



IN PARTNERSHIP WITH:  
**Ecole Centrale de Lille**

**Université Libre de Bruxelles**

Activity Report 2018

## **Project-Team INOCS**

Integrated Optimization with Complex  
Structure

RESEARCH CENTER  
**Lille - Nord Europe**

THEME  
**Optimization, machine learning and  
statistical methods**



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## Project-Team INOCS

*Creation of the Team: 2015 May 01, updated into Project-Team: 2018 March 01*

### Keywords:

#### Computer Science and Digital Science:

- A6. - Modeling, simulation and control
- A6.1. - Methods in mathematical modeling
- A6.2. - Scientific computing, Numerical Analysis & Optimization
- A6.2.3. - Probabilistic methods
- A6.2.6. - Optimization
- A9.6. - Decision support

#### Other Research Topics and Application Domains:

- B4. - Energy
- B4.3. - Renewable energy production
- B4.4. - Energy delivery
- B4.5. - Energy consumption
- B6. - IT and telecom
- B6.3.2. - Network protocols
- B7. - Transport and logistics
- B7.1. - Traffic management
- B7.1.2. - Road traffic
- B8.1. - Smart building/home
- B8.1.1. - Energy for smart buildings
- B8.2. - Connected city
- B8.4. - Security and personal assistance

## 1. Team, Visitors, External Collaborators

### Research Scientists

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#### Administrative Assistants

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## 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:

$$\begin{aligned} \min \quad & f(x) \\ \text{s. t.} \quad & x \in X. \end{aligned} \tag{1}$$

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:

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

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.  $Y(x) = \operatorname{argmin} \{h(x, y) | y \in Y_2, (x, y) \in XY_2\}$  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 activities in this application domain are supported by bilateral grants/contracts with Colisweb, DHL, HappyChic, INFRABEL, and Kéolis.

### 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

#### 5.1.1. Awards

- Martim Joyce-Moniz, former INOCS PhD student supervised by Bernard Fortz, won the Best Dissertation Award of the INFORMS Section on Telecommunications and Network Analytics.
- Bernard Fortz, Enrico Gorgone and Dimitri Papadimitriou received the 2017 Glover-Klingman prize for the best paper published in *Networks* (an international journal) [6].
- Wenjuan Gu, together with co-authors Diego Cattaruzza, Maxime Ogier and Frédéric Semet, has been classified finalist for the best article GT2L (Groupe de Travail Transport et Logistique) award with the paper titled *Adaptive large neighborhood search for multicommodity VRP* [49]. The work has been presented during the conference Roadev 2018 held in Lorient, France.

#### 5.1.2. Publications & dissemination

- Luce Brotcorne was the EURO Plenary Speaker at the XIX Latin-Iberoamerican Conference on Operations Research (CLAIO 2018) in Lima, Peru, September 2018 [28].

- Martine Labbé was plenary speaker at the «Journées de l'optimisation» in Montreal, Canada, May 2018 [31].

## 6. New Software and Platforms

### 6.1. HappyChic-ApproPick

KEYWORDS: Operational research - Optimization - Java

FUNCTIONAL DESCRIPTION: This software is a prototype developed for the bilateral contract with the company HappyChic. This software is a solver for an integrated warehouse order picking problem with manual picking operations. More precisely, the following problems are solved: (1) the assignment of references to storage positions, based on the iterative solving of minimum cost flow problems, (2) the division of clients orders into several parcels, respecting weight and size constraints, using a dynamic programming algorithm based on the split algorithm, (3) the batching of parcels into trolleys to perform picking tours, using a dynamic programming algorithm based on the split algorithm. The objective function is to minimize the total walking distance. This software is designed to deal with the large-sized industrial instances of HappyChic (considering hundreds of clients, thousands of positions and product references) in a short computation time (few minutes).

- Contact: Maxime Ogier

### 6.2. KEOLIS-MEDIATOUR

KEYWORDS: Operational research - Mathematical Optimization - Staff scheduling

FUNCTIONAL DESCRIPTION: This software is a prototype developed under a bilateral contract with the company Keolis. This software is a solver which aims to optimize the scheduling of mediation staff. More precisely, for each member of the mediation staff working in a public transportation network, MEDIATOUR determines his/her schedule along the day, i.e. when and where he/she is present. Various operational constraints must be taken into account such as the coverage of the network. This software is designed to solve large-scale industrial instances (the subway network of Lille) in short computation times (less than 1 minute).

- Contact: Frédéric Semet

### 6.3. PARROT

*Planning Adapter Performing ReRouting and Optimization of Timing*

KEYWORDS: Decision aid - Railway - Scheduling

FUNCTIONAL DESCRIPTION: This is a decision support system addressing the problem of the rescheduling railway schedules on the Belgian network when maintenance operations are planned in the short term (2-3 weeks in advance). The deliverable is a software tool that will take as input: (1) the schedules initially planned for the different trains, (2) the initial routes of the trains, (3) maintenance operations / changes of elements in the form of constraints (unavailable routes etc.). It then provides in output: (1) the new train schedule, (2) the new routing of the fleet. The modifications must respect the constraints corresponding to the operations of maintenance. For example, in some cases it is common to leave at least a few minutes interval between two trains using the same track in the station. This constraint must then be propagated if a maintenance operation delays the arrival of a train. New schedules and routings have to be created following a specific goal. Changes made to schedules and routings must minimize: (1) variations on the time spent at the station, (2) the number of partially canceled trains (additional correspondence (s) or stations that are no longer served), (2) the number of fully canceled trains (no stations served).

- Contact: Martine Labbe

## 7. New Results

### 7.1. Large scale complex structure optimization

#### **Formulation and algorithms for last-mile delivery systems:**

E-commerce is a thriving market around the world and suits very well the busy lifestyle of today's customers and this growing e-commerce poses a huge challenge for transportation companies, especially in the last mile delivery. We addressed first a fleet composition problem for last-mile delivery service. This problem occurs at a tactical level when the composition of the fleet has to be decided in advance. It is the case for companies that offer last-mile delivery service. Most of them subcontract the transportation part to local carriers and have to decide the day before which vehicles will be needed to cover a partially known demand. We assumed that the distribution area is divided into a limited number of delivery zones and the time horizon into time-slots. The demand is characterized by packages to be transported from pick-up zones to delivery zones given a delivery time slot. First, we introduced an integer programming model which aims to minimize the total delivery cost while ensuring that the demand is covered, the capacity of each vehicle is not violated, the working time for each period is not exceeded and the total working of each delivery respects the social regulations. Then we present a column-generation based approach, which is able to solve real-life instances in reasonable CPU times [33], [32]. Nowadays, the most common last mile delivery service is home delivery. Besides home delivery, companies like Amazon and Fedex, develop locker delivery. When customers shop online, they can choose a nearby locker as a pickup location. In the past years, a new concept called trunk delivery, has been proposed. Here, customers' orders can be delivered to the trunk of their cars. We jointly considered all these delivery possibilities in the same last-mile system and studied the case where the fleet is limited to a single vehicle. We proposed different formulations for the rising optimization problem. We developed problem defined cuts in order to strengthen the formulations and be able to tackle real-size instances. Last we designed and implemented a branch-and-cut algorithm [55], [53].

**Large neighborhood algorithm for multi-commodity vehicle routing problem:** When delivering fresh fruits and vegetables to catering the multi commodity aspect should be taken into account and deliveries to customers are not made in once, but each commodity can be delivered by a different vehicle as long as the total demand of that commodity is delivered. The problem that arises is the commodity constrained split delivery vehicle routing problem (C-SDVRP). We propose a heuristic based on the adaptive large neighborhood search (ALNS) to efficiently solve medium and large sized instances of the C-SDVRP. We take into account the distinctive features of the C-SDVRP and adapt several local search moves to improve a solution. Moreover, a mathematical programming based operator (MPO) that reassigns commodities to routes is used to improve a new global best solution. Computational experiments have been performed on benchmark instances from the literature. The results assess the efficiency of the algorithm, which can provide a large number of new best-known solutions in short computational times [50].

