



CIRRELT

Centre interuniversitaire de recherche
sur les réseaux d'entreprise, la logistique et le transport

Interuniversity Research Centre
on Enterprise Networks, Logistics and Transportation

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www.cirrelt.ca

Journées de l'optimisation 8-10 mai 2017

Optimization Days May 8-10, 2017

**1er Anniversaire du chapitre montréalais de recherche opérationnelle
8 mai 15:30-17:10, salle banque CIBC**

**Operations Research Student Chapter MORSC first anniversary
May 8, 15:30-17:10, room banque CIBC**



The CORS/INFORMS Montréal Operations Research Student Chapter (MORSC) was established in May of 2016 as an inter-university association for students working on Operations Research and Management Science (OR/MS) topics in Montréal. The chapter was created to serve as a hub for knowledge sharing and socializing among students.

It organizes student research seminars, panels, networking events, workshops and tutorials while developing and maintaining an integrated website (www.mtl-students.com) and an [online repository](#) of tutorial videos and learning material. We also keep chapter members up to date via weekly e-mail announcements, and a semi-annual [newsletter](#) that includes interviews with experts, news of upcoming conferences and information on the chapter's activities.

Coming up on a year since its establishment, we have prepared a program in which we review the chapter's story, highlight the year's events, present membership statistics and financial reporting, and have some give-aways to chapter members and attendees. We conclude the event with the following talk by our distinguished guest speaker, **Professor Bernard Gendron**:



Canadian Operational Research Society
Société Canadienne de Recherche Opérationnelle



Activité de Speed Networking 9 mai 15:30-17:00, Salon Deloitte

A la suite du succès du panel « VOUS TERMINEZ VOS ÉTUDES SUPÉRIEURES : QU'EST-CE QUI VOUS ATTEND? », le GERAD, le CIRRELT et la section étudiante Montréalaise de Recherche Opérationnelle ont organisé une activité de Speed Networking. Lors de cette activité, les étudiants aux cycles supérieurs auront l'occasion de discuter avec des représentants de compagnies qui développent des outils basés sur la recherche opérationnelle. Les étudiants en apprendront davantage sur les méthodologies utilisées et sur les logiciels développés. Ils auront également un aperçu des différences entre la recherche académique et la pratique industrielle.

Pour débiter l'activité, chaque représentant présentera la compagnie pour laquelle il travaille et décrira son travail. Puis, les étudiants seront jumelés en équipe. Chaque équipe aura une dizaine de minutes avec chacun des représentants pour une période de questions et réponses. L'activité sera suivie d'un cocktail de réseautage entre les étudiants et les représentants de l'industrie afin d'approfondir les discussions.

Industry Speed-Networking Activity May 9th, 15:30-17:00, Salon Deloitte

As a result of the success of last year's panel "Life after PhD", GERAD, CIRRELT and the Montréal Operations Student Chapter have teamed up again to organize the "Industry speed networking activity". During this activity, graduate students will have the opportunity to discuss with representatives of companies developing and applying OR tools. They will learn of what methodologies and software are being developed and get a peak of how OR is approached in industry versus how it's approached in academia.

The event starts with each representative giving a brief presentation to all participants about their company and what they do. Then, participants will be grouped in small teams. Each team will have approximately ten minutes with each of the representatives for a Q & A exchange. This activity will be followed by a networking cocktail among all participants and industry partners for further discussion and contact information exchange.



1^{er} Atelier Canadien sur l'optimisation des soins de santé (CHOW)

10 et 11 mai 2017, salle Banque Nationale du Canada

Immédiatement après les Journées d'optimisation, se tiendra à HEC Montréal le premier Atelier canadien sur l'optimisation des soins de santé (CHOW). Organisé par la Chaire de recherche du Canada en analytique et logistique de soins de santé et la Chaire de recherche du Canada en analytique et optimisation en santé, et sous le parrainage du CIRRELT et du Centre pour l'ingénierie des soins de santé de l'Université de Toronto, cet atelier vise à fournir un forum pour les chercheurs travaillant dans l'optimisation des soins de santé et ceux qui s'y intéressent, leur permettant de réseauter et d'apprendre les dernières avancées dans le domaine.

L'atelier comprendra une séance plénière et sept exposés magistraux portant sur une sélection de méthodes d'optimisation avancées et modernes appliquées aux soins de santé. Le programme détaillé est disponible sur le site suivant: <https://symposia.cirrelt.ca/JOPT/fr/Programmesante>

1st Canadian Healthcare Optimization Workshop (CHOW)

May 10-11, 2017, Room Banque Nationale du Canada

Immediately following Optimization Days, the first Canadian Healthcare Optimization Workshop (CHOW) will be held at HEC Montreal, organized by Canada Research Chair in Healthcare Analytic and Logistics and Canada Research Chair in Novel Optimization and Analytics in Health, with sponsorship from CIRRELT and the Centre for Healthcare Engineering at the University of Toronto. This workshop aims to provide a forum for researchers working in healthcare optimization, or those who are interested in getting into the area, to network with other researchers and learn about the latest advances in the field.

The workshop will include one plenary talk and seven tutorial-like sessions covering a selection of advanced, modern optimization methods applied to healthcare. For the program, visit:

<https://symposia.cirrelt.ca/JOPT2017/en/Programmesante>



Instructions aux participants et aux présidents de séances

La durée de chaque présentation est fixée à 25 minutes. Nous vous demandons de prévoir un exposé d'environ 20 minutes pour permettre les questions des participants.

Si vous présidez une séance, assurez-vous de faire respecter l'horaire en indiquant périodiquement aux auteurs le temps qui leur est encore alloué pour compléter leur exposé. De plus, si un auteur n'est pas présent, nous vous demandons de laisser passer les 25 minutes normalement prévues. Ces mesures permettront aux participants de se déplacer d'une salle à l'autre, s'ils le désirent, pour assister à des exposés dans des séances différentes.



Instructions to Participants and Session Chairs

Each talk should last 25 minutes. We ask you to prepare for about 20 minutes to allow questions from the audience.

If you act as chairperson, we ask you to adhere to the schedule:

- periodically inform each author of the time remaining to complete his (her) talk;
- in case of no show, take a 25 minute-break before moving to the next talk.

These measures will allow people to move freely between sessions.

