


INTELLIGENT METHODS FOR SOLVING OPTIMIZATION PROBLEMS

Contact details

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Areas of expertise

Combinatorial Optimization – is concerned with optimization problems where the set of feasible solutions is discrete or can be reduced to a discrete one, and the goal is to find the best possible solution. Because finding an optimal solution in polynomial time is not possible, there is a huge interest especially in practice on methods and algorithms that find a sub-optimal solution in reasonable time.

Metaheuristic Algorithms – are providing sub-optimal solutions for complex optimization problems in reasonable time. They are usually inspired from nature (genetic algorithms, ant colony optimization, etc.). An increased interest was accorded to hybrid approaches that combine exact methods based on integer linear programming with local search based metaheuristics.

Knowledge Organization - designates a field of study related to Information Science. In this meaning, KO is about activities such as document description, indexing and classification. These activities are done by specialists as well as by computer algorithms. KO as a field of study is concerned with organizing systems (KOS) used to organize documents, document representations and concepts.

Team and key skills

Assoc. Prof. Dr. Petrica Pop Sitar – graduated Babes-Bolyai University of Cluj-Napoca, Master of Science and PhD University of Twente, the Netherlands. Currently Dean of the Faculty of Science, Technical University of Cluj-Napoca.

Assist. Prof. Dr. Andrei Horvat Marc – graduated Babes-Bolyai University of Cluj-Napoca, specialization Mathematics and Doctor in applied mathematics since 2008 from the same University.

Assist. Oliviu Matei – graduated from the Technical University of Cluj-Napoca as a B.Eng. and from the Vrije Universiteit of Amsterdam as a Ms.Sc. Currently he is a PhD student at the Technical University of Cluj Napoca.

Assist. Cosmin Sabo – graduated Lucian Blaga University of Sibiu in 2000, specialization Computer Science. Director of R & D since 2010 in the field of Knowledge Organization.

Development strategy

- Identification and development of connections with the business medium that may use the results of our research
- Stimulation of national and international cooperation with other research teams
- Creation of an attractive research environment for young researchers

Representative projects

“**Algorithmical methods for solving combinatorial optimization problems**”, project **CEEX**, ET34, 2006-2008, <http://ceex-et34.ubm.ro> Within this research project we have elaborated new mathematical models based on integer programming and mixed (linear and integer) programming for several combinatorial optimization problems.

We designed as well new techniques and heuristic algorithms for solving them. These new algorithms have been implemented and tested on benchmark instances from the literature.

“New hybrid metaheuristic methods for solving network design problems”, PN-II-RU-TE-2011-3-0113, 2011-2014. Within this research project we plan to elaborate new hybrid methods for solving complex network design problems. These methods are going to combine exact methods with metaheuristic algorithms based on local search. These two streams of techniques have their own advantages and disadvantages and can be seen as being complementary.

“Selective graph colouring problem”, grant PHC Bosphore 26284RB, EGIDE, 2012-2013. Within this research project we are studying the selective coloring problem which consists on finding a coloring of the nodes of a graph whose nodes are partitioned in n clusters such that we select exactly one node from each cluster and color these nodes with smallest number of colours. This optimization problem finds many interesting application in telecommunication and scheduling problems.

“Research, development and implementation of organizing the documents”, ANCS, 2010-2013. The project aims to realize a integrate system of organizing the information and the informational flow. A segment of applicability is the Integrated systems for Libraries. Fulfilling these objectives is done through industrial research, experimental development and introduction into production. www.ebibliophil.ro

Significant results

1. P. C. Pop, Generalized Network Design Problems, Modeling and Optimization, De Gruyter, Germany, ISBN 978-3-11-026768-6, 203 pagini, 2012.
2. P. C. Pop, I. Kara and A. Horvat Marc, New Mathematical Models of the Generalized Vehicle Routing Problem and Extensions, *Applied Mathematical Modelling*, Elsevier, Vol. 36, Issue 1, 2012, pp. 97-107.
3. P. C. Pop, O. Matei and C. Pop Sitar, An Improved Hybrid Algorithm for Solving the Generalized Vehicle Routing Problem, *Neurocomputing* (va apareea), DOI information: 10.1016/j.neucom.2012.03.032.
4. V. Francu and C. Sabo, Implementation of a UDC-based multilingual thesaurus in a library catalogue: the case of BiblioPhil, Knowledge Organization, Vol. 37, Issue 3, 2010, pp. 209-215.
5. P. C. Pop, On the Prize-Collecting Generalized Minimum Spanning Tree Problem, *Annals of Operations Research*, Vol. 150, No. 1, 2007, pp. 193-204.
6. P. C. Pop, W. Kern and G. Still, A New Relaxation Method for the Generalized Minimum Spanning Tree Problem, *European Journal of Operational Research*, Vol. 170, 2006, pp. 900-908.
7. P. C. Pop and C. Pop Sitar, New Models of the Generalized Fixed-Charge Network Design Problem, *Carpathian Journal of Mathematics* , Vol. 28, No.1, 2012, pp. 143-150.
8. P. C. Pop, C. Pop Sitar, I. Zelina, V. Lupse and C. Chira, Heuristic algorithms for solving the generalized vehicle routing problem, *International Journal of Computers, Communications & Control*, Vol. 6, No. 1, pp. 158-166, 2011.
9. P. C. Pop, A survey of different integer programming formulations of the generalized minimum spanning tree problem, *Carpathian Journal of Mathematics*, Vol. 25, No. 1, 2009, pp. 104-118.
10. O. Matei, Patent A 2011 00939: Device for remote monitoring and signalling of the human body parameters – internationally pending.
11. C. Sabo. The product eBibliophil is in the phase of introduction into production, respectively testing to the beneficiaries.

The offer addressed to the economic environment

Research & development in core areas	Elaboration of new intelligent methods for solving complex optimization problems. We will focus on developing new nature inspired algorithms based on group intelligence, extension and improving the existent methods and hybridizing the metaheuristic algorithms with exact methods based on integer programming.
Research & development in applied fields	<ol style="list-style-type: none"> 1. Proposal of new intelligent methods for solving complex optimization problems such as network design problems, facility and location problems, transportation problems, scheduling problems, etc. 2. Document and information flows, indexing of documents, knowledge organization, real time applications.
Consulting	The research team has the necessary abilities for providing the necessary consulting activities to the beneficiaries for implementing the research results in the proposed field of research. These abilities are confirmed by the previously obtained results.