**A matheuristic for the packaging and shipping problem:** E-commerce has been continuously growing in the last years to a primary retail market. Recently in France, the threshold of 1 billion of online transactions was overcome. Due to a high demand fluctuation of e-commerce, the workforce sizing for the logistic chain is a challenging problem. Companies have to develop good strategies to have a sustainable workforce size while guaranteeing a high-level service. In this work, we consider the management of the workforce for a warehouse of an e-commerce company. Specifically, we address issues as i) How the workforce at the warehouse can be determined; ii) What is the daily operational production planning; iii) How the demand peaks can be smoothed, and the production maintained ideally constant over the time horizon. To provide answers to these issues, we introduce the Packaging and Shipping Problem (PSP). The PSP looks for a solution approach that jointly determines the workforce over a multi-period horizon and daily operational plans while minimizing the total logistics cost. We consider two strategies that aim to enhance the flexibility of the process and the efficiency of resources use: reassignment and postponement. To tackle the Packaging and Shipping Problem we propose a model, and a three-phase matheuristic. This heuristic is proved to be competitive with respect to the direct solution of the model with a commercial solver on real-life based instances [18].

**Heuristic and column generation approaches for the joint order batching and picker routing problem:**

Picking is the process of retrieving products from the inventory. It is mostly done manually by dedicated employees called pickers and is considered the most expensive of warehouse operations. To reduce the picking cost, customer orders can be grouped into batches that are then collected by traveling the shortest possible distance. We proposed an industrial case study for the HappyChic company where the warehouse has an acyclic layout: pickers are not allowed to backtrack. We developed a two-phase heuristic approach to solve this industrial case [59]. Moreover, we proposed an exponential linear programming formulation to tackle the joint order batching and picker routing problem. Variables, or columns, are related to the picking routes in the warehouse. Computing such routes is in general an intractable routing problem and relates to the well known traveling salesman problem (TSP). Nonetheless, the rectangular warehouse's layouts can be used to efficiently solve the corresponding TSP. Experimented on a publicly available benchmark, the algorithm proves to be very effective. It improves many of the best known solutions and provides very strong lower bounds. This approach is also applied to the HappyChic industrial case to demonstrate its interest for this field of application [41].

**Distribution network configuration problems:** A distribution network is a system aiming to transfer a certain type of resource from feeders to customers. Feeders are producers of a resource and customers have a certain demand in this resource that must be satisfied. Distribution networks can be represented on graphs and be subject to constraints that limit the number of intermediate nodes between some elements of the network (hop constraints) because of physical constraints. We used layered graphs for hop constrained problems to build extended formulations [21]. Preprocessing techniques allowed to reduce the size of the layered graphs used. The model was studied on the hop-constrained minimum margin problem in an electricity network. This problem consists of designing a connected electricity distribution network, and to assign customers to electricity feeders at a maximum number of hops  $H$  so as to maximize the minimum capacity margin over the feeders to avoid an overload for any feeder. A related theoretical work considers a very special case of hop constrained network design, namely the 2 edge-disjoint 3-paths polyhedron [15].

**Switched Ethernet network design problems:** We studied models arising in the design of switched Ethernet networks implementing the Multiple Spanning Tree Protocol [23]. In these problems, multiple spanning trees have to be established in a network to route demands partitioned into virtual local access networks. Different mixed-integer formulations for the problem have been proposed and compared, both theoretically and computationally.

**Delay management in public transportation:** The Delay Management Problem arises in Public Transportation networks, and is characterized by the necessity of connections between different vehicles. The attractiveness of Public Transportation networks is strongly related to the reliability of connections, which can be missed when delays or other unpredictable events occur. Given a single initial delay at one node of the network, the Delay Management Problem is to determine which vehicles have to wait for the delayed ones, with the aim of minimizing the dissatisfaction of the passengers. We derived strengthened mixed integer linear programming formulations and new families of valid inequalities for that problem. The implementation of branch-and-cut methods and tests on a benchmark of instances taken from real networks show the potential of the proposed formulations and cuts [20].

**Discrete ordered median problem:** The discrete ordered median problem consists in locating  $p$  facilities in order to minimize an ordered weighted sum of distances between clients and closest open facility. We formulate this problem as a set partitioning problem using an exponential number of variables. Each variable corresponds to a set of demand points allocated to the same facility with the information of the sorting position of their corresponding costs. We develop a column generation approach to solve the continuous relaxation of this model. Then, we apply a branch-price-and-cut algorithm to solve small to large sized instances of DOMP in competitive computational time [62].

**Genome wide association studies:** We studied the Polymorphic Alu Insertion Recognition Problem (PAIRP). Alu (*Arthrobacter luteus*) forms a major component of repetitive DNA and are frequently encountered during the genotyping of individuals. The basic approach to find Alus consists of (i) aligning sequence reads from a set of individual(s) with respect to a reference genome and (ii) comparing the possible Alu insertion induced

by the alignment with the Alu insertions positions already known for the reference genome. The sequence genome of the reference individual is known and will be highly similar, but not identical, to the genome of the individual(s) being sequenced. Hence, at some locations they will diverge. Some of this divergence is due to the insertion of Alu polymorphisms. Detecting Alus has a central role in the field of Genetic Wide Association Studies because basic elements are a common source of mutation in humans. We investigated the PAIRP relationship with the the Clique Partitioning of Interval Graphs (CPIG). Our results [12], [26] provide insights of the complexity of the problem, a characterization of its combinatorial structure and an exact approach based on Integer Linear Programming to exactly solve the correspond instances.

**A branch-and-cut algorithm for the maximum  $k$ -balanced subgraph of a signed graph:** A signed graph is  $k$ -balanced if its vertex set can be partitioned into at most  $k$  sets in such a way that positive edges are found only within the sets and negative edges go between sets. The maximum  $k$ -balanced subgraph problem is the problem of finding a subgraph of  $G$  that is  $k$ -balanced and maximum according to the number of vertices. This problem has applications in clustering problems appearing in collaborative vs conflicting environments. We provide a representatives formulation for the problem and present a partial description of the associated polytope, including the introduction of strengthening families of valid inequalities. A branch-and-cut algorithm is described for finding an optimal solution to the problem. An ILS metaheuristic is implemented for providing primal bounds for this exact method and a branching rule strategy is proposed for the representatives formulation. Computational experiments, carried out over a set of random instances and on a set of instances from an application, show the effectiveness of the valid inequalities and strategies adopted in this work [22].

**Feature selection in support vector machine:** This work focuses on support vector machine (SVM) with feature selection. A MILP formulation is proposed for the problem. The choice of suitable features to construct the separating hyperplanes has been modelled in this formulation by including a budget constraint that sets in advance a limit on the number of features to be used in the classification process. We propose both an exact and a heuristic procedure to solve this formulation in an efficient way. Finally, the validation of the model is done by checking it with some well-known data sets and comparing it with classical classification methods [25].

## 7.2. Bilevel Programming

**Pricing problems in energy management:** Power systems face higher flexibility requirements from generation to consumption due to the increasing penetration of non-controllable distributed renewable energy. In this context, demand side management aims at reducing excessive load fluctuation and match the price of energy to their real cost for the grid. Pricing models for demand side management methods are traditionally used to control electricity demand. First, we proposed bilevel pricing models to explore 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. Moreover, we assumed that the smart grid optimizes the usage of a renewable energy generation source and a storage capacity. Results over a rolling horizon were obtained [14], [28], [36]. Next, we considered four types of actors: furnishers sell electricity, local agents trade and consume energy, aggregators trade energy and provide energy to end-users, who consume it. This gives rise to three levels of optimization. The interaction between aggregators and their end-users is modelled with a bilevel program, and so is the interaction between furnishers, and local agents and aggregators. Since solving bilevel programs is difficult in itself, solving trilevel programs requires particular care. We proposed three possible approaches, two of them relying on a characterization of the intermediary optimization level [35]. Finally, Time and-Level-of-Use is a recently proposed energy pricing scheme, designed for the residential sector and providing suppliers with robust guarantee on the consumption. We formulate the supplier decision as a bilevel, bi-objective problem optimizing for both financial loss and guarantee. A decomposition method is proposed, related to the optimal value transformation. It allows for the computation of an exact solution by finding possible Pareto optimal candidate solutions and then eliminating dominated ones. Numerical results



on experimental residential power consumption data show the method effectively finds the optimal candidate solutions while optimizing costs only or incorporating risk aversion at the lower-level [37].

