sensor nodes and performs all communication between them. This article dealt with the Data Mule Scheduling Problem

(DMSP), where in addition to the data mule routing, it is necessary to plan the speed that this data mule will use and also to schedule the attendance of the sensors in this route. Mixed integer linear programming and heuristics based on the GRASP and GVNS metaheuristics were proposed. Besides that, a set of instances were generated in order to evaluate and validate the methods.

Jean Torres, Emerson Silva and Edna Hoshino. Heuristic Approaches to the Distinguishing Substring Selection Problem

The Distinguishing Substring Selection Problem aims to find a target string close to all strings in a given set of good strings and far enough of strings in another set of bad strings. This problem has applications in bioinformatic and it is related to the closest substring problem and others selection string problems. In this work we investigate two heuristics for the problem based on rounding procedures and variable neighborhood search approaches. Both heuristics consider the solution of the linear relaxation of an integer programming formulation for the problem as an initial solution. We conducted computational experiments in three groups of instances. The rounding procedure provides good solutions and the VNS improves these results using different rounding procedures as neighborhood structures. To the best of our knowledge, this is the first paper that provide computational results for the problem.

Diógenes Ferreira and Vitor N. Coelho. Calibration of a type 2 controller applied to a buck converter: a multi-objective analysis

Control lops are nowadays everywhere, from tiny devices to robust industrial applications. However, even when only few parameters are dealt, manually fine-tune has been shown to be a meticulous task for achieving designers desired performance. Fine-tuning a controller parameters is an arduous job that requests expertise of the domain. On the other hand, metaheuristics have been barely applied for accomplishing this task. In particular, due to different behaviors that a control loop can have, a multi-objective analysis is essential. In this work, we apply a well-known Multi-Objective Variable Neighborhood Search for assisting the design of a Buck Converter, integrating the optimization process with an evaluation mechanism integrated with a circuit simulation

software. The obtained set of non-dominated solutions presented different interesting characteristics in terms of response to some pre-defined load variations. We suggest that the proposed framework is a promising tool for assisting decision makers to design more efficient and dynamic systems.

Helen Costa, Leandro R. Galvão, Luiz H. C. Merschmann and Marcone J. F. Souza. A VNS algorithm for feature selection in hierarchical classification context

Feature selection, usually adopted as a preprocessing step for data mining, is used to select a subset of predictive features aiming to improve the performance of a predictive model. Despite of the benefits of feature selection for classification task, to the best of our knowledge, there is no work in the literature that addresses feature selection in conjunction with global hierarchical classifiers. Thus, in this paper, we fill this gap proposing a feature selection method based on Variable Neighborhood Search (VNS) metaheuristic for the hierarchical classification context. Computational experiments were carried out on four bioinformatics datasets to evaluate the effect of the proposed algorithm on classification performance when using a global hierarchical classifier. As result, we have obtained a classifier performance improvement for two datasets and a competitive result for a third dataset, which indicates the suitability of the proposed method for the hierarchical classification scenario.

Matheus Vilas Boas, Haroldo Santos and Luiz Merschmann. Optimal Decision Trees for Feature Based Parameter Tuning: Integer Programming Model and VNS Heuristic

In this paper we propose a hybrid approach for the Feature Based Parameter Tuning Problem (FBPTP) of Mixed-Integer Programming (MIP) solvers. These solvers are complex programs composed of many procedures whose execution is embedded in the Branch-and-Bound framework and their execution can be configured by setting different parameters. The diversity of models that can be formulated as MIP problems can be exploited to devise better parameter settings for groups of problems, considering lessons learned from previous experiments. Decision trees can be used to define the best parameter settings for different problem types. However the construction of optimal

decision trees is a NP-Hard problem. Thus, we propose an Integer Programming Model to construct optimal decision trees for FBPTP. A Variable Neighborhood Search heuristic is employed to accelerate the production of high quality solutions. Encouraging computational results were obtained for the open source MIP solver COIN-OR CBC: executions in the test sets considering decisions based on our decision trees built using training sets prove the effectiveness of the proposed method compared to default settings, an improvement of 7% in solver's performance was obtained both in execution times as well in the number of solved instances.

