Activity Report 2016

Team INOCS

Integrated Optimization with Complex Structure

Inria teams are typically groups of researchers working on the definition of a common project, and objectives, with the goal to arrive at the creation of a project-team. Such project-teams may include other partners (universities or research institutions).

RESEARCH CENTER
Lille - Nord Europe

THEME
Optimization, machine learning and statistical methods

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Team INOCS

Creation of the Team: 2015 May 01

Keywords:

Computer Science and Digital Science:

6. - Modeling, simulation and control
6.1. - Mathematical Modeling
6.2. - Scientific Computing, Numerical Analysis & Optimization
6.2.3. - Probabilistic methods
6.2.6. - Optimization
8.6. - Decision support

Other Research Topics and Application Domains:

4. - Energy
4.3. - Renewable energy production
4.4. - Energy delivery
4.5. - Energy consumption
6. - IT and telecom
6.3.2. - Network protocols
7. - Transport and logistics
7.1. - Traffic management
7.1.2. - Road traffic
8.1. - Smart building/home
8.1.1. - Energy for smart buildings
8.2. - Connected city
8.4. - Security and personal assistance

1. Members

Research Scientists

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Miguel Anjos [Inria-International Chair, Researcher, HDR]

Faculty Members

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Martine Labbé [Université Libre de Bruxelles, Professor, HDR]
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Marcio Costa Santos [Université Libre de Bruxelles, since Dec 2016]
Samuel Deleplanque [Université Libre de Bruxelles]
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Diego Ponce Lopez [Université Libre de Bruxelles]

Visiting Scientists

Yasemin Arda Da Silveira [HEC-École de gestion de l'Université de Liège, from Oct 2016 until Nov 2016]
Bernard Gendron [Université de Montréal, from Oct 2016 to Dec 2016]
Juan Alejandro Gomez Herrera [Ecole Polytechnique de Montréal, Oct 2016]
Daniele Vigo [Université de Bologne, Dec 2016]

Administrative Assistants

Aurore Hermant [Inria]
Julie Vandewalle [Université Libre de Bruxelles, Secretary]

Others

Maxime Ogier [Ecole Centrale de Lille, Associate Professor]
Mohammed Skiredj [Inria, Trainee, from Mar 2016 to Aug 2016]

2. Overall Objectives

2.1. Introduction

INOCS is a cross-border "France-Belgium" project team in the Applied Mathematics Computation and Simulation Inria domain. The main goal of this team is the study of optimization problems involving complex structures. The scientific objectives of INOCS are related to modeling and methodological concerns. The INOCS team will focus on:

1. integrated models for problems with complex structure (CS) taking into account the whole structure of the problem;
2. on the development of solution methods taking explicitly into account *the nature and the structure of the decisions as well as the properties of the problem.*

Even if CS problems are in general NP-hard due to their complex nature, exact solution methods or matheuristics (heuristics based on exact optimization methods) will be developed by INOCS. The scientific contribution of INOCS will result in a toolbox of models and methods to solve challenging real life problems.

2.2. Schedule of tasks

The research program development of INOCS is to move alternatively :

- *from problems towards new approaches in optimization*: Models and solution algorithms will be developed to fit the structure and properties of the problem. From them, new generic approaches will be used to optimize problems with similar properties.
- *from innovative approaches towards problems*: The relevance of the proposed approaches will be assessed by designing new models and/or solution methods for various classes of problems. These models and methods will be based on the extension and integration of specific, well studied, models and methods.

Even if these two axes are developed sequentially in a first phase, their interactions will lead us to explore them jointly in the mid-term.

3. Research Program

3.1. Introduction

An optimization problem consists in finding a best solution from a set of feasible solutions. Such a problem can be typically modeled as a mathematical program in which decision variables must

1. satisfy a set of constraints that translate the feasibility of the solution and
2. optimize some (or several) objective function(s). Optimization problems are usually classified according to types of decision to be taken into strategic, tactical and operational problems.

We consider that an optimization problem presents a complex structure when it involves decisions of different types/nature (i.e. strategic, tactical or operational), and/or presenting some hierarchical leader-follower structure. The set of constraints may usually be partitioned into global constraints linking variables associated with the different types/nature of decision and constraints involving each type of variables separately. Optimization problems with a complex structure lead to extremely challenging problems since a global optimum with respect to the whole sets of decision variables and of constraints must be determined.

Significant progresses have been made in optimization to solve academic problems. Nowadays large-scale instances of some NP-Hard problems are routinely solved to optimality. *Our vision within INOCS is to make the same advances while addressing CS optimization problems*. To achieve this goal we aim to develop global solution approaches at the opposite of the current trend. INOCS team members have already proposed some successful methods following this research lines to model and solve CS problems (e.g. ANR project RESPET, Brotcorne *et al.* 2011, 2012, Gendron *et al.* 2009, Strack *et al.* 2009). However, these are preliminary attempts and a number of challenges regarding modeling and methodological issues have still to be met.

3.2. Modeling problems with complex structures

A classical optimization problem can be formulated as follows:

$$\begin{array}{ll} \min & f(x) \\ s.\,t. & x \in X, \end{array} \tag{1}$$

In this problem, X is the set of feasible solutions. Typically, in mathematical programming, X is defined by a set of constraints. x may be also limited to non-negative integer values.