Résumé du programme / Program Outline

Lundi 8 mai / Monday, May 8

Heure / Hour	Séance / Session	Salle / Room
08h00 – 08h45	Inscriptions / Registration and e-mail facilities	Tata Communications
	Petit déjeuner / Breakfast	Investissement Québec
08h45 - 09h00	Séance d'ouverture / Opening Session	Amphi. Banque Nationale
09h00 - 10h00	Séance plénière / Plenary Session – Iris Vis	Amphi. Banque Nationale
10h00 - 10h30	Pause-café / Coffee Break	Investissement Québec
10h30 - 12h10	Exposé magistral / Tutorial – Jean-François Cordeau	Banque CIBC
	Séances en parallèle / Parallel Sessions	1 ^{er} étage
12h10 - 14h00	Pause / Break	
14h00 – 15h00	Séance plénière / Plenary Session – Kees Jan Roodbergen	Amphi. Banque Nationale
15h00 - 15h30	Pause-café / Coffee Break	Investissement Québec
15h30 - 17h10	Anniversaire du Chapitre étudiant de Montréal / Montreal Operations Research Student Chapter Anniversary – Bernard Gendron	Banque CIBC
	Séances en parallèle / Parallel Sessions	1 ^{er} étage
17h15 – 21h00	Réception vins et fromages / Wine and Cheese Party	Salon l'Oréal

Mardi 9 mai / Tuesday, May 9

08h00 – 09h00	Inscriptions / Registration	Tata Communications
	Petit déjeuner / Breakfast	Investissement Québec
09h00 – 10h00	Séance plénière / Plenary Session – Katya Scheinberg	Amphi. Banque Nationale
10h00 – 10h30	Pause-café / Coffee Break	Investissement Québec
10h30 – 12h10	Exposé magistral / Tutorial – Emma Frejinger	Banque CIBC
	Séances en parallèle / Parallel Sessions	1 ^{er} étage
12h10 – 14h00	Pause / Break	
14h00 – 15h00	Séance plénière / Plenary Session – Meinolf Sellmann	Amphi. Banque Nationale
15h00 – 15h30	Pause-café / Coffee Break	Investissement Québec
15h30 – 17h10	Exposé magistral / Tutorial – Julien Darlay	Banque CIBC
	Séances en parallèle / Parallel Sessions	1 ^{er} étage
	Activité de Speed Networking / Speed-Networking Activity	Salon Deloitte
17h10– 19h00	Cocktail Speed-Networking (inscrits seulement / registered only)	Salon Deloitte

Mercredi 10 mai / Wednesday, May 10

08h00 – 09h00	Petit déjeuner / Breakfast	Investissement Québec
09h00 - 10h00	Séance plénière / Plenary Session – Brian Denton	Amphi. Banque Nationale
10h30 – 12h10	Exposé magistral / Tutorial – Timothy Chan	Banque CIBC
	Séances en parallèle / Parallel Sessions	1 ^{er} étage

Emplacement des activités

- Toutes les activités se dérouleront à HEC Montréal, 3000 chemin de la Côte-Sainte-Catherine
- L'entrée Louis-Colin est accessible à partir de la station de métro Université-de-Montréal

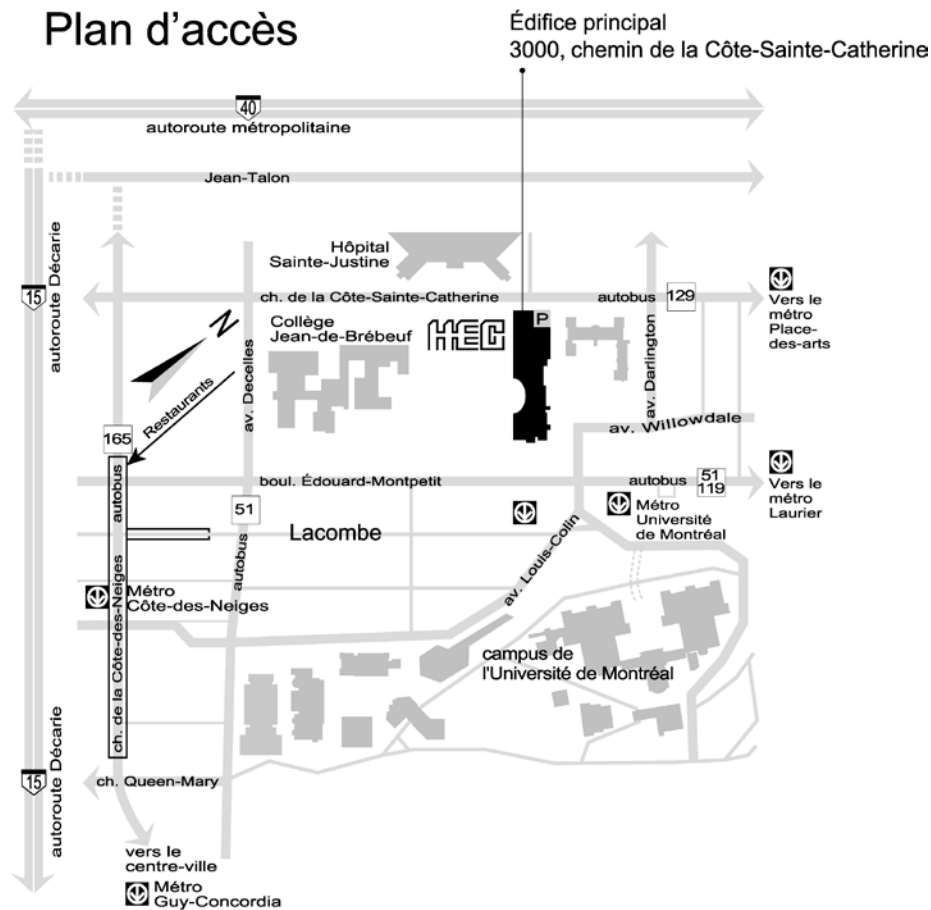
Inscriptions	Salle Tata Communications, en face de l'amphithéâtre Banque Nationale (rez-de-jardin)
Petits déjeuners et pauses-café	Salle Investissement Québec, adjacente à l'amphithéâtre Banque Nationale (rez-de-jardin)
Réception vins et fromages	Salon l'Oréal (rez-de-jardin)
Cocktail Speed-Networking	Salon Deloitte (4 ^e étage, section bleue)
Séances plénières	Amphithéâtre Banque Nationale (rez-de-jardin)
Exposés magistraux	Salle Banque CIBC (1 ^{er} étage, section verte)
CHOW	Banque de développement du Canada (1 ^{er} étage, section bleue)
Toutes les autres séances	1 ^{er} étage (section verte)