Christian Blum. ILP-Based Reduced Variable Neighborhood Search for Large-Scale Minimum Common String Partition

The minimum common string partition problem is a challenging NP-hard optimization problem from the bioinformatics field. In this work we, first, present a modification which allows to apply the current state-of-the-art technique from the literature to much larger problem instances. Second, also based on the introduced modification, we develop a reduced variable neighborhood search algorithm for tackling large-scale problem instances. The skaking step of this algorithm destroys the incumbent solution partially, in a randomized way, and generates a complete solution on the basis of the partial solution by means of integer linear programming techniques. The proposed algorithm is compared to the state-of-the-art technique from the literature. The results show that the proposed algorithm consistently outperforms the state-of-the-art algorithm in the context of problem instances based on large alphabet sizes.

Rodney Oliveira Marinho Diana, Sergio Ricardo De Souza and Moacir F. França Filho. A Variable Neighborhood Descent as ILS local search to the minimisation of the total weighted tardiness on unrelated parallel machines and sequence dependent setup times

This paper addresses the total weighted tardiness problem on unrelated parallel machines with sequence dependent setup times and job ready times. The problem consists in scheduling a set of jobs reducing the penalty costs caused by the delays in the job due dates. This is a NP-Hard problem and has been extensively studied in recent literature. In order to solve this, an ILS-VND hybrid metaheuristic is proposed, where a

local search heuristic Variable Neighborhood Descent (VND) is integrated with Iterated Local Search (ILS) metaheuristic with multiple restarts. The results is compared with two state-of-art metaheuristics proposed in the literature. This comparison indicates that for the scenarios in which setup times are short, the proposed method outperforms the references metaheuristics.

Anderson Zudio, Daniel H. S. Costa, Bruno P. Masquio, Igor M. Coelho and Paulo E. D. Pinto. BRKGA/VND Hybrid Algorithm for the Classic Three and Two-dimensional Bin Packing Problem

The classic bin packing problem consists of packing a set of boxes with fixed orientation into the minimum number of bins. In this work we present a variable neighborhood descent (VND) algorithm which improves the state-of-art biased random-key genetic algorithm (BRKGA) for the three and two-dimensional bin packing case. The method associates an integer sequence representing the order of boxes to be packed with neighborhoods that consider the most recent state of the bins. The approach is applied to elite individuals that have high improvement potential. The devised BRKGA/VND hybrid method shows significantly superior individual quality through the populations. The approach is tested with a standard set of 820 instances and a new proposed benchmark composed by bigger instances. The computational results demonstrate that the BRKGA/VND equals or improves solution quality compared to other literature algorithms in the standard set and consistently outperforms BRKGA in the new benchmark.

Olfa Harrabi, Jouhaina Siala and Hend Bouziri. On integrating an Iterated Variable Neighborhood Search within a bi-objective Genetic Algorithm: Sum Coloring of Graphs Case Application

The minimum sum coloring of graphs is a variant of the classical graph coloring problem which is known to be NP-hard. The problem consists on minimizing the sum colorings of different graph vertices. In this paper, we propose a new bi-objective model for the underlying problem. We also propose for the resolution a hybrid schema which combines a bi-objective genetic algorithm with an Iterated Variable Neighborhood Search. The proposed approach relies on the use of different dedicated evolutionary operators mainly crossover and mutation. We also note two important features of the Variable

Neighborhood Search: the use of destroy/repair method for shaking step and a multi-neighborhood search. Combined methods led us to preliminary promising results.

Jerzy Duda and Adam Stawowy. A novel variable neighborhood search for multi-family capacitated lot-sizing problem

The paper presents a novel variable neighborhood search (VNS) algorithm combined with a linear programming solver (LPS) to solve multi-item multi-family capacitated lot-sizing problem with setup times independent of the family sequence. The model has a direct application to real production planning in foundry industry, where the goal is to create the batches of manufactured castings and the sequence of the melted metal loads to prevent delays in delivery of goods to customers.
We developed simple and fast VNS based algorithm with problem-specific operators that are responsible for the neighborhood generating. For majority of test instances the proposed heuristic is able to provide better results than state-of-the art commercial solver.