**Unit commitment under market equilibrium constraints:** Traditional (deterministic) models for the Unit Commitment problem (UC) assume that the net demand for each period is perfectly known in advance, or in more recent and more realistic approaches, that a set of possible demand scenarios is known (leading to stochastic or robust optimization problems). However, in practice, the demand is dictated by the amounts that can be sold by the producer at given prices on the day-ahead market. We modeled and solved the UC problem with a second level of decisions ensuring that the produced quantities are cleared at market equilibrium. In its simplest form, we are faced to a bilevel optimization problem where the first level is a MIP and the second level linear. As a first approach to the problem, we assumed that demand curves and offers of competitors in the market are known to the operator. Following the classical approach for these models, we turned the problem into a single-level program by rewriting and linearizing the first-order optimality conditions of the second level. In recent work, this approach was extended to include network capacities effects and a decoupling of prices in different zones [45], [46], [47], [48].

**Market regulation:** We proposed a bilevel programming model to study a problem of market regulation through government intervention. One of the main characteristics of the problem is that the government monopolizes the raw material in one industry, and competes in another industry with private firms for the production of commodities. Under this scheme, the government controls a state-owned firm to balance the market; that is, to minimize the difference between the produced and demanded commodities. On the other hand, a regulatory organism that coordinates private firms aims to maximize the total profit by deciding the amount of raw material bought from the state-owned firm. Two equivalent single-level reformulations are proposed to solve the problem. Additionally, three heuristic algorithms are designed to obtain good-quality solutions with low computational effort. Extensive computational experimentation is carried out to measure the efficiency of the proposed solution methodologies. A case study based on the Mexican petrochemical industry is presented. Additional instances generated from the case study are considered to validate the robustness of the proposed heuristic algorithms [66].

**Rank pricing:** One of the main concerns in management and economic planning is to sell the right product to the right customer for the right price. Companies in retail and manufacturing employ pricing strategies to maximize their revenues. The Rank Pricing Problem considers a unit-demand model with unlimited supply and uniform budgets in which customers have a rank-buying behavior. Under these assumptions, the problem is first analyzed from the perspective of bilevel pricing models and formulated as a non linear bilevel program with multiple independent followers. We also present a direct non linear single level formulation. Two different linearizations of the models are carried out and two families of valid inequalities are obtained which, embedded in the formulations by implementing a branch-and-cut algorithm, allow us to tighten the upper bound given by the linear relaxation of the models. We show the efficiency of the formulations, the branch-and-cut algorithms and some preprocessing through extensive computational experiments [16].

**Bilevel minimum spanning tree problem:** Consider a graph whose edge set is partitioned into a set of red edges and a set of blue edges, and assume that red edges are weighted and contain a spanning tree of  $G$ . Then, the Bilevel Minimum Spanning Tree Problem (BMSTP) consists in pricing (i.e., weighting) the blue edges in such a way that the total weight of the blue edges selected in a minimum spanning tree of the resulting graph is maximized. We propose different mathematical formulations for the BMSTP based on the properties of the Minimum Spanning Tree Problem and the bilevel optimization. We establish a theoretical and empirical comparison between these new formulations and we also provide reinforcements that together with a proper formulation are able to solve medium to big size instances [65].

**Bilevel programming models for location problems:** First, we addressed a multi-product location problem in which a retail firm has several malls with a known location. A particular product comes in  $p$  types. Each mall has a limited capacity for products to be sold at that location, so the firm has to choose what products to sell at what mall. Furthermore, the firm can apply discrete levels of discount on the products/ The objective of the

firm is to find what products to sell at which mall, with what level of discount, so that its profit is maximized. Consumers are located in points of the region. Each consumer has a different set of acceptable products, and will purchase one of these, or none if it is not convenient for her. Consumers maximize their utility. The agents (firm and consumers) play a Stackelberg game, in which the firm is the leader and the customers the follower. Once the firm decides the products to sell at each mall and the possible discounts, consumers purchase (or not) one of their acceptable products wherever their utility is maximized. We model the problem using bilevel formulations, which are compared on known instances from the literature [43]. Second we studied a location problem of controversial facilities. On the one hand, a leader chooses among a number of fixed potential locations which ones to establish. On the second hand, one or several followers who, once the leader location facilities have been set, choose their location points in a continuous framework. The leader's goal is to maximize some proxy to the weighted distance to the follower's location points, while the follower(s) aim is to locate his location points as close as possible to the leader ones. We develop the bilevel location model for one follower and for any polyhedral distance, and we extend it for several followers and any so-called p-norm. We prove the NP-hardness of the problem and propose different mixed integer linear programming formulations. Moreover, we develop alternative Benders decomposition algorithms for the problem. Finally, we report some computational results comparing the formulations and the Benders decompositions on a set of instances [63].

**Stackelberg games:** First 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 identify 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 [61].

Second, we formulate a Stackelberg Security game that coordinates resources in a border patrol problem. In this security domain, resources from different precincts have to be paired to conduct patrols in the border due to logistic constraints. Given this structure the set of pure defender strategies is of exponential size. We describe the set of mixed strategies using a polynomial number of variables but exponentially many constraints that come from the matching polytope. We then include this description in a mixed integer formulation to compute the Strong Stackelberg Equilibrium efficiently with a branch and cut scheme. Since the optimal patrol solution is a probability distribution over the set of exponential size, we also introduce an efficient sampling method that can be used to deploy the security resources every shift. Our computational results evaluate the efficiency of the branch and cut scheme developed and the accuracy of the sampling method. We show the applicability of the methodology by solving a real world border patrol problem [58].

### 7.3. Robust/Stochastic programming

**Locating stations in a one-way electric car sharing system under demand uncertainty:** We focused in [60] on a problem of locating recharging stations in one-way station based electric car sharing systems which operate under demand uncertainty. We modeled this problem as a mixed integer stochastic program and develop a Benders decomposition algorithm based on this formulation. We integrated a stabilization procedure to our algorithm and conduct a large-scale experimental study on our methods. To conduct the computational experiments, we developed a demand forecasting method allowing to generate many demand scenarios. The method was applied to real data from Manhattan taxi trips.

**Integrated shift scheduling and load assignment optimization for attended home delivery:** We studied an integrated shift scheduling and load assignment optimization problem for attended home delivery. The proposed approach is divided into two phases, each one corresponding to a different planning level: tactical and operational. In the tactical planning, a daily master plan is generated for each courier. This master plan

defines the working shifts, the origin-destination pairs to visit, and the number of client requests to serve. In the operational planning, delivery orders are allocated to couriers in real-time. The stochastic and dynamic nature of client orders is included in the tactical and operational decision levels, respectively. For the tactical level, we developed and implemented a multi-cut L-shaped algorithm. Experimental results demonstrate that our approach provides robust tactical solutions that easily accommodate to fluctuations in client orders, preventing additional costs related to the underutilization of couriers and to the use of external couriers to satisfy all delivery requests, when compared to an approach using the mean demand value. Moreover, these results also indicate that the failure to incorporate robust tactical solutions in the operational planning results in infeasible operational plans that are inadmissible regarding the couriers' working time (e.g., minimum and maximum number of working hours) and work regulations (e.g., allocation of consecutive working hours to the couriers).