Location of Activities

- All activities take place at HEC Montréal, 3000 chemin de la Côte-Sainte-Catherine
- The Louis-Colin entrance can be reached from the Université-de-Montréal metro station

Registration	Tata Communications Room, across from Banque Nationale Lecture Hall (Garden level)
Breakfasts and coffee breaks	Investissement Québec Room, beside Banque Nationale Lecture Hall (Garden level)
Wine and Cheese Party	L'Oréal Room (Garden level)
Networking Cocktail	Deloitte Room (4 th floor, blue section)
Plenary sessions	Banque Nationale Lecture Hall (Garden level)
Tutorials	Salle Banque CIBC (1 st floor, green section)
CHOW	Banque de développement du Canada (1 st floor, blue section)
All other sessions	1 st floor (green section)

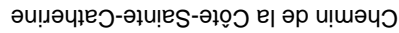
Plan du quartier / Area Map



On peut trouver des restaurants sur la rue Lacombe (entre Decelles et Côte-des-Neiges) et sur le chemin Côte-des-Neiges. On peut également déjeuner au Cercle HEC (club facultaire, avec réservation seulement) au 6^e étage ou à la cafétéria de HEC Montréal (rez-de-jardin).

Restaurants can be found on Lacombe Street (between Decelles and Côte-des-Neiges) and on Côte-des-Neiges Road. Lunch can also be obtained at the Cercle HEC (Faculty Club, with reservation only) on the 6th floor or in HEC Montréal cafeteria (garden level).

HEC Montréal
3000, chemin de la Côte-Saint-Catherine
Montréal QC H3T 2A7



Programme / Program

Lundi 8 mai 201 / Monday, May 8, 2017

08h45 Amphithéâtre Banque Nationale : Séance d'ouverture

MA1 Séance plénière 1 / Plenary Session 1

Salle: Amphithéâtre Banque Nationale
Président: Coelho, Leandro, Université Laval

09h00 Future Port Operations - New Research Challenges

Vis, Iris, i.f.a.vis@rug.nl

Worldwide, container terminal operators continuously work on improving operational processes to increase efficiency and to remain competitive. More and more massive volumes of containers arrive at the same time in ports requiring the design of new technologies and tools to ensure an efficient unloading and loading process of vessels. In this keynote, an overview of operations in container terminals will be presented. Models and solution approaches will be shown for a variety of decision problems occurring at the berth, storage yard and international transportation processes. A discussion on new avenues for academic research based on current trends and technological developments will be provided.

MB1 Exposé magistral 1 / Tutorial 1

Salle: Banque CIBC
Président: Rekik, Monia, Université Laval

10h30 Recent (and not so Recent) Advances in Benders Decomposition

Cordeau, Jean-François, HEC Montréal, jean-francois.cordeau@hec.ca

Benders decomposition is a mathematical decomposition technique designed to solve large-scale linear and mixed-integer programs comprising two sets of variables such that a more tractable subproblem is obtained when the values of some "complicating" variables are fixed. The technique works by projecting the original problem on the space of the complicating variables, and by using a cutting plane method where cuts are generated by solving the subproblem. In the 55 years following its introduction by Jacques F. Benders in 1962, the approach has been applied successfully to a wide variety of problems arising, among others, in supply chain management, transportation, telecommunications, and energy management. Despite its success, however, it has long remained less well known than dual decomposition methods such as Lagrangian relaxation and Dantzig-Wolfe decomposition. Over the last decade, one has witnessed a renewed interest in Benders decomposition with the introduction of several novel ideas that improve performance. The purpose of this tutorial is to introduce the basic Benders decomposition methodology, to present several acceleration techniques, and to survey recent advances. Applications to network design problems will also be discussed.

MB2 Intégration de niveaux de décision 1 / Decision Level Integration 1

Salle: Gérard-Parizeau
Président: Aloise, Daniel, École Polytechnique de Montréal

- 10h30 Short- and Medium-Term Scheduling Optimization for Underground Mines**
Campeau, Louis-Pierre, Polytechnique Montréal, louis-pierre.campeau@gerad.ca
Gamache, Michel, Polytechnique Montréal, michel.gamache@polymtl.ca
- Applications of operations research to short-term underground mine scheduling are very few, mostly because of the complexity and specificity of its constraints. This presentation will discuss the advances made with a model for short- and medium-term scheduling in large underground mines. The results of the model application to real-world and fictional data sets will also be explained. Comments on future work and possibilities in this field will conclude the presentation.
- 10h55 Metaheuristics for Integrated Production Scheduling, Express Material Deliveries, and Outbound Distribution**
Thevenin, Simon, HEC Montréal, simon.thevenin@hec.ca
Zufferey, Nicolas, University of Geneva, N.Zufferey@unige.ch
Glardon, Rémy, École Polytechnique Fédérale de Lausanne, remy.glardon@epfl.ch
- We propose metaheuristics to optimize the short-term production planning and scheduling at a fast-moving consumer good company. The proposed approach integrates multiple decisions. More precisely, it finds the size of the production lots; provides a detailed production schedule; triggers the express deliveries of raw materials; and manages the production distribution.
- 11h20 Models and Methods for an Integrated Load Plan Design and Vehicle Routing Problem**
Lehuédé, Fabien, IMT-Atlantique - LSN, fabien.lehuede@imt-atlantique.fr
Medina, Juliette, CRC-Services, j.medina@4snetwork.com
Hewitt, Mike, Loyola University Chicago, mhewitt3@luc.edu
Péton, Olivier, École des Mines de Nantes, olivier.peton@emn.fr
- The distribution of goods in large structured networks is generally organized in two layers: (i) a long haul network, made of logistics hubs and terminals, and (ii) a local distribution network between a terminal and its associated customers. The routing of goods in long haul networks is studied in the field of service network design and, more precisely, load plan design. Local distribution deals with solving vehicle routing problems. We consider a case where meeting the delivery deadline is particularly hard which motivates the joint design of load plans and local delivery routes. We present models to solve this problem as a continuous time service network design.
- 11h45 A Bi-Objective Approach for Integrating Vehicle Routing Operations into Tactical Clustering Decisions**
Aloise, Daniel, Polytechnique Montréal, daniel.aloise@gerad.ca
Rocha, Diego, IFRN-Ceará, drlima7@gmail.com
Aloise, Dario J., Universidade do Estado do Rio Grande do Norte, aloisedj@gmail.com
Contardo, Claudio, Université du Québec à Montréal, claudio.contardo@gerad.ca
- In this work we consider a bi-objective vehicle routing problem in which, in addition to the classical minimization of the total routing cost, the operator is also required to minimize the maximum diameter of the routes, this is the maximum distance between any two customers serviced within the same route. This problem arises in multiple practical applications. In addition to the problem description, we provide a formal linear-integer formulation of the problem and an ad-hoc constraint method capable of handling small-size problems. We also introduce a variable neighborhood search-based algorithm for the solution of larger problems. Finally, we provide a critical analysis of the results obtained after executing our algorithm on some classical instances of the capacitated vehicle routing problem.