Guilherme Dhein, Alberto Kummer Neto and Olinto Araújo. The Multiple Traveling Salesman Problem with Backup Coverage

We consider a variant of the classical Multiple Traveling Salesmen Problem in which the distance between any two vehicles is never greater than a fixed distance D. This new feature allows salesmen to help each other timely if an emergency happens, with an estimated backup response time related to D. To achieve this goal, a spatial and temporal synchronization is required, and it incorporates routes interdependence dificulties to be overcomed. A Genetic Algorithm and a Local Search Genetic Algorithm that embodies a Variable Neighborhood Descent procedure are proposed to solve this problem. Computational results are reported on modified benchmark instances taken from TSPLIB in order to exhibit prospects of the proposed algorithms. Through an analysis of results, the highly effective performance of our proposed Local Search Genetic Algorithm is shown in comparison to the classical Genetic Algorithm.

Dalessandro Vianna, Camila Soares, Edwin Mitacc, Iara Tammela and Rodolfo Cardoso. Hybrid VNS Heuristics for the production scheduling of costumes for Brazilian carnival samba schools

The Brazilian carnival samba schools' parade is one of the biggest popular shows in the planet, currently considered a Brazilian mark. Yearly, each carnival association makes a new carnival, building complex structures of floats and costumes in a short period. Although, the costume production scheduling is still performed manually. The purpose of this work is to propose different heuristic solutions for the addressed problem, based on the metaheuristics VNS, GRASP and Simulated Annealing and in hybrid versions of these metaheuristics. In addition to these heuristics, another innovative contribution is a mixed linear integer programming model proposed for the problem. Computational experiments highlight the efficiency of hybrid VNS heuristics, with emphasis on the VNS-GRASP that combines the strategy of multiple restarts of GRASP with the flexibility of VNS search.

Huggo Silva Ferreira, Eduardo Theodoro, Thiago Noronha, Slim Belhaiza and Christian Prins. Variable Neighborhood Search for Vehicle Routing Problem with Multiple Time Windows

The Vehicle Routing Problem (VRP) with Multiple Time Windows is a generalization of VRP, where the customers have one or more time windows in which they can be visited. The best heuristic in the literature is a Hybrid Variable Neighborhood Tabu Search (HVNTS) that mostly deals with infeasible solutions, because it is assumed that one may not reach some regions of the search space without passing through infeasible solutions. In this short paper, we propose a simpler Variable Neighborhood Search heuristic where all the computational effort is spent on searching for feasible solutions. Computational experiments showed that the proposed heuristic is competitive with the best heuristic in the literature.

Thiago Henrique Nogueira, Helena Ramalhinho and Martín Gomez Ravetti. A hybrid Lagrangean metaheuristic for single machine scheduling problem with sequence-dependent setup times, release dates and due dates

In this article, a hybrid Lagrangean metaheuristic is proposed for single machine scheduling problems with sequence-dependent setup times, release dates and due dates.

The objective function considered throughout this work is the minimization of the total tardiness. The proposed hybrid Lagrangean metaheuristic is a Lagrangean relaxation integrated with a VNS. The proposed algorithm generates strong lower and upper bounds, and it uses the information of the Lagrangean multipliers to construct and perturb feasible solutions. The algorithm performance is compared with previous hybrid approaches, and we find that the upper bounds obtained are especially good, proving optimality for several instances and tight gaps for others. Furthermore, to the best of our knowledge, the proposed methodology presents competitive results when compared with previous related works.

Ali Baniamerian, Mahdi Bashiri and Fahimeh Zabihi. A modified variable neighborhood search hybridized with genetic algorithm for vehicle routing problems with cross-docking

This paper addresses a novel hybrid metaheuristic combining the Genetic algorithm (GA) and Modified Variable Neighborhood Search (MVNS) for the vehicle routing problem with cross-docking. In this paper, we propose four shaking and two neighbourhood structures in a modified version of the VNS. The basic VNS is an efficient and successful method to solve combinatorial optimization problems, but sometimes applying it in problems with large solution space is time consuming, so to avoid expending too much computational time, a multi-part solution representation with a new searching approach is proposed and some modifications are applied to the VNS and hybridized with the GA. To show the effectiveness of the proposed hybridized approach, a comparative study is performed for existing vehicle routing problem with cross docking test problems.