**Bookings in the European gas market: Characterization of feasibility and computational complexity results:** As a consequence of the liberalisation of the European gas market in the last decades, gas trading and transport have been decoupled. At the core of this decoupling are so-called bookings and nominations. Bookings are special long-term capacity right contracts that guarantee that a specified amount of gas can be supplied or withdrawn at certain entry or exit nodes of the network. These supplies and withdrawals are nominated at the day-ahead. These bookings then need to be feasible, i.e., every nomination that complies with the given bookings can be transported. While checking the feasibility of a nomination can typically be done by solving a mixed-integer nonlinear feasibility problem, the verification of feasibility of a set of bookings is much harder. We consider the question of how to verify the feasibility of given bookings for a number of special cases. For our physics model we impose a steady-state potential-based flow model and disregard controllable network elements. We derive a characterization of feasible bookings, which is then used to show that the problem is in coNP for the general case but can be solved in polynomial time for linear potential-based flow models. Moreover, we present a dynamic programming approach for deciding the feasibility of a booking in tree-shaped networks even for nonlinear flow models [56].

## 8. Bilateral Contracts and Grants with Industry

### 8.1. Bilateral Contracts with Industry

Fluxys (2016-2018). Study of optimization problems arising in the management of gas networks.

HappyChic (2018). Study and implementation of optimization methods for problems arising in the warehouse management context.

Keolis (2018). Study and implementation of optimization methods for problems arising in the management of mediation officers in public transportation.

Utocat (2018). Study optimization problems arising in the blockchain.

### 8.2. Bilateral Grants with Industry

Design and Pricing of Electricity Services in a Competitive Environment within the Gaspard Monge Research Program (PGMO) funded by the Fondation Mathématiques Jacques Hadamard. EDF is the industrial partner (2015-2018).

Robust Energy Offering under Market Equilibrium Constraints within the Gaspard Monge Research Program (PGMO) funded by the Fondation Mathématiques Jacques Hadamard. EDF is the industrial partner (2017-2019).

### 8.3. Inria Innovation Lab

COLINOCS is an Inria Innovation Lab between Colisweb, a start-up company addressing last-mile delivery and INOCS, which was created at the end of 2016. This collaboration roots back to 2015, when a bilateral contract was devoted to optimization problems arising in courier scheduling. The main objective of this Innovation Lab is to model and solve optimization problems related to revenue management, transport mutualization, a better visibility on their activities for the couriers. See also: <https://www.inria.fr/centre/lille/actualites/inria-innovation-lab-colinocs-entre-colisweb-et-l-equipe-inocs>.



## 9. Partnerships and Cooperations

### 9.1. Regional Initiatives

#### 9.1.1. Lille

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).

#### 9.1.2. Brussels

ValueBugs is a citizen participatory research project, funded by INNOVIRIS (2018-2020). The objective of ValueBugs is to collectively develop a method for decentralized insect production in cities while enhancing the value of food waste on a small scale. In practical terms, peelings are consumed by insect larvae that have reached the end of their development and offer many promising outlets: feed for hens, farmed fish, pets... and much more! This new, totally innovative sector will be a new tool to be put in the hands of every citizen: we must therefore imagine it collectively.

### 9.2. National Initiatives

#### 9.2.1. 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 - 2019). The PI-commodality 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.

#### 9.2.2. F.R.S.-FNRS (Belgium)

Bilevel optimization is a branch of mathematical optimization that deals with problems whose constraints embed an auxiliary optimization problem. The F.R.S.-FNRS research project “bilevel optimization” (2018-2019) will study such bilevel problems with bilinear objectives and simple second level problems. Each follower chooses one strategy in a given fixed set of limited size. Two classes of such problems will be studied: Pricing Problems and Stackelberg Security Games.

In pricing problems, prices for products must be determined to maximize the revenue of a leader given specific behaviors of customers (followers). More precisely, we will consider the single minded pricing problem and the rank pricing problem.

In Stackelberg games, mixed strategies to cover targets, must be determined in order to maximize the defender expected payoff given that attackers (followers) attack targets that maximize their own payoffs.

### 9.3. International Initiatives

#### 9.3.1. Inria International Labs

##### Inria Chile

Associate Team involved in the International Lab:

### 9.3.1.1. BIPLOS

Title: Bilevel Problems in LOGistics and Security

International Partner (Institution - Laboratory - Researcher):

Universidad de Chile (Chile) - Instituto Sistemas Complejos de Ingeniería (ISCI) - Ordóñez Fernando

Start year: 2017

See also: <https://project.inria.fr/biplos/>

This project is devoted to bilevel optimisation problems with application in the security and logistics domains. Stackelberg games, including one defender and several followers, and competitive location problems will be considered. Mixed integer linear optimisation models and efficient algorithms to solve them will be developed.

## 9.3.2. Inria Associate Teams Not Involved in an Inria International Labs

### 9.3.2.1. LOBI

Title: Learning within Bilevel Optimization

International Partner (Institution - Laboratory - Researcher):

Polytechnique Montréal (Canada) - Institut de Valorisation des Données (IVADO) - Gilles Savard

Start year: 2018

See also: <https://team.inria.fr/lobi/>

The interplay between optimization and machine learning is one of the most important developments in modern computational science. Simultaneously there is a tremendous increase in the availability of large quantities of data in a multitude of applications, and a growing interest in exploiting the information that this data can provide to improve decision-making. Given the importance of big data in business analytics, its explicit integration into an optimization process is a challenge with high potential impact. The innovative project is concerned with the interconnection between machine learning approaches and a particular branch of optimization called bilevel optimization in this “big data” context. More precisely, we will focus on the development of new approaches integrating machine learning within bilevel optimization (LOBI: “Learning au sein de l’Optimisation BIniveau”) for two important practical applications, the pricing problem in revenue management and the energy resource aggregation problem in smart grids. The applications arise from current industry collaborations of the teams involved, and will serve as testbeds to demonstrate the potential impact of the proposed approach.

### 9.3.2.2. North-European associated team

Title: Physical-internet services for city logistics

International Partner (Institution - Laboratory - Researcher):

Norwegian School of Economics - Stein Wallace

Start year: 2017

In this project, we consider an urban logistic terminal and new logistics services which could be developed according to a Physical Internet approach. The main objective is to evaluate the services using optimization models created within the project. We are developing optimization models to identify win-win cooperation between carriers based on supply and demand. We aim to explore how to include stochasticity in the description of the supplies and demands, as well as travel times, and to what extent the plans within a day can improve by such knowledge. The second task is to develop solution algorithms for these models. These are real scientific challenges as we are facing stochastic mixed integer problems.

### 9.3.3. Inria International Partners

#### 9.3.3.1. 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 Enterprise Networks, Transportation and Logistics (CIRRELT), Montreal, Canada.  
 Department of Industrial Engineering, Universidad de Talca, Curicó, Chile.  
 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 Electrical and Information Engineering, University of Padova, Italy.  
 Department of Mathematics, University of Aveiro, Portugal.  
 Department of Statistics and Operations Research, University of Lisbon, Portugal.  
 Instituto de Matemáticas, University of Seville, Spain.  
 Departamento de Estadística e Investigación Operativa, Universidad de Murcia, Spain.  
 Dipartimento di Matematica, Università degli studi di Padova, Italy.

## 9.4. International Research Visitors

### 9.4.1. Visits of International Scientists

#### 9.4.1.1. Visiting Professors and Ph.D. students

Claudia Archetti, Professor at Università de Brescia, December 2018.  
 Stein Wallace, Professor at NHH Norwegian School of Economics, October 2018.  
 Martin Schmidt, Professor at Erlangen University, August 2018.  
 Alejandro Jofre, Professor at Universidad de Chile, from June 2018 until July 2018.  
 Sebastián Dávila, Ph.D. student at Universidad de Chile, June 2018.  
 Vladimir Marianov, Professor at Pontificia Universidad Católica de Chile, June 2018.  
 Fernando Ordóñez, Professor at Universidad de Chile, June 2018.  
 Alfredo Marin, Professor at Universidad de Murcia, March 2018.  
 Eduardo Alvarez Miranda, Professor at Universidad de Talca, January - February 2018.