MB3	Méthodes exactes pour les problèmes de transport / Exact methods for routing problems <hr/> Salle: Marie-Husny Président: Martinelli, Rafael, PUC-Rio
10h30	A Comparison of Formulations for the Three-Level Lot Sizing and Transportation Problem Gruson, Matthieu , HEC Montréal, matthieu.gruson@hec.ca Cordeau, Jean-François , HEC Montréal, jean-francois.cordeau@hec.ca Jans, Raf , HEC Montréal, raf.jans@hec.ca <p>In this talk we will present several MIP formulations to solve the three-level lot sizing and transportation problem. The formulations are either adapted from the two-level lot sizing literature or new. The results of extensive computational experiments will be given to compare the performance of each formulation.</p>
10h55	A Branch-and-Cut Algorithm for the Routing and Refueling Station Location Problem Arslan, Okan , HEC Montreal, okan.arslan@hec.ca Karasan, Oya , Bilkent University, karasan@bilkent.edu.tr Mahjoub, A.Ridha , Université Paris Dauphine, mahjoub@lamsade.dauphine.fr Yaman, Hande , Bilkent University, hyaman@bilkent.edu.tr <p>We introduce a novel model for the routing and refueling station location problem for alternative fuel vehicles and develop a branch-and-cut algorithm as an exact solution methodology. Computational experiments show that the algorithm improves solution times by orders of magnitude with respect to previously developed models and methods.</p>
11h20	Exact Methods for the Time Window Assignment Vehicle Routing Problem Dalmeijer, Kevin , Erasmus University Rotterdam, kevindalmeijer@gmail.com Desaulniers, Guy , Polytechnique Montreal, guy.desaulniers@gerad.ca <p>We consider the Time Window Assignment Vehicle Routing Problem (TWAVRP), the problem of assigning time windows for delivery before demand volume becomes known. We consider both branch-and-cut and branch-price-and-cut algorithms to solve this problem to optimality. The algorithms are compared on their performance on a set of test-instances.</p>
11h45	Exact and Heuristic Algorithms for a Industrial and Tramp Ship Routing and Scheduling Problem Martinelli, Rafael , Pontifícia Universidade Católica do Rio de Janeiro, martinelli@puc-rio.br Homsi, Gabriel , Pontifícia Universidade Católica do Rio de Janeiro, ghomsi@inf.puc-rio.br Vidal, Thibaut , Pontifícia Universidade Católica do Rio de Janeiro, vidalt@inf.puc-rio.br <p>We tackle a ship routing problem which extends the Pickup and Delivery Problem with Time Windows with heterogeneous fleet, compatibility constraints and different ship starting points. We propose a Hybrid Genetic Search with Advanced Diversity Control and a column generation algorithm. Our experiments show the good performance of the methods.</p>

MB4 Design de réseaux / Network Design

Salle: Meloche Monnex

Président: Zetina, Carlos, Université Concordia

10h30 A Two-Stage Robust Approach for the Reliable Logistics Network Design Problem

Cheng, Chun, Polytechnique Montreal, tsinghuauniversity.chengchun@gmail.com

Zhang, Ying, yingzhang8996@gmail.com

Qi, Mingyao, Tsinghua University, gimy@sz.tsinghua.edu.cn

Rousseau, Louis-Martin, Polytechnique Montreal, louis-martin.rousseau@cirrelt.net

This paper examines a three-echelon logistics network in which all supply and transshipment nodes are subject to disruptions. Uncertainty sets are employed to describe the concerned possible scenarios without depending on probabilistic information. We adopt a two-stage robust optimization approach where location decisions are made before and recourse decisions are made after disruptions being revealed. Three related two-stage robust models are constructed, which are solved exactly by a column-and-constraint generation algorithm. Numerical tests demonstrate that the proposed algorithm outperforms the Benders decomposition method in both solution quality and computational time, and that the system's reliability can be gradually improved with only a slight increase in normal cost.

10h55 Branch-and-cut methods for the Network Design Problem with Vulnerability Constraints

Joyce-Moniz, Martim, Polytechnique Montréal, mjoycemoniz@gmail.com

Gouveia, Luis, University of Lisbon, legouveia@fc.ul.pt

Leitner, Markus, University of Vienna, markus.leitner@univie.ac.at

The Network Design Problem with Vulnerability Constraints imposes resilience against failures and bounds on the lengths of each communication path. When solving the state-of-the-art formulations in CPLEX, we cannot solve most instances based on large-sized networks. Therefore, we propose branch-and-cut methods that greatly improve the efficiency of solving this problem.

11h20 Design of Green Food Systems under Nutritional Considerations

Rohmer, Sonja, sonja.rohmer@wur.nl

Gerdessen, J.C., joke.vanlemmen@wur.nl

Claassen, G.D.H. (Frits), frits.claassen@wur.nl

This research aims to propose an integrated network design problem for the global food system, incorporating production and consumption decisions within one common framework. Including sourcing, processing and transportation aspects, the developed model optimises both cost and environmental objectives and investigates possible trade-offs and shifts in environmental burdens.

11h45 A Benders Based Algorithm for the Uncapacitated Multicommodity Network Design Problem

Zetina, Carlos, Université Concordia, czet_88@hotmail.com

Contreras, Ivan, Université Concordia, icontrer@encs.concordia.ca

Cordeau, Jean-François, HEC Montréal, jean-francois.cordeau@hec.ca

In this study, we present a novel exact algorithm for the uncapacitated multicommodity network design problem. Our algorithm combines the use of a modified Benders reformulation of the model, bound strengthening and heuristics to obtain primal bounds. We analyze the performance of the algorithm on benchmark instances and compare them with current solution methods.