Sinaide Nunes Bezerra, Marcone Jamilson Freitas Souza and Sérgio Ricardo de Souza. A GVNS algorithm for solving the Multi-Depot Routing Vehicle Problem

This paper presents an algorithm based on the General Variable Neighborhood Search (GVNS) metaheuristic for solving the Multi-Depot Vehicle Routing Problem (MDVRP). The MDVRP consists in design a set of vehicle routes serving all customers, such that maximum number of vehicle per depot and vehicle-capacity are respected, and the total cost of transportation is minimized. The proposed algorithm uses Randomized Variable

Neighborhood Descent (RVND) as local search method and it is tested in classical instances of the problem. The obtained results are presented and discussed in this paper.

Mateus N. Coelho, Vitor N. Coelho, Igor Machado Coelho, Bruno Nazário Coelho and Marcone Jamilson Freitas Souza. Learning music time series with a parallel hybrid forecasting model calibrated with GVNS

This paper focus on the learning of music time series. In this context, from compressed digital audio files, we sought to verify how a song can be learned, both in terms of amplitude and frequency. Given the enormous amount of data contained in those time series, the use of classical learning methods becomes limited. Typical compressed acquisitions in MP3 files usually contains 44100 samples per second. In this context, the use of metaheuristic algorithms for this learning task in a big-data environment is justified while using deep learning strategy sounds necessary. In this paper, a Hybrid Forecasting Model, calibrated with the General Variable Neighborhood Search, with parallel processing using Graphical Processing Units, is used as a deep learning tool. Case studies composed of simple musical compositions are used for verifying the potential of the method for such application. The obtained results are consistent with musical theories. We suggest that the techniques investigated here are promising tools for the learning, classification and computational music composition.

Julia C. Freitas and Puca H. V. Penna. Randomized Variable Neighborhood Descent Heuristic to solve the Flying Sidekick Traveling Salesman Problem

Unmanned aerial vehicles (UAV), or drones, have the potential to reduce cost and time in last mile deliveries. This paper presents the scenario which a drone works in collaboration with a delivery truck to distribute parcels. This Traveling Salesman Problem (TSP) variant has some particularities that makes it insufficient, primarily consisting of a lack of literature regarding the matter. In more detail some restrictions include the drones have a flying time-limit that inhibits them from visiting all customers, the parcel must not exceed the payload of the drone and multiple trips to the depot are not permitted. To solve the problem, the initial solution is created from the optimal TSP solution obtained by the Concorde solver. Next, an implementation of the Randomized Variable Neighborhood Descent (RVND) heuristic is used as a local search to obtain the problem solution. To test

the proposed heuristic, 11 instances based on the well-known TSP benchmark set were created. Computational experiments show the use of drones for last mile delivery can reduce the total delivery time up to almost 20%. Moreover providing a faster delivery this system has a positive environmental impact as it reduces the truck travel distance.

Bruno Ferreira Rosa, Marcone Jamilson Freitas Souza and Sergio Ricardo De Souza. Algorithms based on VNS for solving the Single Machine Scheduling Problem with Earliness and Tardiness Penalties

This work implements and compares four algorithms based on Variable Neighborhood Search (VNS), named RVNS, GVNS_f, GVNS_r and GVNS_rf, for solving the Single Machine Scheduling Problem with Earliness and Tardiness Penalties (SMSPETP). Computational experiments showed that the algorithm GVNS_f obtained better-quality solutions compared with the other algorithms, including an algorithm found in the literature. The algorithms GVNS_r and GVNS_rf obtained solutions close to the GVNS_f, and outperformed the algorithm of the literature, both with respect to the quality of the solutions and the computational times.