#### 9.4.1.2. Internships

Brou Koua, Esatic, Abidjan, Cote d'Ivoire, December 2018 - January 2019.  
 Lilian Lopez Vera, Autonomous University of Nuevo León, Monterrey, Mexico February-June 2018.

## 10. Dissemination

### 10.1. Promoting Scientific Activities

#### 10.1.1. Scientific Events Organisation

##### 10.1.1.1. General Chair, Scientific Chair

- IWOBIP 2018, 2nd International Workshop on Bilevel Programming, Lille, France, June 2018: Luce Brotcorne, Martine Labbé.
- Operations Research 2018, Brussels, Belgium, September 2018: Bernard Fortz.

### 10.1.1.2. Member of the Organizing Committees

7th Winter School on Network Optimization, Estoril, Portugal, January 2018: Bernard Fortz.

International Symposium on Mathematical Programming (ISMP), Bordeaux, July 2018: Luce Brotcorne, Bernard Fortz.

## 10.1.2. Scientific Events Selection

### 10.1.2.1. Member of the Conference Program Committees

ORBEL 2018, Liège, Belgium, January 2018: Bernard Fortz

6th INFORMS Transportation Science and Logistics Society Workshop, January, 2018: Luce Brotcorne, Frédéric Semet

ROADEF2018 - 18ème Conférence de la Société Française de Recherche Opérationnelle et d'Aide à la Décision, Metz, France, February 2018: Luce Brotcorne, Bernard Fortz, Frédéric Semet

ISCO 2018: International Symposium on Combinatorial Optimization, Marrakesh, Morocco, April, 2018: Martine Labbé

Odysseus 2018, International Workshop on Freight Transportation, Cagliari, Italy, June 2018: Martine Labbé, Frédéric Semet

Matheuristics 2018, Tours, France, June 2018: Martine Labbé

EURO/ALIO International Conference 2018 on Applied Combinatorial Optimization, Bologna, June 2018: Martine Labbé

International Symposium on Mathematical Programming (ISMP), Bordeaux, July 2018: Martine Labbé (Program Committee), Frédéric Semet (Scientific Committee)

EURO 2018, European Conference of Operational Research Societies, Valencia, Spain, July 2018: Luce Brotcorne, Bernard Fortz

INFORMS Annual Meeting, Phoenix, United States, November 2018: Luce Brotcorne (cluster chair), Bernard Fortz

### 10.1.3. Journal

#### 10.1.3.1. Member of the Editorial Boards

EURO Journal on Computational Optimization: Martine Labbé - Editor in chief, Bernard Fortz - Editor.

Computers and Operations Research: Luce Brotcorne - Associate editor.

INFORMS Journal on Computing: Bernard Fortz - Associate editor.

International Transactions in Operations Research: Bernard Fortz, Martine Labbé - Associate editors.

Transportation Science: Martine Labbé - Member of the Advisory Board.

#### 10.1.3.2. Reviewer - Reviewing Activities

Annals of Operations Research, Applied Computing and Informatics, Central European Journal of Operations Research, Computers & Operations Research, Computational Optimization and Applications, Discrete Applied Mathematics, EURO Journal on Transportation and Logistics, European Journal of Operational Research, IISE Transactions, INFORMS Journal on Computing, International Journal of Management Science and Engineering Management, Mathematical Programming Computation, Networks, Omega, Operations Research, Optimization and Engineering, RAIRO - Operations Research, Transportation Science: Luce Brotcorne, Diego Cattaruzza, Bernard Fortz, Martine Labbé, Maxime Ogier, Frédéric Semet.

#### **10.1.4. Invited Talks**

XIX Latin-Iberoamerican Conference on Operations Research (CLAIO 2018), Lima, Peru, September 2018: Luce Brotcorne, EURO Plenary speaker [28].

Journées de l'optimisation, Montreal, Canada, May 2018 : Martine Labbé, Plenary Speaker [31].

#### **10.1.5. Leadership within the Scientific Community**

EURO Working Group "Pricing and Revenue Management": Luce Brotcorne - coordinator.

EURO Working Group "European Network Optimization Group (ENOG)": Bernard Fortz - coordinator.

EURO Working Group "Vehicle routing and logistics optimization (VEROLOG)": Frédéric Semet - Member of the board.

INFORMS Women in OR/MS : Luce Brotcorne - International liaison.

SIAG/Optimization Prize committee: Martine Labbé - Chair.

ORBEL (Belgian Operations Research Society): Bernard Fortz - Member of the board of administration and treasurer.

ORBEL representative for EURO and IFORS: Bernard Fortz.

CNRS GdR 3002: Operations Research: Frédéric Semet - Member of the steering committee.

#### **10.1.6. Scientific Expertise**

Scientific orientation committee of the Interuniversity Centre on Enterprise Networks, Transportation and Logistics (CIRRELT), Canada: Bernard Fortz, Frédéric Semet - Members.

Centro de Matemática, Aplicações Fundamentais e Investigação Operacional, University of Lisbon: Martine Labbé - Member.

DFG Review Panel "Mathematics" for Clusters of Excellence, 2018: Martine Labbé - Member.

Scientific committee of France-Netherlands Exchange Program: Luce Brotcorne - Member.

Evaluation committee for Inria/MITACS Exchange Program: Luce Brotcorne - Member.

Evaluation committee COST GTRI: Luce Brotcorne - Member.

President of the FRIA PE1 - jury 1: Bernard Fortz - Chair.

Scientific board of PICOM competitiveness cluster: Frédéric Semet - Member.

Agence Nationale de la Recherche (ANR): Luce Brotcorne, Frédéric Semet - Reviewer.

Fond de Recherche Nature et Technologie du Québec: Frédéric Semet - Reviewer.

Research Council of Norway: Frederic Semet - Reviewer.

#### **10.1.7. Research Administration**

Committee for the Technological Development (CDT): Luce Brotcorne - Member.

CRIStAL: Frédéric Semet - Deputy-director.

Scientific council of Centrale Lille: Frédéric Semet - Elected member.

## **10.2. Teaching - Supervision - Juries**

### **10.2.1. Teaching**

Master: Bernard Fortz, Recherche Opérationnelle et Applications, 30hrs, M1, Université de Mons (campus Charleroi), Belgique.

Master: Bernard Fortz, Continuous Optimization, 24hrs, M1 & M2, Université libre de Bruxelles, Belgique.

Master: Martine Labbé, Computer science seminar, 12hrs, M2, Université libre de Bruxelles, Belgique.

Master: Frédéric Semet, Non-linear Optimization, 30hrs, M2, Centrale Lille.

Master: Frédéric Semet, Operations Research, 28hrs, M2, Centrale Lille.

Master: Luce Brotcorne, Optimisation, 14hrs, M1, Polytech Lille.

Master: Luce Brotcorne, Recherche opérationnelle, 16hrs, M1 apprentissage, Polytech Lille.

Master: Luce Brotcorne, Diego Cattaruzza, Maxime Ogier, Frédéric Semet, Numerical Analysis and Optimization, 132hrs, M1, Centrale Lille.

Master: Diego Cattaruzza, Maxime Ogier, Object-Oriented Programming, 48hrs, M1, Centrale Lille.

Master: Diego Cattaruzza, Maxime Ogier, Operations Research, 16hrs, M1, Centrale Lille.

Master: Frédéric Semet, Large-scale optimization methods, 24hrs, M1, Centrale Lille.

Licence: Diego Cattaruzza, Maxime Ogier, Object-Oriented Programming, 36hrs, L3, Centrale Lille.