Salle: Nancy et Michel-Gaucher
Président: Sarrazin, François, Université Laval

10h30 Development of an Economically Sustainable and Balanced Tactical Forest Management Plan: A Case Study in Quebec

Mobtaker, Azadeh, École de technologie supérieure, azadeh.mobtaker.1@ens.etsmtl.ca
Ouhimmou, Mustapha, École de technologie supérieure,
Mustapha.Ouhimmou@etsmtl.ca
Rönnqvist, Mikael, Université Laval, mikael.ronnqvist@gmc.ulaval.ca
Paquet, Marc, École de technologie supérieure, marc.paquet@etsmtl.ca

We study the tactical forest management problem and aim to avoid “creaming” of the forest resources over long period. We propose a goal programming model and solve it for a Canadian case. Results show the proposed model outperforms conventional cost minimization strategy by ensuring a balanced use of wood supply over a longer period.

10h55 Implementation of a Logistical Center: Costs, Benefits and Deployment

Sarrazin, François, Université Laval, francois.sarrazin@forac.ulaval.ca
LeBel, Luc, Université Laval, luc.lebel@sbfl.ulaval.ca
Lehoux, Nadia, Polytechnique Montréal, nadia.lehoux@polymtl.ca

The objective of this research project is to choose the optimal site for the establishment of a logistical center comprising a sort yard and transportation coordination in the Mauricie region of the province of Quebec, Canada. To achieve this, we are proposing a profit maximization model for a forest products supply chain which can include a yard specifically dedicated to sorting while making possible the combining of different deliveries to diminish empty transportation returns.

11h20 Un nouveau modèle pour la planification forestière spatiale avec des contraintes d'adjacence

Gharbi, Chourouk, Université Laval, chourouk.gharbi.1@ulaval.ca

L'objet de la planification forestière spatiale consiste à décider le lieu et le moment de récolter le bois d'une manière qui permet de satisfaire la demande en bois en tenant en considération des aspects spatiaux et environnementaux (Rönnqvist et al. 2015). Les restrictions spatiales sont représentées dans la littérature par principalement deux approches soit l'URM (unit restriction model) et l'ARM (area restriction model). Il a été prouvé que l'approche ARM est plus complexe de point de vue modélisation, cependant elle fournit des résultats plus performants. Les chercheurs ont recours à plusieurs approches de résolutions telles que les méthodes exactes, les méta-heuristiques et la simulation. Cependant, il existe encore des défis de modélisation et de résolution des problèmes de la planification forestière spatiale (Rönnqvist et al. 2015). L'objectif de notre projet est de proposer une nouvelle méthodologie qui permettrait de formuler et de résoudre le problème de la planification forestière tactique en considérant des restrictions spatiales.

11h45 Forest Biomass Value Chain Design- case study in Newfoundland

Abasian, Foroogh, Foroogh.Abasian@cirrelt.ca

We address the network design problem in the Canadian forest industry context to maximize its fiber value. Several assortments including sort yards and biorefineries have been introduced to the network to create higher value from existing supply. New assortments affects network flows and consequently all tactical decisions including harvesting, purchasing, transportation (direct or backhaul), sorting and operating. Hence, our goal is to

design a forest network taking into account tactical decisions in a collaborative environment. We develop a mixed integer linear programming for defined problem. A real case study of Newfoundland forest industry validates the developed model. The result of optimization shows supply management, value creation and collaboration create the improvement up to 29% for the entire network.

MB6 Problèmes de transport multi-attributs / Multi-Attribute Vehicle Routing Problems

Salle: CPA du Québec

Président: Gouveia, Luis, University of Lisbon

10h30 A Matheuristic for Assembly, Production and Inventory Routing Problems

Chitsaz, Masoud, HEC Montréal, masoud.chitsaz@cirrelt.net

Cordeau, Jean-François, HEC Montréal, jean-francois.cordeau@hec.ca

Jans, Raf, HEC Montréal, raf.jans@hec.ca

We introduce and formulate the assembly routing problem (ARP). We propose a three-phase matheuristic to solve not only the the ARP, but also the PRP and the IRP. We obtained 818 new best known solutions out of 2,628 standard IRP and PRP test instances.

10h55 A Variable MIP Neighborhood Descent Algorithm for an ATM Inventory Routing Problem

Coelho, Leandro C., Université Laval, leandro.coelho@cirrelt.ca

Larrain, Homero, PUC, homero@ing.puc.cl

We introduce the variable MIP neighborhood descent algorithm, a general-purpose algorithm which takes advantage of the MIP formulation of a problem to speed up the solution of a branch-and-cut algorithm. We test this algorithm on an inventory routing problem arising when replenishing a network of ATMs.

11h20 Multiple Depot Vehicle Scheduling Problem with controlled trip shifting

Desfontaines, Lucie, Polytechnique Montréal, lucie.desfontaines@polymtl.ca

Desaulniers, Guy, Polytechnique Montreal, guy.desaulniers@gerad.ca

We are interested in improving the classical Vehicle Scheduling problem with multiple depots by allowing a slight modification of departure schedules. By shifting some trips one can indeed expect to cover all trips with fewer vehicles and/or less expensive transit connexions. However, reducing operational costs this way should not be detrimental to the overall quality of departure schedules. Therefore our model controls these three criterions: the number of shifted trips, the interval between two same-line consecutive trips and the quality of passenger's connexions. In order to solve this problem we propose two column generation based algorithms: an exact one and a heuristic one. We also apply several graph reductions which allow solving larger instances. Tests on real urban data show that slightly shifting some trips can yield to a significant reduction in the number of vehicles used.

