Sunday, 10:00-11:30

■ SNA-01

Sunday, 10:00 - 11:20

Hybrid metaheuristics

Chair: *Angelo Sifaleras*, University of Macedonia, Economic and Social Sciences, Greece

1 - Hybrid Metaheuristic for Bicluster Editing Problem

Gilberto F. de Sousa Filho, Departamento de Ciências Exatas Universidade Federal da Paraíba(UFPB) Rio Tinto - PB - Brazil, *Lucidio dos Anjos F. Cabral, Luiz Satoru Ochi, Fábio Protti*

The NP-hard Bicluster Editing Problem consists of adding and/or removing at most k edges to make a bipartite graph $G = (V, E)$ a vertex-disjoint union of complete bipartite subgraphs. It has applications in the analysis of gene expression data. We propose the metaheuristics GRASP, VNS, and its hybridization for the Bicluster Editing Problem.

2 - A Simulated Annealing Algorithm within a Variable Neighborhood Search Framework to Solve the BMPG

Idelfonso Izquierdo-Marquez, Information Technology Laboratory, CINVESTAV-Tamaulipas, Km. 5.5 Carretera Cd. Victoria-Soto la Marina, 87130, Cd. Victoria Tamps., Mexico, *Aldo Gonzalez-Gomez, Alberto Garcia-Robledo, Jose Torres-Jimenez*

The bandwidth minimization problem on graphs (BMPG) consists in finding an assignment of the numbers from 1 to n to the n vertices of a graph in such a way the maximum difference between any two adjacent vertices is the minimum possible. In this work we developed a new algorithm that combines simulated annealing and variable neighborhood search metaheuristics. The algorithm uses an internal dual representation of the problem, a neighborhood function composed by three perturbation operators working over the two internal representations, and an evaluation function that partitions the search space in $(n + 1)! - 1$ equivalence classes by defining a factorial base number system. For better performance the parameters of the algorithm and the probabilities of selecting one of the three operators were tuned by extensive experimentation using a technique based on covering arrays and diophantine equations. The resulting algorithm is able to reach the current best lower bounds for a great number of instances of the BMPG.

3 - A Simulated Annealing with Variable Neighborhood Search Approach to Construct Mixed Covering Arrays

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Nowadays, the software use had been extended along almost all human activity areas and along with it, the reliability of software had become a need. Software testing consumes a significant portion of the cost of development of a new piece of software, and it is an stage that it is not feasible to ignore. A basic way to test a software is by doing an exhaustive testing process, but sometimes in the real world it is not feasible due to time and resource constraints. An alternative approach is called software interaction testing which is based on combinatorial structures called covering arrays and mixed covering arrays that are used to represent test-suites. This paper focuses on constructing MCAs by using a hybrid approach based on Simulated Annealing and a Variable Neighborhood Search function (SA-VNS). The quality of the solutions found was measured by solving a benchmark reported in the literature, and a comparison against other approaches shows that our proposed approach is an attractive and competitive option to construct MCAS.

4 - A hybrid Particle Swarm Optimization - Variable Neighborhood Search Algorithm for Constrained Shortest Path Problems

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Given a graph G for which each of its links are associated with two positive weights, cost and delay, we consider the problem of selecting a set of k link-disjoint paths from a node s to another node t such that the total cost of these paths is minimum and that the total delay of these paths is not greater than a specified bound. This problem is called the constrained shortest link-disjoint path problem (CSDP). If we would like to determine only one minimum cost path from node s to node t, then, the problem is called constrained shortest path problem (CSP). Both problems are NP-hard, thus, for the solution of these problems a hybridized version of Particle Swarm Optimization (PSO) algorithm and Variable Neighborhood Search (VNS) method

is proposed. Particle Swarm Optimization is a population-based swarm intelligence algorithm. PSO simulates the social behavior of social organisms by using the physical movements of the individuals in the swarm. Its mechanism enhances and adapts to the global and local exploration. The VNS is used to improve the solution of each particle and, as it is desired, to keep the computational time as low as possible. This hybridization is expected to increase the exploration abilities of the proposed algorithm using PSO and its exploitation abilities using VNS. As there are not any benchmark instances in the literature, a number of benchmark instances were produced and the proposed algorithm is compared with other algorithms in order to show the advantages of the proposed method.

5 - Adaptive differential evolution with crossover neighborhood search DE-CrNS

Darko Kovačević, Faculty of Organizational Sciences, University of Belgrade, Belgrade, Serbia, *Nenad Mladenović, Bratislav Petrović, Pavle Milošević*

There are two metaheuristics that deserve considerable attention in the past years by both academics and practitioners. Variable neighborhood search (VNS) is a unique and effective concept of combinatorial and global metaheuristic, based on the principles of systematic changes in the environment in conjunction with local searches. On the other side, Differential Evolution (DE), which presents a simple concept of the global search space based evolutionary algorithm that is used in many practical applications. In this paper we will present hybrid system based on the effective DE algorithms for finding the global optimum of problems that we extend the concept of variable neighborhood perturbation parameter vector.

6 - GENVNS-TS-CL-PR: A heuristic approach for solving the vehicle routing problem with simultaneous pickup and delivery

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This work addresses the Vehicle Routing Problem with Simultaneous Pickup and Delivery (VRPSPD). Due to its complexity, we propose a heuristic algorithm for solving it, so-called GENVNS-TS-CL-PR. This algorithm combines the heuristic procedures Cheapest Insertion, Cheapest Insertion with multiple routes, GENIUS, Variable Neighborhood Search (VNS), Variable Neighborhood Descent (VND), Tabu Search (TS) and Path Relinking (PR). The first three procedures aim to obtain an good initial solution, and the VND and TS are used as local search methods for VNS. TS is called after some iterations without any improvement through of the VND. The PR procedure is called after each VNS iteration and it connects a local optimum with an elite solution generated during the search. The algorithm uses an strategy based on Candidate List to reduce the number of solutions evaluated in the solution space. The algorithm was tested on benchmark instances taken from the literature and it was able to generate high quality solutions.

■ SNA-02

Sunday, 10:00 - 11:20

Matheuristics

Chair: *Anton Eremeev*, Sobolev Institute of Mathematics, Omsa, Russia

1 - Computing low-energy homopolymer conformations by Branch-and-Prune and VNS

Antonio Mucherino, IRISA,ISTIC University of Rennes, Rennes, France, *Leo Liberti, Carlile Lavor*

Homopolymers such as proteins are very important biological molecules. Finding their three-dimensional conformations is an interesting and challenging problem in biology. Given a certain function describing the total energy in the molecule, the problem of identifying the lowest energy conformations for the molecule can be seen as a global optimization problem, which is generally NP-hard. The conformational space that is explored in order to solve the problem is generally a continuous one. In this work, we discretize this conformational space, and we employ a deterministic algorithm, called branch-and-prune, for the solution of the optimization problem. Moreover, we also combine this deterministic algorithm with a simple VNS in discrete space for speeding up the search. Preliminary results are promising.

2 - A matheuristic approach for maximum lifetime coverage in wireless sensor networks under connectivity constraints

F. Castaño, Université de Bretagne-Sud LabSTICC Lorient, France, *A. Rossi, M. Sevaux, N. Velasco*

Power limitation is a major concern regarding the implementation of wireless sensor networks