Licence: Frédéric Semet, Advanced programming and Complexity, 24hrs, L3, Centrale Lille.

Licence: Diego Cattaruzza, Maxime Ogier, Object-Oriented Programming, 40hrs, L2, Centrale Lille.

Licence: Diego Cattaruzza, Web Technologies and Multimedia, 32hrs, L2, Centrale Lille.

Licence: Bernard Fortz, Algorithmique 1, 12hrs, L1, Université libre de Bruxelles, Belgique.

Licence: Bernard Fortz, Algorithmique 2, 24hrs, L2, Université libre de Bruxelles, Belgique.

Licence: Bernard Fortz, Algorithmique et Recherche Opérationnelle, 24hrs, L3, Université libre de Bruxelles, Belgique.

Licence: Martine Labbé, Projets d'informatique 3 transdisciplinaire, 12hrs, L3, Université libre de Bruxelles, Belgique.

### 10.2.2. Supervision

PhD: Luciano Porretta, Models and methods for the study of genetic associations, Université libre de Bruxelles, January 2018, Bernard Fortz.

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

PhD in progress: Mathieu Besançon, Approche bi-niveau de réponse à la demande dans les réseaux électriques intelligents, from September 2018, Miguel Anjos, Luce Brotcorne, Frédéric Semet.

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

PhD in progress: Concepción Domínguez Sánchez, Mixed integer linear models and algorithms for pricing problems, from October 2017, Martine Labbé.

PhD in progress: Wenjuan Gu, Location routing for short and local fresh food supply 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: Fränk Plein, Models and methods for the robust verification of booked capacities in gas networks in a decentralized setting, from October 2017, Martine Labbé.

PhD in progress: Luis Alberto Salazar Zendeja, Formulations and resolution methods for network interdiction problems, from November 2018, Diego Cattaruzza, Martine Labbé, Frédéric Semet.

PhD in progress: Yuan Yuan, Vehicle routing problems with synchronization for city logistics, from Oct 2016, Diego Cattaruzza, Frédéric Semet.

### 10.2.3. Juries

PhD: “Design of reliable aerospace system architecture”, University of Edinburgh. Lukas Matthias Schaefer, Bernard Fortz - Reviewer.

PhD: “Fast and scalable optimization for segment routing”, Université catholique de Louvain. Renaud Hartert, Bernard Fortz - Examiner.

PhD: “Network design under uncertainty and demand elasticity”, Concordia University. Carlos Armando Zetina, Bernard Fortz - External examiner.

Habilitation: “Optimization for complex problems in air and rail transport”, Université de Lille 1. Paola Pellegrini, Bernard Fortz - Reviewer.

Habilitation: “A journey through optimization: from global to discrete optimization and back”, Université de Lorraine. Bernardetta Addis, Bernard Fortz - Reviewer, Martine Labbé - Examiner.

PhD: “Design of optimal routes for vehicles and drivers”, Universidad de La Laguna. Bencomo Domínguez-Martín, Martine Labbé - Reviewer.

PhD: “A comparative study of labeling algorithms within the branch-and-price framework for vehicle routing with time windows”, Université de Liège. Stefano Michelini, Martine Labbé - Examiner.

PhD: “Mathematical programming models and algorithms for offshore wind park design”, Technical University of Denmark. Martina Fischetti, Martine Labbé - External examiner.

Habilitation: “Linear formulations and exact algorithms for combinatorial optimization”, Sorbonne Université. Pierre Fouilhoux, Martine Labbé - Examiner.

PhD: “Tactical planning on freight transport networks: service design and pricing”, Université de Liège. Christine Tawfik, Luce Brotcorne - Reviewer.

PhD: “A tropical geometry and discrete convexity approach to bilevel programming”, Université de Paris-Saclay. Jean-Bernard Eytard, Luce Brotcorne - Reviewer.

PhD: “Revenue management for transport service providers in physical internet: Freight carriers as case”, Université de Recherche Paris Sciences et Lettres. Bin Qiao, Luce Brotcorne - Reviewer.

### 10.3. Popularization

F. Semet, Club Logistique et Transport, CCI St Quentin, November 2018.

## 11. Bibliography

### Major publications by the team in recent years

- [1] 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>
- [2] 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<sup>o</sup> 1, pp. 13-26 [DOI : 10.1287/IJOC.1110.0472], <http://joc.journal.informs.org/content/25/1/13.abstract>
- [3] L. BROTCORNE, F. CIRINEI, P. MARCOTTE, G. SAVARD. *An exact algorithm for the network pricing problem*, in "Discrete Optimization", 2011, vol. 8, n<sup>o</sup> 2, pp. 246–258 [DOI : 10.1016/j.DISOPT.2010.09.003]
- [4] L. BROTCORNE, M. LABBÉ, P. MARCOTTE, G. SAVARD. *Joint design and pricing on a network*, in "Operation Research", 2008, vol. 56, pp. 1104-1115 [DOI : 10.1287/OPRE.1080.0617]

- [5] D. CATTARUZZA, N. ABSI, D. FEILLET. *The Multi-Trip Vehicle Routing Problem with Time Windows and Release Dates*, in "Transportation Science", 2016, vol. 50, n<sup>o</sup> 2, pp. 676-693, <https://doi.org/10.1287/trsc.2015.0608>
- [6] 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<sup>o</sup> 1, pp. 110-123, <http://dx.doi.org/10.1002/net.21721>
- [7] B. FORTZ, M. LABBÉ, F. LOUVEAUX, M. POSS. *Stochastic binary problems with simple penalties for capacity constraints violations*, in "Mathematical Programming", 2013, vol. 138, pp. 199-221, <http://dx.doi.org/10.1007/s10107-012-0520-4>
- [8] B. FORTZ, M. THORUP. *Internet Traffic Engineering by Optimizing OSPF Weights*, in "Proc. 19th IEEE Conf. on Computer Communications (INFOCOM)", 2000, pp. 519-528
- [9] S. GARCÍA, M. LABBÉ, A. MARÍN. *Solving large  $p$ -median problems with a radius formulation*, in "INFORMS Journal on Computing", 2011, vol. 23, n<sup>o</sup> 4, pp. 546-556
- [10] B. GENDRON, P.-V. KHUONG, F. SEMET. *A Lagrangian-Based Branch-and-Bound Algorithm for the Two-Level Uncapacitated Facility Location Problem with Single-Assignment Constraints*, in "Transportation Science", 2016, vol. 50, n<sup>o</sup> 4, pp. 1286-1299, <https://doi.org/10.1287/trsc.2016.0692>
- [11] M. LABBÉ, P. MARCOTTE, G. SAVARD. *A bilevel model of taxation and its application to optimal highway pricing*, in "Management science", 1998, vol. 44, n<sup>o</sup> 12-part-1, pp. 1608-1622

## Publications of the year

### Doctoral Dissertations and Habilitation Theses

- [12] L. PORRETTA. *Models and methods in genome wide association studies*, Université libre de Bruxelles, January 2018, <https://hal.inria.fr/tel-01944087>

### Articles in International Peer-Reviewed Journals

- [13] R. ABSIL, E. CAMBY, A. HERTZ, H. MELOT. *A sharp lower bound on the number of non-equivalent colorings of graphs of order  $n$  and maximum degree  $n - 3$* , in "Discrete Applied Mathematics", January 2018, vol. 234, pp. 3-11, <https://hal.inria.fr/hal-01944274>
- [14] E. ALEKSEEVA, L. BROTCORNE, S. LEPAUL, A. MONTMEAT. *A bilevel approach to optimize electricity prices*, in "Yugoslav Journal of Operations Research", 2018 [DOI : 10.2298/YJOR171115002A], <https://hal.inria.fr/hal-01971679>
- [15] Q. BOTTON, B. FORTZ, L. GOUVEIA. *The 2 edge-disjoint 3-paths polyhedron*, in "Annals of Telecommunications - annales des télécommunications", 2018, vol. 73, n<sup>o</sup> 1-2, pp. 29-36 [DOI : 10.1007/s12243-017-0615-2], <https://hal.inria.fr/hal-01673313>
- [16] H. CALVETE, C. DOMÍNGUEZ, C. GALÉ, M. LABBÉ, A. MARÍN. *The Rank Pricing Problem: models and branch-and-cut algorithms*, in "Computers and Operations Research", 2018, <https://hal.inria.fr/hal-01782958>