Thiago Silva, Gilberto Sousa, Igor Barbosa, Nenad Mladenovic, Lucidio Cabral, Luiz Satoru and Daniel Aloise. Efficient heuristics for the minimum labeling global cut problem

Let G = (V,E,L) be an edge-labeled graph. Let V be the set of vertices of G, E the set of edges, L the set of labels (colors) such that each edge e \in E has an associated label L(e). The goal of the minimum labeling global cut problem (MLGCP) is to find a subset L' \subset L of labels such that G' = (V,E';L\L') is not connected and |L'| is minimized. In this work, we generate random instances for the MLGCP to perform empirical tests. Also propose a set of heuristics using concepts of Genetic Algorithm and metaheuristic VNS, including some of their procedures, like two local search moves, and an auxiliary data structure to speed up the local search. Computational experiments show that the metaheuristic VNS outperforms other methods with respect to solution quality.

Jean Carlos Tibúrcio Campos, Alexandre Xavier Martins and Marcone Jamilson Freitas Souza. A hybrid VNS algorithm for solving the multi-level capacitated minimum spanning tree problem

This work addresses the multi-level capacitated minimum spanning tree (MLCMST) problem. It consists of finding a minimal cost spanning tree such that the flow to be transferred from a central node (root) to the other nodes is bounded by the edge capacities. In this paper a hybrid algorithm, combining the Variable Neighborhood Search (VNS) metaheuristic and one mathematical programming formulation of the literature, is used for solving it. The formulation is used to give an initial solution to VNS. Five neighborhoods are used for exploring the solution space. Results show that the VNS is able to improve the initial solutions and to obtain small gaps solutions for all instance sets.

Josiane Rezende, Marcone Souza, Vitor Coelho and Alexandre Xavier Martins. HMS: a hybrid multi-start algorithm for solving binary linear problems

This work presents a hybrid multi-start algorithm for solving generic binary linear problems. This algorithm, named HMS, is based on the Multi-Start Metaheuristic and combines exact and heuristic strategies to address the problem. The initial solutions are generated by an strategy that applies linear programming and constraint propagation for defining an optimized set of fixed variables. In order to refine them, a local search, guided by the Variable Neighborhood Descent heuristic, is called, which, in turn, uses Local Branching cuts. The algorithm was tested in a set of binary problems from MIPLIB 2010 library and the results pointed out its competitive performance, showing up as a promising matheuristic.

Eduardo Camargo de Siqueira, Sergio Ricardo De Souza and Marcone Jamilson Freitas Souza. A Multi-objective Variable Neighborhood Search algorithm for solving the Hybrid Flow Shop Problem

This paper addresses the Hybrid Flow Shop Problem (HFSP) through the Multi-objective Variable Neighborhood Search metaheuristic (MOVNS). In this problem, we have a set of jobs that must be performed in a set of stages. At each stage, we have a set of unrelated parallel machines. Some jobs may skip stages. The two evaluation criteria under

simultaneous analysis are the minimization of the makespan and the minimization of the weighted sum of tardiness. Instances of the HFSP from literature are solved by four versions of the MOVNS algorithm. The results are evaluated using the Hypervolume, Epsilon, Spacing and Sphere counting metrics.

Alexandre Frias Faria, Sergio Ricardo de Souza and Carlos Alexandre Silva. Variable Neighborhood Search applied to the Multi-way Number Partitioning Problem

This paper presents an algorithm for the optimization version of Multi-Way Number Partitioning Problem (MWNPP). This problem consists in distributing the elements of a given sequence into k disjoint subsets so that the sums of each subset elements fits in the shortest interval. The metaheuristics Variable Neighborhood Search (VNS), adapted for solving the MWNPP, has a good performance over instances less than six subsets. A comparative study with two algorithms of the literature (Karmarkar-Karp Heuristic and Longest Processing Time) is carried out, using randomly generated instances and objective functions values. The statistical tests shows that the results of the VNS proposed are significantly better than constructive methods and improved literature heuristics.