INOCS team plan to address optimization problem where two types of decision are addressed jointly and are interrelated. More precisely, let us assume that variables x and y are associated with these decisions. A generic model for CS problems is the following:

$$\begin{array}{ll} \min & g(x,y) \\ s.\,t. & x \in X, \\ (x,y) & \in XY, \\ y & \in Y(x). \end{array} \tag{2}$$

In this model, X is the set of feasible values for x. XY is the set of feasible values for x and y jointly. This set is typically modeled through linking constraints. Last, $Y(x)$ is the set of feasible values for y for a given x. In INOCS, we do not assume that $Y(x)$ has any properties.

The INOCS team plans to model optimization CS problems according to three types of optimization paradigms: large scale complex structures optimization, bilevel optimization and robust/stochastic optimization. These paradigms instantiate specific variants of the generic model.

Large scale complex structures optimization problems can be formulated through the simplest variant of the generic model given above. In this case, it is assumed that $Y(x)$ does not depend on x. In such models, X and Y are associated with constraints on x and on y, XY are the linking constraints. x and y can take continuous or integer values. Note that all the problem data are deterministically known.

Bilevel programs allow the modeling of situations in which a decision-maker, hereafter the leader, optimizes his objective by taking explicitly into account the response of another decision maker or set of decision makers (the follower) to his/her decisions. Bilevel programs are closely related to Stackelberg (leader-follower) games as well as to the principal-agent paradigm in economics. In other words, bilevel programs can be considered as demand-offer equilibrium models where the demand is the result of another mathematical problem. Bilevel problems can be formulated through the generic CS model when $Y(x)$ corresponds to the optimal solutions of a mathematical program defined for a given x, i.e. $Y(x) = \text{argmin}\,\{h(x,y)|y \in Y_2, (x,y) \in XY_2\}$ where Y_2 is defined by a set of constraints on y, and XY_2 is associated with the linking constraints.

In robust/stochastic optimization, it is assumed that the data related to a problem are subject to uncertainty. In stochastic optimization, probability distributions governing the data are known, and the objective function involves mathematical expectation(s). In robust optimization, uncertain data take value within specified sets, and the function to optimize is formulated in terms of a min-max objective typically (the solution must be optimal for the worst-case scenario). . A standard modeling of uncertainty on data is obtained by defining a set of possible scenarios that can be described explicitly or implicitly. In stochastic optimization, in addition, a probability of occurrence is associated with each scenario and the expected objective value is optimized.

3.3. Solving problems with complex structures

Standard solution methods developed for CS problems solve independent sub-problems associated with each type of variables without explicitly integrating their interactions or integrating them iteratively in a heuristic way. However these subproblems are intrinsically linked and should be addressed jointly. In *mathematical optimization* a classical approach is to approximate the convex hull of the integer solutions of the model by its linear relaxation. The main solution methods are i) polyhedral solution methods which strengthen this linear relaxation by adding valid inequalities, ii) decomposition solution methods (Dantzig Wolfe, Lagrangian Relaxation, Benders decomposition) which aim to obtain a better approximation and solve it by generating extreme points/rays. Main challenges are i) the analysis of the strength of the cuts and their separations for polyhedral solution methods, ii) the decomposition schemes and iii) the extreme points/rays generations for the decomposition solution methods.

The main difficulty in solving *bilevel problems* is due to their non convexity and non differentiability. Even linear bilevel programs, where all functions involved are affine, are computationally challenging despite their apparent simplicity . Up to now, much research has been devoted to bilevel problems with linear or convex follower problems. In this case, the problem can be reformulated as a single-level program involving complementarity constraints, exemplifying the dual nature, continuous and combinatorial, of bilevel programs.

4. Application Domains

4.1. Energy

In energy, the team mainly focuses on pricing models for demand side management. Demand side management methods are traditionally used to control electricity demand which became quite irregular recently and resulted in inefficiency in supply. We have explored the relationship between energy suppliers and customers who are connected to a smart grid. The smart grid technology allows customers to keep track of hourly prices and shift their demand accordingly, and allows the provider to observe the actual demand response to its pricing strategy. We tackle pricing problems in energy according to the bilevel optimization approaches. Some research works in this domain are supported by bilateral grants with EDF.

4.2. Transportation and Logistics

In transportation and logistics, the team addresses mainly integrated problems, which require taking into account simultaneously different types of decision. Examples are location and routing, inventory management and routing or staff scheduling and warehouse operations management. Such problems occur from the supply chain design level to the logistic facility level. Some research works in this application domain are supported by bilateral grants/contrats with Colisweb, INFRABEL or DHL.

4.3. Telecommunications

In telecommunications, the team mainly focuses on network design problems and on routing problems. Such problems are optimization problems with complex structure, since the optimization of capacity installation and traffic flow routing have to be addressed simultaneously. Some research works are conducted within a long-term cooperation with Nokia (formerly Alcatel-Lucent Bell Labs).

5. Highlights of the Year

5.1. Highlights of the Year

- Creation of the Inria Innovation : Colinocs between Colisweb (start-up devoted to attended delivery service within the next 2 hours) and INOCS.
- Miguel Anjos joined us in September as part of the Inria International Chair program and will spend 20% of his time with us until 2020.
- A joint team between Ecole des Mines de St Etienne and INOCS involving N. Absi, D. Cattaruzza, D. Feillet, M. Ogier, F. Semet was finalist of the EURO/ROADEF Challenge 2016 devoted to an Inventory Routing Problem proposed by Air Liquid.