- [17] E. CAMBY, G. CAPOROSSO, M. PAIVA, M. E. V. SEGATTO. *Expected distance based on random walks*, in "Journal of Mathematical Chemistry", February 2018, vol. 56, n<sup>o</sup> 2, pp. 618-629, <https://hal.inria.fr/hal-01944246>
- [18] D. CATTARUZZA, L. BROTCORNE, F. SEMET, B. TOUNSI. *A three-phase matheuristic for the Packaging and Shipping Problem*, in "Applied Mathematical Modelling", August 2018, vol. 64, pp. 713-732, <https://hal.archives-ouvertes.fr/hal-01959341>
- [19] M. A. D. R. S. CRUZ, H. R. D. O. ROCHA, M. H. M. PAIVA, M. E. V. SEGATTO, E. CAMBY, G. CAPOROSSO. *An algorithm for cost optimization of PMU and communication infrastructure in WAMS*, in "International Journal of Electrical Power and Energy Systems", March 2019, vol. 106, pp. 96-104 [DOI : 10.1016/j.ijepes.2018.09.020], <https://hal.inria.fr/hal-01944258>
- [20] V. DAL SASSO, L. DE GIOVANNI, M. LABBÉ. *Strengthened Formulations and Valid Inequalities for Single Delay Management in Public Transportation*, in "Transportation Science", 2018, <https://hal.inria.fr/hal-01925451>
- [21] J. DE BOECK, B. FORTZ. *Extended formulation for hop constrained distribution network configuration problems*, in "European Journal of Operational Research", March 2018, vol. 265, n<sup>o</sup> 2, pp. 488 - 502 [DOI : 10.1016/j.ejor.2017.08.017], <https://hal.inria.fr/hal-01665624>
- [22] R. FIGUEIREDO, Y. FROTA, M. LABBÉ. *A branch-and-cut algorithm for the maximum k-balanced subgraph of a signed graph*, in "Discrete Applied Mathematics", 2018, <https://hal.inria.fr/hal-01937015>
- [23] B. FORTZ, L. GOUVEIA, M. JOYCE-MONIZ. *Optimal design of switched Ethernet networks implementing the Multiple Spanning Tree Protocol*, in "Discrete Applied Mathematics", January 2018, vol. 234, pp. 114 - 130 [DOI : 10.1016/j.dam.2016.07.015], <https://hal.inria.fr/hal-01665614>
- [24] B. FORTZ, D. PAPADIMITRIOU, M. RESENDE. *Preface: Recent advances in telecommunications networks planning and operation*, in "Networks", March 2018, vol. 71, n<sup>o</sup> 2, pp. 95-96, <https://hal.inria.fr/hal-01943965>
- [25] M. LABBÉ, L. I. MARTÍNEZ-MERINO, A. M. RODRÍGUEZ-CHÍA. *Mixed Integer Linear Programming for Feature Selection in Support Vector Machine*, in "Discrete Applied Mathematics", 2018, <https://hal.inria.fr/hal-01924379>
- [26] L. PORRETTA, D. CATANZARO, B. HALLDÓRSSON, B. FORTZ. *A Branch & Price algorithm for the minimum cost clique cover problem in max-point tolerance graphs*, in "4OR: A Quarterly Journal of Operations Research", June 2018, <https://hal.inria.fr/hal-01943982>
- [27] M. RESTREPO, F. SEMET, T. POCREAU. *Integrated Shift Scheduling and Load Assignment Optimization for Attended Home Delivery*, in "Transportation Science", 2018, <https://hal.inria.fr/hal-01963916>

### Invited Conferences

- [28] L. BROTCORNE. *How to integrate customer's behaviour within pricing*, in "CLAIO 2018 - XIX Latin-Iberoamerican Conference on Operations Research", Lima, Peru, September 2018, <https://hal.inria.fr/hal-01971738>

- [29] M. LABBÉ. *Bilevel optimisation, pricing and Stackelberg problems*, in "Winter School on Network Optimization", Estoril, Portugal, January 2018, <https://hal.inria.fr/hal-01958961>
- [30] M. LABBÉ. *Bilevel Programming: Pricing Problems and Stackelberg Games*, in "IWR Doctoral School on Optimization", Heidelberg, Germany, October 2018, <https://hal.inria.fr/hal-01959004>
- [31] M. LABBÉ. *Stackelberg games and Bilevel Bilinear Optimization Problems*, in "Journées de l'optimisation", Montréal, Canada, May 2018, <https://hal.inria.fr/hal-01958984>
- [32] F. SEMET, E. ALEKSEEVA, L. BROTCORNE, Y. MAGNOUCHE, E. SOUFFLET. *Fleet composition for last-mile delivery service*, in "EURO 2018 - 29th European Conference on Operational Research", Valencia, Spain, July 2018, <https://hal.inria.fr/hal-01964556>
- [33] F. SEMET. *Some logistics and transportation optimization problems in the E-commerce industry*, in "Journées du CIRRELT - 2018", Québec, Canada, May 2018, <https://hal.inria.fr/hal-01964218>

### International Conferences with Proceedings

- [34] S. BELIERES, N. JOZEFOWIEZ, F. SEMET. *A Graph Reduction Heuristic For Supply Chain Transportation Plan Optimization*, in "ODYSSEUS 2018 - Seventh International Workshop on Freight Transportation and Logistics", Cagliari, Italy, June 2018, 4 p. , <https://hal.laas.fr/hal-01876531>
- [35] L. BROTCORNE, D. AUSSEL, L. VON NIEDERHÄUSERN. *A Trilevel Energy Market Model*, in "ISMP 2018 - 23rd International Symposium on Mathematical Programming", Bordeaux, France, July 2018, <https://hal.inria.fr/hal-01971754>
- [36] L. BROTCORNE, S. LEPAUL, L. VON NIEDERHÄUSERN. *Pricing in the energy field*, in "European Conference on Operational Research", Valencia, Spain, July 2018, <https://hal.inria.fr/hal-01971715>
- [37] L. BROTCORNE, A. F. MIGUEL, M. BESANÇON, J. A. GOMEZ-HERRERA. *Demand Response Planner for Building Districts*, in "Informs Annual Meeting", Phoenix, United States, November 2018, <https://hal.inria.fr/hal-01971730>
- [38] S. MICHEL, L. BROTCORNE, D. CATTARUZZA, N. MITTON, F. SEMET. *A heuristic approach for the computation of individual trajectories of a fleet of robots under connectivity constraints*, in "Congrès annuel de la société Française de Recherche Opérationnelle et d'Aide à la Décision (ROADEF)", Lorient, France, February 2018, <https://hal.inria.fr/hal-01704705>
- [39] L. VON NIEDERHÄUSERN, L. BROTCORNE, S. LEPAUL. *A Rolling Horizon Method for a Bilevel Demand Side Management Problem*, in "PGMO Days 2018", Paris, France, November 2018, <https://hal.inria.fr/hal-01971767>
- [40] Y. YUAN, D. CATTARUZZA, M. OGIER, F. SEMET. *The last mile delivery problem*, in "ROUTE 2018 - International Workshop on Vehicle Routing, Intermodal Transportation and Related Areas", Snekersten, Denmark, May 2018, <https://hal.inria.fr/hal-01964234>