Felipe Mota, Elizabeth Wanner, Eduardo Luz and Gladston Moreira. VND-based Local Search Operator for Equality Constraints Problem in PSO Algorithm

This paper presents a hybrid PSO algorithm with a VND-based operator for handling equality constraint problems in continuous optimization. The VND operator can be defined both as a local search and a kind of elitism operator for equality constraint problems playing the role of "fixing" the best estimates of the feasible set.
Experiments performed on benchmark problems suggest that the VND operator can enhance both the convergence speed and the accuracy of the final result.

Dragović Ivana, Turajlić Nina, Mladenović Nenad, Petrović Bratislav. The Application of VNS for Optimizing a Boolean Consistent Neural Network

FIS enable the formalization of an experts reasoning process through a set of linguistic if-then rules. FIS can be enhanced by incorporating Interpolative Boolean Algebra (IBA) - a real and/or [0, 1]-valued realization of Boolean algebra. While conventional fuzzy set theory does not satisfy all Boolean axioms, IBA requires the execution of a set of structural transformations before the values can be introduced (so the axioms hold) which guarantees the preservation of the partial order at the value level. To enhance the Consistent FIS (CFIS) a neural network is used to finetune its parameters, in accordance with a set of input-output data, so they better suit the real system. The neuro-CFIS uses the knowledge contained in the data to improve the inference, while eliminating the subjectivity incorporated by experts. With large time-critical problems the optimal solution may be hard to achieve in a reasonable timeframe. VNS was chosen since it requires adding only a few parameters. The expert defines variables, initial membership function parameters and CFIS rules. The parameters are then fine-tuned by VNS.

Keynote Abstracts

Prof. Christian Blum

Artificial Intelligence Research Institute (IIIA), Spanish National Research Council (CSIC)

Title: Construct, Merge, Solve & Adapt (CMSA)

Short Bio

Dr. Christian Blum currently holds the permanent post of a Senior Research Scientist at the Artificial Intelligence Research Institute (IIIA) of the Spanish National Research Council (CSIC) in Bellaterra, Spain. Before that, from 2012 to 2016 he was an Ikerbasque Research Professor at the University of the Basque Country in San Sebastian, Spain. Dr. Blum obtained the PhD in Applied Sciences from the Free University of Brussels in 2004 and a Diploma (equivalent to a Masters Degree) in Mathematics from the University of Kaiserslautern, Germany, in 1998. His main research interests are in swarm intelligence techniques for optimization and control, and in the hybridization of metaheuristics with other techniques for optimization. During the last 15 years Christian has (co-)authored more than 140 publications in international journals, books, and peer-reviewed conference proceedings. In total, his work has currently received about 9700 citations, and his current H-index is 33 (Google Scholar). Apart from acting as area editor for the journal Computers & Operations Research (responsible for metaheuristics), he currently is also associate editor for journals such as Theoretical Computer Science, Natural Computing and Computer Science Reviews. Moreover, he is on the editorial board of several additional journals.

Prof. Nenad Mladenović

Mathematical Institute, Serbian Academy of Sciences and Arts

Title: Less is more approach with VNS

Short Bio

Prof. Nenad Mladenovic received all his degrees from the University of Belgrade, Yugoslavia (BA in mathematics, MSc and PhD in Operational Research). He started his university career in

Belgrade, but has since spent about 10 years in Montreal, Canada at the Operational Research (OR) center GERAD and at McGill University. He was teaching at University of Birmingham and Brunel university, UK during 9 years. He has participated in more than 20 industrial projects and was leader of several industrial and research projects in Yugoslavia, Canada, Belgium, U.K. and France. He has had visiting professor positions in Canada, Spain, Hong Kong, Germany, France and Belgium. In 2012 he became a member of the Academia Europe (The European Academy of Science). He is also a president of YuSIAM (Yugoslav Society of Industrial and Applied Mathematics), member of Serbian Scientific society etc. He has written 21 books and chapters, and has published more than 150 papers in edited proceedings and journals (such as SIAM J Computing, Management Science, Mathematical Programming, Operations Research, INFORMS J on Computing, OR Letters, EJOR, JOGO, JORS). He serves on the editorial board of a number of journals. He has organized many international conferences and was guest editor of more than 10 special issues.