6. New Results

6.1. Large scale complex structure optimization

New decomposition methods for the time-dependent combined network design and routing problem: A significant amount of work has been focussed on the design of telecommunication networks. The performance of different Integer Programming models for various situations has been computationally assessed. One of the settings that has been thoroughly analyzed is a variant where routing decisions (for time-dependent traffic demand), and network design, are combined in a single optimization model. Solving this model with a state-of-the-art solver on representative network topologies, shows that this model quickly becomes intractable. With an extended formulation, both the number of continuous flow variables and the number of fixed charge capacity constraints are multiplied by a factor $|V|$ (where V represents the set of nodes) leading to large model. However, the linear relaxation of this extended formulation yields much better lower bounds. Nevertheless, even if the extended model provides stronger lower bounds than the aggregated formulation, it suffers from its huge size: solving the linear relaxation of the problem quickly becomes intractable when the network size increases, making the linear relaxation expensive to solve. This observation motivates the analysis of decomposition methods [30].

Convex piecewise linear unsplittable multicommodity flow problems We studied the multi-commodity flow problem with unsplittable flows, and piecewise-linear costs on the arcs. They show that this problem is NP-hard when there is more than one commodity. We propose a new MILP models for this problem, that was compared to two formulations commonly used in the literature. The computational experiments reveal that the new model is able to obtain very strong lower bounds, and is very efficient to solve the considered problem [40].

Tree Reconstruction Problems: We studied the problem of reconstructing a tree network by knowing only its set of terminal nodes and their pairwise distances, so that the reconstructed network has its total edge weight minimized. This problem has applications in several areas, namely the inference of phylogenetic trees and the inference of routing networks topology. Phylogenetic trees allow the understanding of the evolutionary history of species and can assist in the development of vaccines and the study of biodiversity. The knowledge of the routing network topology is the basis for network tomography algorithms and it is a key strategy to the development of more sophisticated and ambitious traffic control protocols and dynamic routing algorithms [31].

Comparison of formulations and solution methods for the discrete ordered p-median problem: We presented several new formulations for the Discrete Ordered Median Problem (DOMP) based on its similarity with some scheduling problems. Some of the new formulations present a considerably smaller number of constraints to define the problem with respect to some previously known formulations. Furthermore, the lower bounds provided by their linear relaxations improve the ones obtained with previous formulations in the literature even when strengthening is not applied. We also present a polyhedral study of the assignment polytope of our tightest formulation showing its proximity to the convex hull of the integer solutions of the problem. Several resolution approaches, among which we mention a branch and cut algorithm, are compared. Extensive computational results on two families of instances, namely randomly generated and from Beasley's OR-library, show the power of our methods for solving DOMP [34].

New models and algorithms for integrated vehicle routing problems
We address a real-life inventory routing problem, which consists in designing routes and managing the inventories of the customers simultaneously. The problem was introduced during the 2016 ROADEF/EURO challenge. The proposed problem is original and complex for several reasons : the logistic ratio optimization objective, the hourly time-granularity for inventory constraints, the driver/trailer allocation management. Clearly, this problem is an optimization problem with complexe structure, for which we proposed a branch-cut-and-price based method : a cut and-column generation procedure was developed, along with a heuristic pricing algorithm to generate new columns and a heuristic fixing procedure to generate integer solutions. The solution method allowed the team including INOCS members to qualify to the final phase of the ROADEF/EURO challenge 2016 [41].

Column generation approach for pure parsimony haplotyping: The knowledge of nucleotides chains that compose the double DNA chain of an individual has a relevant role in detecting diseases and studying populations. However, determining experimentally the single nucleotides chains that, paired, form a certain portion of the DNA is expensive and time-consuming. Mathematical programming approaches have been proposed instead, e.g. formulating the Haplotype Inference by Pure Parsimony problem (HIPP). Abstractly, we are given a set of genotypes (strings over a ternary alphabet 0, 1, 2) and we want to determine the smallest set of haplotypes (binary strings over the set 0, 1) so that each genotype can be 'generated' by some pair of haplotypes, meaning that they are compatible with the genotype and can fully explain its structure. In order to deal with larger instances, we proposed a new model involving an exponential number of variables to be solved via column generation, where variables are dynamically introduced into the model by iteratively solving a pricing problem. We compared different ways of solving the pricing problem, based on integer programming, smart enumeration and local search heuristic. The efficiency of the approach is improved by stabilization and by a heuristic to provide a good initial solution. Results show that, with respect to the linear relaxations of both the polynomial and exponential-size models, our approach yields a tighter formulation and outperforms in both efficiency and effectiveness the previous model for instances with a large number of genotypes [39].

6.2. Bilevel Programming

Bilevel approaches for energy management problems: We have proposed the first bilevel pricing models to explore the relationship between energy suppliers and customers who are connected to a smart grid. Due to their definition, bilevel models enable to integrate customer response into the optimization process of supplier who aims to maximize revenue or minimize capacity requirements. In our setting, the energy provider acts as a leader (upper level) that takes into account a smart grid (lower level) that minimizes the sum of users' disutilities. The latter bases its decisions on the hourly prices set by the leader, as well as the schedule preferences set by the users for each task. The pricing problems, we model, belong to the category of single leader single follower problems. Considering both the monopolistic and competitive environment we present two bilevel bilinear bilinear problems with continuous variables. Heuristics solutions methods are defined to solve large size instances of the models. They are based on the interactions between prices, schedules and peaks. Numerical results on randomly generated instances illustrate numerically the validity of the approach, which achieves an ‘optimal trade-off between three objectives: revenue, user cost, and peak demand. Moreover, they put into highlight the ability of the heuristics to produce high quality results compared to the solution of MIP reformulations of the models[36].