11h45 New Path Elimination Constraints for Multi-Depot Routing Problems

Gouveia, Luis, University of Lisbon, legouveia@fc.ul.pt

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Santos, Daniel, Universidade de Lisboa, drsantos@fc.ul.pt

Multi-depot routing problems arise in distribution logistics where a set of vehicles based at several depots are used to serve a number of clients. Most variants of this problem have the basic requirement that the route of each vehicle starts and ends at the same depot. This talk

describes new inequalities, namely multi-cut constraints (MCC), for multi-depot routing problems that enforce this requirement. The MCCs are exponential in size, and are equivalent to a compact three-index formulation for the problem in terms of the associated linear programming relaxations. In the talk we describe how a generalization of the MCCs can be obtained, in a similar manner, by using a stronger version of the three-index formulation. The connection between the compact and the exponential formulations implies a separation procedure based on max-flow/min-cut computations, which has reduced complexity in comparison with a previously known set of constraints described for the same purpose. The new inequalities are used in a branch-and-cut algorithm. Computational results with instances with 200 clients and up to 20 depots indicate that the algorithm is able to optimally solve the instances generally within a few hundred seconds of computation time.

MB7 Planification et gestion des opérations hydroélectriques 1 / Hydropower Operations Planning and Management 1

Salle: St-Hubert

Président: Séguin, Sara, Université Laval

10h30 An Effective Neighborhood Search for Short-Term Planning of Large-Scale Hydropower Systems

Marchand, Alexia, Polytechnique Montréal, alexia.marchand@polymtl.ca

Gendreau, Michel, Polytechnique Montréal, Michel.Gendreau@cirrelt.ca

Blais, Marko, Hydro-Québec, blais.marko@hydro.qc.ca

Émiel, Grégory, Hydro-Québec, emiel.gregory@hydro.qc.ca

Short-term hydro-generation scheduling aims at minimizing the energy consumption for the next 7 to 15 days on an hourly basis, while satisfying the electrical load as well as operational, regulatory and safety requirements, such as dams safety, grid operations, electrical reliability, units start-ups and shut-downs, flood control, environmental, recreational and maintenance constraints. In an ever-changing environment, planners need to take decisions quickly and often adapt their schedules to new conditions. They need a tool that is fast, reactive, and flexible. We present an effective neighborhood search with new neighborhood structures that quickly provides near-optimal solutions for short-term planning of Hydro-Québec's production system, one of the largest in the world. It can handle multi-objective problems, non-linear and non-convex constraints, as well as unfeasible solutions. We give numerical results on real instances of Hydro-Québec that also consider the wind and small hydro-generation plants.

10h55 Numerical Methods for Solving Mid-Term Hydropower Optimization with Stochastic Dynamic Programming

Demeester, Kenjy, Polytechnique Montréal, kenjy.dem@gmail.com

Côté, Pascal, Rio Tinto, Pascal.Cote@riotinto.com

Orban, Dominique, Polytechnique Montréal, dominique.orban@gerad.ca

In this talk, we present new strategies to reduce the computation time required to optimize hydropower systems management with stochastic dynamic programming (SDP). In the SDP algorithm, the original problem is decomposed as a sequence of small scale nonlinear subproblems. Based on the concavity of the hydropower production functions, which can be accurately estimated by linear approximation, we demonstrate the benefits of using a successive linear programming (SLP) algorithm. We compare the SLP algorithm with other state-of-the-art nonlinear optimization solvers and the numerical results show that the computation time can be reduced significantly without loss of accuracy.

11h20 Scheduling Generator Maintenance Outages in Hydropower Systems

Rodriguez, Jesus, Polytechnique Montreal, rodriguez@ingenieros.com
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Desaulniers, Guy, Polytechnique Montreal, guy.desaulniers@gerad.ca
Côté, Pascal, Rio Tinto, Pascal.Cote@riotinto.com

In the power industry, maintenance of generators is essential for the economic and reliable system operation. Particularly in hydroelectric systems, scheduling of maintenance outages is affected by non-linearities of the power production function and uncertain water inflows. In this talk we present model formulations and solution approaches for this problem.

MB8 Applications en santé / Healthcare Applications

Salle: TAL Gestion globale d'actifs inc.

Président: Sabouri, Alireza, University of Calgary

10h30 Middleware et la E-santé - Application et adaptation pour le Maroc

El Yassini, Khalid, Université Moulay Ismail, Khalid.ElYassini@gmail.com
Oufaska, Kenza, Université Internationale de Rabat, Kenza.Oufaska@gmail.com

L'Internet des Objets (IoT) se base sur un ensemble de technologies et de sous-systèmes qui doivent être interconnectés et interfacés les uns avec les autres en temps réel en adoptant des normes adéquates pour la mesure, la communication, l'intégration, l'interopérabilité et le contrôle. Parmi les solutions axées sur l'interopérabilité, il convient de mentionner les middlewares. Un middleware ou intergiciel est un logiciel tiers qui crée un réseau d'échange d'informations entre différentes applications informatiques. Dans cet article, nous allons nous concentrer sur les défis middleware, rechercher les fonctionnalités qu'un middleware peut offrir pour la couche application dans les systèmes sur lesquels se base IoT dans le monde de la santé et enfin proposer une architecture pour intégrer les middlewares dans l'internet des objets.

10h55 Hospitals' Food Supply Chain Management: A Multi-Objective Dynamic Programming Approach

Mafakheri, Fereshteh, Concordia University, f.mafakheri@concordia.ca

Management of food supply chains for hospitals is a critical task due to varied technical, regulatory, and dietary requirements. We propose a two-stage multi-objective dynamic programming approach to formulate the hospitals' food supply chain management. We consider inpatients dietary requirements, health and safety standards, and waste management guidelines as constraints.

11h20 Operating Room Scheduling with Downstream Constraints

Augustin, Arnaud, Polytechnique Montréal, arnaud.augustin@polymtl.ca

This project aims at developing a decision support system for the scheduling of the Sainte-Justine hospital's operating block. Improving its efficiency is synonym of better quality care and of substantial economies. Moreover, the intensive care unit imposes downstream constraints that must be taken into account so as to avoid cancellations.

11h45 Issuing Policies for Hospital Blood Inventory

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Huh, Tim, University of British Columbia, tim.huh@sauder.ubc.ca
Shechter, Steven, University of British Columbia, steven.shechter@sauder.ubc.ca

We propose a model for allocating red blood cells for transfusion to patients, which is motivated by recent evidence suggesting that transfusing older blood is associated with

increased mortality rate. We study the properties of blood issuance policies that balance the trade-off between “quality” measured in average age of blood transfused and “efficiency” measured in the amount of shortage. Based on our analysis, we design efficient issuance policies and evaluate their performance.