### Conferences without Proceedings

- [41] O. BRIANT, H. CAMBAZARD, D. CATTARUZZA, N. CATUSSE, A.-L. LADIER, M. OGIER. *A column generation based approach for the joint order batching and picker routing problem*, in "ROADEF 2018 - 19ème Congrès Annuel de la Société Française de Recherche Opérationnelle et d'Aide à la Décision", Lorient, France, February 2018, pp. 1-2, <https://hal.archives-ouvertes.fr/hal-01765113>
- [42] L. BROTCORNE, Y. MAGNOUCHE, F. SEMET, E. ALEKSEEVA. *A Revenue Management Approach for Attended Home Delivery*, in "The 6th INFORMS Transportation Science and Logistics Society Workshop", Hong-Kong, China, January 2018, <https://hal.inria.fr/hal-01964679>
- [43] S. DAVILA, M. LABBÉ, V. MARIANOV, F. ORDÓÑEZ, F. SEMET. *Bilevel programming models for multi-product location problems*, in "IWOBIP'18 - 2nd International Workshop on Bilevel Programming", Lille, France, June 2018, <https://hal.inria.fr/hal-01964681>
- [44] J. DE BOECK, M. LABBÉ, E. MARCOTTE, P. MARCOTTE, G. SAVARD. *Dynamic programming approach for bidding problems on day-ahead markets*, in "ISMP 2018 - 23rd International Symposium on Mathematical Programming", Bordeaux, France, July 2018, <https://hal.inria.fr/hal-01958995>
- [45] B. FORTZ, L. BROTCORNE, F. D'ANDREAGIOVANNI, J. DE BOECK. *Unit Commitment under Market Equilibrium Constraints*, in "Journées de l'Optimisation 2018", Montréal, Canada, May 2018, <https://hal.inria.fr/hal-01944151>
- [46] B. FORTZ, L. BROTCORNE, F. D'ANDREAGIOVANNI, J. DE BOECK. *Unit Commitment under Market Equilibrium Constraints*, in "ISMP2018 - 23rd International Symposium on Mathematical Programming", Bordeaux, France, July 2018, <https://hal.inria.fr/hal-01944201>
- [47] B. FORTZ, L. BROTCORNE, F. D'ANDREAGIOVANNI, J. DE BOECK. *Unit Commitment under Market Equilibrium Constraints*, in "IWOBIP'18 - 2nd International Workshop on Bilevel Programming", Lille, France, June 2018, <https://hal.inria.fr/hal-01944168>
- [48] B. FORTZ, L. BROTCORNE, F. D'ANDREAGIOVANNI, J. DE BOECK. *Unit Commitment under Market Equilibrium Constraints*, in "ROADEF 2018 - 19ème congré annuel de le société Française de Recherche Opérationnelle et d'Aide à la Décision", Lorient, France, February 2018, <https://hal.inria.fr/hal-01944100>
- [49] W. GU, D. CATTARUZZA, M. OGIER, F. SEMET. *Adaptive large neighborhood search for multicommodity VRP*, in "ROADEF 2018 - 19ème Congrès de la Société Française de Recherche Opérationnelle et d'Aide à la Décision", Lorient, France, February 2018, <https://hal.archives-ouvertes.fr/hal-01940685>
- [50] W. GU, D. CATTARUZZA, M. OGIER, F. SEMET. *Adaptive large neighborhood search for multicommodity VRP*, in "Odysseus 2018 - the Seventh International Workshop on Freight Transportation and Logistics", Cagliari, Italy, June 2018, <https://hal.archives-ouvertes.fr/hal-01951948>
- [51] W. GU, D. CATTARUZZA, M. OGIER, F. SEMET. *Adaptive large neighborhood search for the commodity constrained split delivery VRP*, in "OR 2018 - International Conference on Operations Research", Brussels, Belgium, September 2018, <https://hal.archives-ouvertes.fr/hal-01948464>
- [52] P. NOLZ, N. ABSI, D. CATTARUZZA, D. FEILLET. *Two-echelon distribution with city hub capacity management*, in "Odysseus 2018 - 7th International Workshop on Freight Transportation and Logistics", Cagliari, Italy, June 2018, <https://hal.archives-ouvertes.fr/hal-01966725>

- [53] Y. YUAN, D. CATTARUZZA, M. OGIER, F. SEMET. *A branch-and-cut algorithm for the generalized traveling salesman problem with time windows*, in "OR 2018 - International Conference on Operations Research", Brussels, Belgium, September 2018, <https://hal.archives-ouvertes.fr/hal-01941124>
- [54] Y. YUAN, D. CATTARUZZA, M. OGIER, F. SEMET. *A branch-and-cut algorithm for the generalized traveling salesman problem with time windows*, in "ROADEF 2018 - 19ème Congrès de la Société Française de Recherche Opérationnelle et d'Aide à la Décision", Lorient, France, February 2018, <https://hal.archives-ouvertes.fr/hal-01941090>
- [55] Y. YUAN, D. CATTARUZZA, M. OGIER, F. SEMET. *Last mile delivery problem: the one-vehicle case*, in "Odysseus 2018 - 7th Workshop on Freight Transportation and Logistics", Cagliari, Italy, June 2018, <https://hal.archives-ouvertes.fr/hal-01951934>

### Research Reports

- [56] M. LABBÉ, F. PLEIN, M. SCHMIDT. *Bookings in the European Gas Market: Characterisation of Feasibility and Computational Complexity Results*, Université Libre de Bruxelles (U.L.B.), Belgium, December 2018, <https://hal.inria.fr/hal-01954262>

### Other Publications

- [57] M. BESANÇON, L. BROTCORNE, M. F. ANJOS, J. A. GOMEZ-HERRERA. *Increase in power demand guarantee: a bilevel approach*, May 2018, Optimization days, <https://hal.inria.fr/hal-01971748>
- [58] V. BUCAREY, C. CASORRÁN, M. LABBÉ, F. ORDÓÑEZ, O. FIGUEROA. *Coordinated defender strategies for border patrols*, November 2018, working paper or preprint, <https://hal.inria.fr/hal-01917782>
- [59] M. BUÉ, D. CATTARUZZA, M. OGIER, F. SEMET. *An integrated order batching and picker routing problem*, July 2018, working paper or preprint, <https://hal.archives-ouvertes.fr/hal-01849980>
- [60] H. CALIK, B. FORTZ. *A Benders decomposition method for locating stations in a one-way electric car sharing system under demand uncertainty*, December 2018, working paper or preprint, <https://hal.inria.fr/hal-01962059>
- [61] C. CASORRÁN, B. FORTZ, M. LABBÉ, F. ORDÓÑEZ. *A study of general and security Stackelberg game formulations*, November 2018, working paper or preprint, <https://hal.inria.fr/hal-01917798>
- [62] S. DELEPLANQUE, M. LABBÉ, D. PONCE LOPEZ, J. PUERTO. *A Branch-Price-and-Cut Procedure for the Discrete Ordered Median Problem*, December 2018, working paper or preprint, <https://hal.inria.fr/hal-01954865>
- [63] M. LABBÉ, M. LEAL, J. PUERTO. *New models for the location of controversial facilities: A bilevel programming approach*, November 2018, working paper or preprint, <https://hal.inria.fr/hal-01933601>
- [64] M. LABBÉ, P. MARCOTTE. *Bilevel Network Design*, November 2018, working paper or preprint, <https://hal.inria.fr/hal-01937014>
- [65] M. LABBÉ, M. POZO, J. PUERTO. *Computational comparisons of different formulations for the Bilevel Minimum Spanning Tree Problem*, November 2018, working paper or preprint, <https://hal.inria.fr/hal-01937013>

- [66] H. MARAVILLO, J.-F. CAMACHO-VALLEJO, J. PUERTO, M. LABBÉ. *A market regulation bilevel problem: a case study of the Mexican petrochemical industry*, November 2018, working paper or preprint, <https://hal.inria.fr/hal-01922518>