New formulations for solving Stackelberg games: We analyzed general Stackelberg games (SGs) and Stackelberg security games (SSGs). SGs are hierarchical adversarial games where players select actions or strategies to optimize their payoffs in a sequential manner. SSGs are a type of SGs that arise in security applications, where the strategies of the player that acts first consist in protecting subsets of targets and the strategies of the followers consist in attacking one of the targets. We review existing mixed integer optimization formulations in both the general and the security setting and present new formulations for the the second one. We compare the SG formulations and the SSG formulations both from a theoretical and a computational point of view. We indentify which formulations provide tighter linear relaxations and show that the strongest formulation for the security version is ideal in the case of one single attacker. Our computational experiments show that the new formulations can be solved in shorter times [46].

6.3. Robust/Stochastic programming

Decomposition method for stochastic staff management problems : We addressed an integrated shift scheduling and load assignment optimization problem for attended home delivery, which is a last-mile delivery service requiring the presence of the customer for the delivery. We were mainly interested in generating a daily master plan for each courier. We proposed a tactical problem integrating a shift scheduling problem and a load assignment problem under demand uncertainty, which was modeled as a two-stage stochastic programming model. This model integrates two types of decisions. First-stage decisions are related to the design of a schedule that includes the periods of the day in which each courier must work and the o-d pairs to visit at each time period. Second-stage decisions (recourse actions) consist of the allocation of a number of packages to be delivered at each time period, for each o-d pair, by each courier, such that the demand (number of packages to deliver) for each scenario is satisfied. Recourse is the ability to take corrective actions after a random event has taken place. The objective is to minimize the sum of the daily staffing cost plus the expected daily recourse cost. To solve this problem, we proposed and implemented a multi-cut integer L-shaped algorithm, where the second stage decomposes by time periods and by demand scenarios. To strengthen the first stage model, some valid inequalities are added, and some of the existing constraints are lifted. Results on real-world based instances from a delivery company demonstrate that our approach provides robust tactical solutions that easily accommodate to fluctuations in customer orders, preventing additional costs related to the underutilization of couriers and the use of external couriers to satisfy all delivery requests [37], [43].

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Fluxys (2016-2018). Study of optimization problems arising in the management of gas networks.
- Colisweb (2015-2016). Study of optimization problems arising in courier scheduling. This bilateral contract leads to the creation of an Inria Innovation Lab at the end of 2016.

7.2. Bilateral Grants with Industry

- PARROT (Planning Adapter performing ReRouting and Optimization of Timing), part of BEWARE Fellowships Academia funded by the COFUND program of the European Union (FP7 - Marie Curie Actions). INFRABEL is the industrial partner of this project.(2014-2018)
- Design and Pricing of Electricity Services in a Competitive Environment within the Gaspard Monge Research Progam (PGMO) funded by the Fondation Mathématiques Jacques Hadamard. EDF is the industrial partner (2015-2018).
- BENMIP: A generic bender decomposition-based (mixed) integer programming solver within the Gaspard Monge Research Progam (PGMO) funded by the Fondation Mathématiques Jacques Hadamard.(2015-2017)

8. Partnerships and Cooperations

8.1. Regional Initiatives

The ELSAT research program addresses the issues involved in sustainable transportation and mobility. Within ELSAT, INOCS is involved on two projects devoted to hybrid optimization methods in logistics and to city logistics in collaboration with LAMIH (University of Valenciennes), LGI2A (University of Artois) and LEOST (IFSTTAR). ELSAT is supported by the CPER 2015-2020 (State-Region Contract).

8.2. National Initiatives

8.2.1. ANR

ANR project PI-Commodality “Co-modal freight transportation chains: an approach based on physical internet” in collaboration with CGS-ARMINES (Paris), LAAS (Toulouse), DHL (2016 - 2018). The PI-co-modality project aims to design new sustainable logistic services between preset origins and destinations. It is based on innovative approaches both in terms of: 1) Logistics and transportation services : by considering the PI-internet approach, specifically: mesh logistics and transportation networks based on available capacities, by designing consistent integrated co-modal chains; 2)Methodology : by addressing the underlying problems according to two approaches: centralized and decentralized, by proposing news realistic models relevant for practitioner taking into account the consistency, by developing state-of-the-art decision making algorithms.

8.2.2. National Initiatives (Belgium)

Combinatorial Optimization: Meta-heuristics and Exact Methods (2012-2017, coordinator: Bernard Fortz (GOM-ULB/INOCS-Inria). Inter-university Attraction Pole funded by the Belgian Federal Science Policy Office. Study and modeling of combinatorial optimization problems; Advancements in algorithmic techniques; Implementation of solution methods for large-scale, practically relevant problems.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

Program: COST

Project acronym: TD1207

Project title: Mathematical Optimization in the Decision Support Systems for Efficient and Robust Energy Networks

Duration: 04/2014 - 04/2017

Coordinator: Thorsten Koch (ZIB, Germany)

INOCS partners: Bernard Fortz, Martine Labbé

Abstract: Energy Production and Distribution (EP&D) is among the biggest challenges of our time, since energy is a scarce resource whose efficient production and fair distribution is associated with many technical, economical, political and ethical issues like environmental protection and people health. EP&D networks have rapidly increased their size and complexity, e.g. with the introduction and interconnection of markets within the EU. Thus, there is an increasing need of systems supporting the operational, regulatory and design decisions through a highly inter-disciplinary approach, where experts of all the concerned fields contribute to the definition of appropriate mathematical models. This is particularly challenging because these models require the simultaneous use of many different mathematical optimization tools and the verification by experts of the underlying engineering and financial issues. The COST framework is instrumental for this Action to be able to coordinate the inter-disciplinary efforts of scientists and industrial players at the European level.