MC1 Séance Plénière 2 / Plenary Session 2

Salle: Amphithéâtre Banque Nationale
Président: Coelho, Leandro, Université Laval

14h00 Warehouse Logistics: Past, Present and Future

Roodbergen, Kees Jan, University of Groningen, k.i.roodbergen@rug.nl

Warehouses play an important role in supply chains, for example by grouping products from different suppliers for combined shipment to the final customer. Especially in the context of e-commerce, the design of warehouse processes is challenging. Many logistics processes in warehouses can be formulated as Operations Research problems. Some of these problems are very specific to the warehousing context, but other problems prove to be special cases or interesting variants of more general OR problems. For example, the (Stochastic) Traveling Salesman Problem is well-known, and it also arises in warehouses. But interestingly, in the warehousing context, it is not only relevant to find a tour to visit the "cities", but it is also possible to change the locations of the "cities" to further reduce travel times. In this presentation, first a brief historical context on Operations Research in warehouses is provided. Secondly, recent advancements are highlighted, and finally ideas on future research directions are provided.

MD1 Anniversaire du Chapitre étudiant de Montréal en Recherche Opérationnelle / Montreal Operations Research Student Chapter anniversary

Salle: Banque CIBC
Président: Zetina, Carlos, Université Concordia

15h30 Network Design and Facility Location in Transportation

Gendron, Bernard, Université de Montréal, bernard.gendron@cirrelt.ca

In this talk, I will give an overview of the applications in transportation of network design and facility location models. In particular, I will present three research projects I am involved in that illustrate typical applications. The first one comes from the forest industry and concerns the location of logging camps for workers. The second one focuses on the location of vehicle inspection facilities, taking into account the allocation of patrols. The third one is a facility location problem for an express package delivery company.

MD2 Intégration de niveaux de décision 2 / Decision Level Integration 2

Salle: Gérard-Parizeau
Président: Nassief, Wael, Université Concordia

15h30 Improving Airline Crew Satisfaction by Considering Flight Preferences in the Crew Pairing Problem

Quesnel, Frédéric, Polytechnique Montréal, frederic.quesnel@gerad.ca

The airline crew scheduling problem is studied by many researchers. Usually, the problem is divided in two steps: the crew pairing problem (CPP) and the crew rostering problems

(CRP). While the goal of the CPP is to find feasible pairings at minimum cost, the CRP aims at finding a feasible schedule that satisfy as many employee preferences (preferred airlegs, vacations, etc.) as possible. The main challenge with this approach is that the pairings generated by the CPP may not be suitable for the objective of the CRP. For instance, typical solutions to the CPP contain very few pairings with multiple airlegs preferred by a single crew member, limiting the total number of preferences that can be granted. In order to create pairings that are more compatible with the CRP, we propose a new mathematical formulation for the CPP that favors pairings containing multiple airlegs that are preferred by a single crew member. We show how such model can be solved with column generation, using shortest path problems with resource constraints as subproblems. Finally, we present results showing the effectiveness of our method.

15h55 **Integrated Bus Driver Rostering and Days off Scheduling**

Er-Rbib, Safae, Polytechnique Montréal, safae.errbib@gmail.com

We consider the problem of assigning duties and days off simultaneously to bus driver rosters in order to balance as much as possible the weekly working time among the rosters while satisfying various working rules concerning mostly the rest periods between two working days, and the number of days off per week. We model this problem as an integer program and we report computational results obtained on real-world instances.

16h20 **The Container Scheduling and Cross-Dock Door Selection Problem**

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Guignard, Monique, University of Pennsylvania, guignard_monique@yahoo.fr

Hahn, Peter, University of Pennsylvania, petermhahn@gmail.com

Jaumard, Brigitte, Concordia University, bjaumard@ciise.concordia.ca

In this talk, we introduce an integrated scheduling and selection problem that is motivated by a cross-docking application. The daily decisions of scheduling containers and selecting dock doors to unload these containers are carried out simultaneously. The objective is to minimize the total weighted tardiness cost resulting from scheduling containers plus the total labor cost resulting from selecting dock doors to unload containers. We introduce two integer programming models for static and dynamic environments. Computational experiments show that our new static model significantly outperforms the best existing one, and the dynamic one is able to solve real life instances optimally in a reasonable time.

MD3 **Optimisation combinatoire 1 / Combinatorial Optimization 1**

Salle: Marie-Husny

Président: Himmich, Ilyas, Polytechnique Montréal

15h30 **Optimal Design of Data Centers**

Camby, Eglantine, Université Libre de Bruxelles, ecamby@ulb.ac.be

Caporossi, Gilles, HEC Montréal, gilles.caporossi@gerad.ca

We present our current research on data centers design. Our goal is to find a network on 64 vertices with a small average distance and a bounded maximum degree, and some robustness properties. First, we establish some mathematical properties and then we find some interesting candidates by optimization.

15h55 **Integer Column Generation using Decomposition**

Tahir, Adil, Polytechnique Montréal, adil.tahir@polymtl.ca

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Desaulniers, Guy, Polytechnique Montreal, guy.desaulniers@gerad.ca

Integer column generation using decomposition (ICG) is a new primal method that aims to solve the popular set partitioning problem. This method finds a sequence of integer solutions, with non-increasing cost, leading to optimal or near-optimal solutions in reasonable time. Potential columns favoring integrality are generated using a suited dual vector. Some acceleration strategies improving the effectiveness of ICG will be discussed. Computational experiments on some large-scale bus drivers scheduling and aircrew pairing problems will be presented. The results obtained demonstrate the efficiency of ICG.

16h20 **ANNULÉ / Pick-up and delivery with complex loading constraints: application to the gasoline distribution**

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Correa, Ayoub Insa, Université de Thies, Sénégal, ayoub@univ-thies.sn

In this work, we present a Branch & Price method to solve a real-world pick-up and delivery problem arising in the sector of the distribution of gasoline. The underlying network consists of four distinct depots, a group of private carriers with heterogeneous tank trucks and five types of gasoline to replenish three groups of customers on a weekly basis. Complex loading and routing rules are handled in the sub-problem, a very difficult shortest path problem with resource constraints. Acceleration strategies will be discussed. Numerical results on real data show the high potential of the proposed approach.