Program: JPI Urban Europe

Project acronym: e4-share

Project title: Models for Ecological, Economical, Efficient, Electric Car-Sharing

Duration: 10/2014 - 09/2017

Coordinator: Markus Leitner (University of Vienna, Austria)

Other partners:

- Austrian Institute of Technology, Austria
- Université Libre de Bruxelles (INOCS), Belgium
- University of Bologna, Italy
- tbw research GesmbH, Austria

Abstract: Car-sharing systems and the usage of electric cars become increasingly popular among urban citizens. Thus, providing vast opportunities to meet today's challenges in terms of environmental objectives, sustainability and living quality. Our society needs to manage a transformation process that ultimately shall lead to fewer emissions and less energy consumption while increasing the quality of public space available. In e4-share, the team will lay the foundations for efficient and economically viable electric car-sharing systems by studying and solving the optimization problems arising in their design and operations. A main goal is to derive generic methods and strategies for optimized planning and operating in particular for flexible variants which best meet preferences of customers but impose nontrivial challenges to operators. This project will develop novel, exact and heuristic, numerical methods for finding suitable solutions to the optimization problems arising at the various planning levels as well as new, innovative approaches considering these levels simultaneously.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- Department of Statistics and Operations Research, University of Vienna, Austria.
- Centre for Quantitative Methods and Operations Management, HEC-Liège, Belgique.
- Interuniversity Centre on Entreprise Networks, Transportation and Logistics, Montreal, Canada.
- Instituto Sistemas Complejos de Ingeniería (ISCI), Santiago, Chile.
- The Centre for Business Analytics, University College Dublin, Ireland.
- Department of Electrical, Electronic, and Information Engineering, University of Bologna, Italy.
- Department of Mathematics, University of Aveiro, Portugal.
- Department of Statistics and Operations Research, University of Lisbon, Portugal.

- Instituto de Matemáticas, University of Seville.
- Dipartimento di Matematica, Universita degli studi di Padova.

8.4.2. Participation in Other International Programs

- STIC Algérie, University of Oran, Algeria.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Yasemin Arda Da Silveira, HEC-École de gestion de l'Université de Liège, Visiting Scientist from Oct 2016 until Nov 2016
- Bernard Gendron, Université de Montréal, Visiting Scientist from Oct 2016 to Dec 2016
- Juan Alejandro Gomez Herrera, Ecole Polytechnique de Montréal, Visiting Scientist Oct 2016
- Daniele Vigo, Université de Bologne, Visiting Scientist, Dec 2016.

9. Dissemination

9.1. Promoting Scientific Activities

9.1.1. Scientific Events Organisation

9.1.1.1. Member of the Organizing Committees

Luce Brotcorne:

- Meeting of the EURO Working group on Pricing and Revenue Management, Hamburg, Germany, April 2016.

Bernard Fortz:

- Winter School on Network Optimization, Estoril, Portugal, January 2016.

9.1.2. Scientific Events Selection

9.1.2.1. Chair of Conference Program Committees

Bernard Fortz:

- INFORMS Telecommunications conference, Boca Raton, FL, USA, March 2016.

9.1.2.2. Member of the Conference Program Committees

Luce Brocorne:

- ROADEF 2016, Compiègne, France, February 2016.
- EURO 2016, Stream Organizer, Poznan, Poland, July 2016.

Bernard Fortz:

- ORBEL 30, Louvain-la-Neuve, Belgium, January 2016.

Martine Labbé:

- DRCN, Paris, France, March 2016.
- International Symposium on Combinatorial Optimization (ISCO), Vietri sul Mare, Italy, May 2016.
- Ninth Triennal Symposium on transportation analysis (TRISTAN IX), June 2016.
- Meeting of the EURO working group on Locational Decisions (EWGLA), Malaga, Spain, September 2016.
- XLVIII Brazilian Symposium on Operational Research (XLVIII SBPO), Vitória, Brazil, September 2016.
- Matheuristics 2016, Brussels, Belgium, September 2016.

Frédéric Semet:

- Ninth Triennal Symposium on transportation analysis (TRISTAN IX), June 2016.
- National Conference of the Tunisian Operations Research Society (TORS), December 2016.

9.1.3. Journal

9.1.3.1. Member of the Editorial Boards

Luce Brotcorne:

- Associate editor: Computers and Operations Research

Bernard Fortz:

- Associate editor: INFORMS Journal on Computing
- Guest editor of special issues of Networks and EURO Journal on Computational Optimization

Martine Labbé:

- Editor in chief: EURO Journal on Computational Optimization
- Associate editor: International Transactions in Operations Research
- Member of the Advisory Board: Transportation Science

9.1.4. Invited Talks

Luce Brotcorne:

- CESO 2016, Plenary speaker, Paris, France, May 2016
- EDF Lab Seminar, Paris, France, France, September 2016
- RIM seminar, Erasmus, Rotterdam, Netherlands, December 2016.

Diego Cattaruzza:

- Invited seminar, HEC-École de gestion de l'université de Liège, Liège, Belgium, February 2016.

Bernard Fortz:

- OMOR seminar, ESSEC, Cergy, France, December 2016.
- SDN day 2016, Orange Gardens, Paris, France, November 2016.

Martine Labbé:

- Winter School on Network Optimization, Invited Lecturer, Lisbon, Portugal, January 2016.
- First International Workshop in Bilevel Programming, Monterrey, Plenary Speaker, Mexico, March 2016.
- ROADEF Conférence, Plenary Speaker, Compiègne, France, February 2016.
- European Study Group with Industry, Plenary Speaker, Avignon, France, May 2016
- Graphs and Optimization (GO) Meeting, Plenary Speaker, Rigi Kaldbad, Switzerland, July 2016.
- Séminaire POC15, Plenary Speaker, Paris, France, October 2016 .

Frédéric Semet

- Symposium in honor of G. Laporte, Eindhoven, Netherlands, April 2016.
- AIRO Conference, Plenary Speaker, Trieste, Italy, September 2016.

9.1.5. Leadership within the Scientific Community

Luce Brotcorne:

- Coordinator of EURO Working Group: “Pricing and Revenue Management”.

Bernard Fortz:

- Member of the board of administration and treasurer of ORBEL (Belgian OR Society).
- ORBEL representative for EURO and IFORS.

– Coordinator of EURO Working Group: “European Network Optimization Group (ENOG)”.

Martine Labbé:

– Vice-chair of the SIAM Activity Group on Optimization (SIAG/OPT).
– Chair of the SIAG/Optimization Prize committee.

Frédéric Semet:

– Member of the board of EURO Working Group:“Vehicle routing and logistics optimization (VEROLOG)”.
– Member of the steering committee of CNRS GdR 3002 : Operations Research.
– Coordinator of GdR Working Group: “Transportation and Logistics (GT2L)”.

9.1.6. Scientific Expertise

Luce Brotcorne:

– Member of the scientific committee of France-Netherlands Exchange Program.
– Member of the evaluation committee for Inria/MITACS Exchange Program.

Bernard Fortz:

– President of the FRIA PE1 - jury 1.
– Member of the CIRRELT scientific orientation committee.

Martine Labbé:

– Member of the Scientific Advisory Board of IWR and its Graduate school HGS MathComp, Heidelberg University.
– Member of the Centro de Matemática, Aplicaçoes Fundamentais e Investigaçao Operacional, University of Lisbon.
– Member of the 2016 selection jury for the research program “Mathematics and ...” of the Vienna Science and Technology Fund.

Frederic Semet:

– Member of the CIRRELT scientific orientation committee.
– Scientific board member of PICOM competitiveness cluster.
– Reviewer for Agence Nationale de la Recherche (ANR), Fond de Recherche Nature et Technologie du Québec.

9.1.7. Research Administration

Luce Brotcorne:

– Scientific Manager (correspondant scientifique) for international relations department
– Member of the International Relations working (COST-GTRI).
– Member of the committee for the Technological Development (CDT).
– Member of the committee for the recruitment of Junior Research Scientist (CR1/CR2) at Inria Bordeaux and Inria Lille in 2016
– Member of the committee for the recruitment of assistant professor at University of Valenciennes in 2016

Frédéric Semet:

– Deputy director of CRIStAL.
– Elected member of the scientific council of Centrale Lille

9.2. Teaching - Supervision - Juries

9.2.1. Supervision

PhD : Lijuan Zhang, Optimisation and Simulation of a cross-dock facility, 18/03/2016, Frédéric Semet, Benoit Trouillet

PhD : Diego Ponce Lopez, The Discrete Ordered Median Problem revisited: new formulations, properties and algorithms, Université Libre de Bruxelles, 18/07/2016, Martine Labbé, Justo Puerto

PhD : Martim Joyce Moniz, Models and methods for Traffic Engineering problems with single-path routing, Université Libre de Bruxelles, 06/10/2016, Bernard Fortz, Luis Gouveia

PhD : Sezin Afsar, Revenue Optimization and Demand Response Models using Bilevel Progamming in Smart Grid Systems, 07/12/2016, Luce Brotcorne, Gilles Savard

PhD : Bayrem Tounsi, Contributions in E-commerce supply chain : Integration in E-fullfilment and delivery services pricing,19/12/2016, Luce Brotcorne, Yezekael Hayel

PhD : Kacem Danach, Hyperheuristics in logistics 21/12/2016, Shahin Gelareh, Frédéric Semet

PhD in progress : Burak Celik, Models and methods for Stackelberg games using bilevel optimization and mixed integer linear programming, from Nov 2016, Luce Brotcorne, Martine Labbé

PhD in progress : Yaheng Cui, Models and methods for decentralized decision in logistics networks, from Oct 2016, Luce Brotcorne, Eric Ballot

PhD in progress : Wenjuan Gu, Location routing for short and local fresh food supplu chain, from Oct 2016, Maxime Ogier, Frédéric Semet

PhD in progress : Léonard Von Niederhausern, Design and pricing of new services in energy in a competitive environment, from Oct 2015, Luce Brotcorne, Didier Aussel

PhD in progress : Yuan Yuan, Vehicle Routing Problems with Synchronization for City Logistics, from Oct 2016, Diego Cattaruzza, Frédéric Semet

PhD in progress : Carlos Casorrán Amilburu, Models and algorithms for Solving Bimatrix Stackelberg games, from October 2014, Martine Labbé.

PhD in progress : Jérôme De Boeck, Optimization problems in energy, from October 2015, Bernard Fortz.

PhD in progress : Luciano Porretta, Models and methods for the study of genetic associations, from May 2011, Bernard Fortz.

PhD in progress : Fabio Sciamannini, Comumn generatin approaches for solving variants of node coloring problems, from October 2014, Bernard Fortz, Martine Labbé.

9.2.2. Juries

Luce Brotcorne:

- PhD : "Design, Planning and Execution of Sustainable Intermodal Port-Hinterland Transport Networks", Ypsilantis Panagiotis, Erasmus University, Rotterdam. Rob Zuidwijk.

Bernard Fortz:

- PhD : "Revenue Optimization and Demand Response Models using Bilevel Progamming in Smart Grid Systems", Sezin Afşar, Inria Lille-Nord Europe. Luce Brotcorne and Gilles Savard.
- HdR : "Problèmes d'optimisation en milieu urbain : modèles, méthodes et défis", Andréa Cynthia Santos, Université de Technologie de Troyes.
- PhD : "The discrete ordered median problem revisited: new formulations, properties and algorithms", Diego Ponce, Université Lire de Bruxelles and Université de Séville. Martine Labbé and Justo Puerto.

- PhD : “Optimization of information flows in telecommunication networks” (rapporteur), Thibaut Lefebvre, CNAM. Sourour Elloumi, Eric Gourdin, Cédric Bentz.

Martine Labbé:

- PhD : “Recherche de flots stables dans des réseaux de transport multi-agents” (rapporteur), Nadia Chaabane, IUniversité de Toulouse. Cyril Briant and Marie-José Huguet.
- PhD : “Models and methods for Traffic Engineering problems with single-path routing”, Martim Joyce Moniz, Université Libre de Bruxelles, Bernard Fortz and Luis Gouveia.
- HdR : “Network Optimization: Algorithmic Approaches and Polyhedral Investigations:”, Markus Leitner, University of Vienna.

Frédéric Semet:

- PhD : “Design, Planning and Execution of Sustainable Intermodal Port-Hinterland Transport Networks”, Juliette Médina, Ecole des Mines de Nantes. Fabien Le Huédé, Olivier Peton.

9.3. Popularization

- PICOM workshop on Logistics, May 2016.
- Rendez-vous du Plateau Meetings: Prescriptive analytics for an agile logistics, December 2016.

10. Bibliography

Major publications by the team in recent years

[1] I. Bilegan, L. Brotcorne, D. Feillet, Y. Hayel. *Revenue Management for rail container transportation*, in "Euro Journal on Transportation and Logistics", 2015, vol. 4, pp. 261-283

[2] S. Binart, P. Dejax, M. Gendreau, F. Semet. *A 2-stage method for a field service routing problem with stochastic travel and service times*, in "Computers & Operations Research", 2016, vol. 65, pp. 64–75

[3] Q. Botton, B. Fortz, L. Gouveia. *On the hop-constrained survivable network design problem with reliable edges*, in "Computers & Operations Research", 2015, vol. 64, n° 0, pp. 159 - 167 [*DOI :* 10.1016/j.cor.2015.05.009], http://www.sciencedirect.com/science/article/pii/S0305054815001264

[4] Q. Botton, B. Fortz, L. Gouveia, M. Poss. *Benders Decomposition for the Hop-Constrained Survivable Network Design Problem*, in "INFORMS Journal on Computing", 2013, vol. 25, n° 1, pp. 13-26 [*DOI :* 10.1287/ijoc.1110.0472], http://joc.journal.informs.org/content/25/1/13.abstract

[5] L. Brotcorne, F. Cirinei, P. Marcotte, G. Savard. *A tabu search algorithm for the network pricing problem*, in "Computers & Operations Research", 2012, vol. 39, n° 11, pp. 2603-2611

[6] L. Brotcorne, S. Hanafi, R. Mansi. *One-level reformulation of the bilevel knapsack problem using dynamic programming*, in "Discrete Optimization", 2013, vol. 10, n° 1, pp. 1-10

[7] C. Casorrán, B. Fortz, M. Labbé, F. Ordóñez. *Novel formulations for general and security Stackelberg games*, 2016, working paper or preprint, https://hal.inria.fr/hal-01429265

[8] L. CASTELLI, M. LABBÉ, A. VIOLIN. *A network pricing formulation for the revenue maximization of european air navigation service providers*, in "Transportation Research Part C: Emerging Technologies", 2013, vol. 33, pp. 214–226

[9] D. CATANZARO, L. GOUVEIA, M. LABBÉ. *Improved integer linear programming formulations for the job Sequencing and tool Switching Problem*, in "European Journal of Operational Research", 2015, vol. 244, n° 3, pp. 766–777

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[12] D. CATTARUZZA, N. ABSI, D. FEILLET, T. VIDAL. *A memetic algorithm for the multi trip vehicle routing problem*, in "European Journal of Operational Research", 2014, vol. 236, n° 3, pp. 833–848 [*DOI :* 10.1016/J.EJOR.2013.06.012]

[13] D. CATTARUZZA, N. ABSI, D. FEILLET, D. VIGO. *An iterated local search for the multi-commodity multi-trip vehicle routing problem with time windows*, in "Computers & Operations Research", 2014, vol. 51, pp. 257–267 [*DOI :* 10.1016/J.TRPRO.2015.03.027]

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[17] S. GELAREH, R. N. MONEMI, F. SEMET, G. GONCALVES. *A branch-and-cut algorithm for the truck dock assignment problem with operational time constraints*, in "European Journal of Operational Research", 2016, vol. 249, n° 3, pp. 1144–1152

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[23] R. LAHYANI, M. KHEMAKHEM, F. SEMET. *Rich vehicle routing problems: From a taxonomy to a definition*, in "European Journal of Operational Research", 2015, vol. 241, n° 1, pp. 1–14

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Publications of the year

Doctoral Dissertations and Habilitation Theses

[25] M. JOYCE-MONIZ. *Models and methods for Traffic Engineering problems with single-path routing*, Université Libre de Bruxelles (U.L.B.), Belgium, October 2016, https://hal.inria.fr/tel-01421865

[26] D. PONCE LOPEZ. *The Discrete Ordered Median Problem revisited: new formulations, properties and algorithms*, Université Libre de Bruxelles (U.L.B.), Belgium, July 2016, https://hal.inria.fr/tel-01421868

Articles in International Peer-Reviewed Journals

[27] S. BINART, P. DEJAX, M. GENDREAU, F. SEMET. *A 2-stage method for a field service routing problem with stochastic travel and service times*, in "Computers and Operations Research", 2016, vol. 65, pp. 64-75, https://hal.archives-ouvertes.fr/hal-01223020

[28] L. CASTELLI, M. LABBÉ, A. VIOLIN. *Network pricing problem with unit toll*, in "Networks", 2016, vol. 69, n° 1, pp. 83–93, https://hal.inria.fr/hal-01419552

[29] D. C. CATTARUZZA, N. ABSI, D. FEILLET. *Vehicle routing problems with multiple trips*, in "4OR: A Quarterly Journal of Operations Research", 2016, forthcoming, https://hal-emse.ccsd.cnrs.fr/emse-01250603

[30] B. FORTZ, E. GORGONE, D. PAPADIMITRIOU. *A Lagrangian heuristic algorithm for the time-dependent combined network design and routing problem*, in "Networks", 2017, vol. 69, n° 1, pp. 110–123 [*DOI :* 10.1002/NET.21721], https://hal.archives-ouvertes.fr/hal-01428061

[31] B. FORTZ, O. OLIVEIRA, C. REQUEJO. *Compact Mixed Integer Linear Programming models to the Minimum Weighted Tree Reconstruction Problem*, in "European Journal of Operational Research", 2017, vol. 256, n° 1, pp. 242 - 251, https://hal.inria.fr/hal-01410554

[32] S. GELAREH, R. N. MONEMI, F. SEMET, G. GONCALVES. *A branch-and-cut algorithm for the truck dock assignment problem with operational time constraints*, in "European Journal of Operational Research", 2016, https://hal.inria.fr/hal-01429317

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[34] M. LABBÉ, D. PONCE LOPEZ, J. PUERTO. *A comparative study of formulations and solution methods for the discrete ordered p-median problem*, in "Computers & operations research", 2016, vol. 78, pp. 230–242, https://hal.inria.fr/hal-01419555

[35] D. PAPADIMITRIOU, B. FORTZ. *Distributed monitoring problem*, in "Electronic Notes in Discrete Mathematics", 2016, vol. 52, pp. 13–20, https://hal.inria.fr/hal-01410556

Articles in Non Peer-Reviewed Journals

[36] S. AFSAR, L. BROTCORNE, P. MARCOTTE, G. SAVARD. *Achieving an optimal trade-off between revenue and energy peak within a smart grid environment*, in "Renewable Energy", March 2016, https://hal.inria.fr/hal-01230915

Invited Conferences

[37] F. SEMET, M.-I. RESTREPO, T. POCREAU. *Integrated Shift Scheduling and Load Assignment Optimization for Attended Home Delivery*, in "GO X - International Colloquium on Graphs and Optimization 2016", Mount RIgi, Switzerland, July 2016, https://hal.inria.fr/hal-01367274

[38] F. SEMET. *Challenging optimization problems in E-commerce logistics*, in "46th Annual Conference of the Italian Operations Research Society", Trieste, Italy, Italian Operations Research Society, September 2016, https://hal.inria.fr/hal-01367276

International Conferences with Proceedings

[39] V. DAL SASSO, L. DE GIOVANNI, M. LABBÉ. *A Column Generation Approach for Pure Parsimony Haplotyping*, in "OASIcs-OpenAccess Series in Informatics", 2016, vol. 50, https://hal.inria.fr/hal-01419553

[40] B. FORTZ, M. JOYCE-MONIZ, L. GOUVEIA. *On the convex piecewise linear unsplittable multicommodity flow problem*, in "2016 12th International Conference on the Design of Reliable Communication Networks (DRCN)", 2016, pp. 9–13, https://hal.inria.fr/hal-01410555

Conferences without Proceedings

[41] N. ABSI, D. CATTARUZZA, D. FEILLET, M. OGIER, F. SEMET. *Inventory Routing Problem over the long term: a math-heuristic approach*, in "Verolog 2016", Nantes, France, June 2016, https://hal.inria.fr/hal-01335601

[42] D. C. CATTARUZZA, L. BROTCORNE, N. MITTON, T. RAZAFINDRALAMBO, F. SEMET. *A two-phase matheuristic for the multi-robot routing problem under connectivity constraints*, in "Congrès annuel de la société Française de Recherche Opérationnelle et d'Aide à la Décision (ROADEF)", Compiègne, France, February 2016, https://hal.inria.fr/hal-01256730

[43] M.-I. RESTREPO, F. SEMET, T. POCREAU. *Location-allocation and load assignment problem for a package delivery company*, in "Verolog 2016", Nantes, France, June 2016, https://hal.inria.fr/hal-01335612

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Other Publications

[45] S. AFSAR, L. BROTCORNE, P. MARCOTTE, G. SAVARD. *Exact and Heuristic Methods for Energy Pricing Problem*, January 2016, working paper or preprint, https://hal.inria.fr/hal-01230919

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