16h45 **Primal Neighbourhood Search Algorithm for Solving the Shortest Path Problem with Resource Constraints**

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Ben Amor, Hatem, KRONOS, Hatem.BenAmor@kronos.com
Soumis, François, Polytechnique Montréal, francois.soumis@gerad.ca

We propose a new exact primal method for solving the shortest path problem with resource constraints. Our algorithm performs a search in the neighbourhood of a set of source-task paths. We first define the notion of adjacency in the context of the SPPRC. Then, we develop some polyhedral properties that are useful in the definition and exploration of the neighbourhood. Computational results on the VCSP show that the proposed solution approach is more efficient than classical dynamic programming algorithm.

MD4 **Localisation / Location**

Salle: Meloche Monnex

Président: Sereshti, Narges, Industrial Engineering, Dalhousie University

15h30 **Exploiting Landmark Constraints for Mobile Robot Localization and Mapping**

Qian, Duowen, duowen.qian@mail.mcgill.ca

This work considers exploiting a priori landmark information within the nonlinear least-squares algorithm to estimate the location of a mobile robot in a planar environment. Additionally, newly observed landmarks are augmented to the a priori landmarks, realizing mapping as well as localization.

15h55 **A Two-Echelon Location-Routing Problem in the Dutch Inland Waterway Network**

Deluster, Rogier, Université Laval, r.deluster@gmail.com
Coelho, Leandro C., Université Laval, leandro.coelho@cirrelt.ca

Refueling of liquefied natural gas (LNG) ships is called “bunkering” and can be done from a bunker terminal, from a LNG tanker truck or from a LNG bunker ship. This project determines

the most cost effective fleet and facility composition for a cost effective transition to a LNG powered waterway network in The Netherlands.

16h20 Hub Location under the Risk of Interdiction

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Vidyarthi, Navneet, Concordia University, navneetv@jmsb.concordia.ca

We study the hub-and-spoke network design problem under the risk of interdiction. The problem is modeled as a 3-stage sequential game, resulting in a tri-level mixed integer program. We present different approaches to reduce the model to 2 levels, followed by an efficient exact method to solve the problem to optimality.

16h45 Where to Locate the New Depot of a Food Company: A Case Study in Montreal

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Laporte, Gilbert, HEC Montréal, gilbert.laporte@cirrelt.ca

In this project, we dealt with the problem of locating new depot in the Montreal area to better satisfy the clients of a food delivery company. We used the facility location model and the CVRPTW to solve this problem and define the location and the number of vehicles of the new depot.

MD5 Horaires de personnel / Personnel Scheduling

Salle: Nancy et Michel-Gaucher

Président: Rekik, Monia, Université Laval

15h30 Ré-optimisation en temps réel des horaires de personnel

Hassani, Rachid, Polytechnique Montréal, rachid.hassani@gerad.ca

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Desaulniers, Guy, Polytechnique Montreal, guy.desaulniers@gerad.ca

Le retard et l'absence des employés peuvent représenter pour une société un coût équivalent à 35% de la somme totale consacrée à la paie (Mercer, 2010). Il est par conséquent fondamental de les gérer au mieux. L'objectif de cette présentation est d'exposer une méthode de ré-optimisation en temps réel des horaires de personnel suite à une petite perturbation due au retard ou à l'absence d'un employé. La méthode devra proposer au décideur des choix de réadaptation des horaires et évaluer les coûts des modifications occasionnées en tenant compte des coûts immédiats (coût de gestion) et des coûts futurs déterministes (impact des modifications sur les horaires futurs et la rémunération des employés). La méthode utilise principalement l'information duale trouvée lors de la première optimisation. Cette information est actualisée après chaque correction d'une perturbation à l'aide de la méthode de régression M.A.R.S. Les tests informatiques menés sur un ensemble contenant 1050 instances de problèmes réels allant jusqu'à 191 employés ont montré l'efficacité de notre méthode de correction d'horaires. Celle-ci arrive à trouver la solution optimale pour plus de 95% de ces instances, et ceci en une seconde en moyenne.

15h55 Réoptimisation de l'horaire d'un employé en surtemps

Saadi, Cherifa, Polytechnique Montréal, cherifasaadi91@gmail.com

La planification de personnel est un problème de recherche opérationnelle très important. En effet, en cours d'opération, il arrive qu'on allonge le quart de travail d'un certain employé

pour différentes raisons. Dans ce cas, l'employé peut tomber en surtemps, augmentant ainsi son salaire horaire. L'entreprise cherche alors à réoptimiser l'horaire de cet employé en surtemps tout en minimisant les coûts totaux et en assurant une couverture adéquate. Ce projet répond à ce problème de réoptimisation en utilisant un programme en nombres entiers.

16h20 Optimization of Employee Shift Schedules with Inter-Department Transfers

Attia, Dalia, Polytechnique Montréal, dalia.attia@polymtl.ca

Desaulniers, Guy, Polytechnique Montreal, guy.desaulniers@gerad.ca

Soumis, François, Polytechnique Montréal, francois.soumis@gerad.ca

Employee scheduling with inter-department transfers integer program is intractable for large instances. We propose a three-phase heuristic, solving small integer programs. The first phase identifies probable inter-departments transfer's needs. The second creates for each department, employee schedules using previously gathered information. The third globally fulfills remaining demand.

16h45 A Two-Stage Solution Approach for Multi-Department Multi-Day Shift Scheduling Problems

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We address a personalized multi-department multi-day shift scheduling problem where employees can be transferred between departments if needed. A two-stage solution approach is proposed. The first stage considers the integrated problem where data is aggregated. The second stage constructs personalized schedules based on the information deduced from the first stage. Different approaches are proposed and compared for the second stage on a large set of instances.

MD6 Planification du transport / Transportation Planning

Salle: CPA du Québec

Président: Larrain, Homero, Pontificia Universidad Católica de Chile

15h30 Using GPS Information to Improve Transportation Planning in the Furniture Industry and Reduce GHG Emissions

Coelho, Leandro C., Université Laval, leandro.coelho@cirrelt.ca

Renaud, Jacques, Université Laval, jacques.renaud@fsa.ulaval.ca

Belhassine, Khaled, Université Laval, khaled.belhassine.1@ulaval.ca

Jaballah, Rabie, Université Laval, rabie.jaballah.1@ulaval.ca

In this presentation we show how we acquire, transform and analyze GSP data from our partner to determine the congestion faced by its vehicle fleet. We develop time dependent algorithms to optimize their routes in function of congestion data. We can determine the best departure time to minimize the transportation time and evaluate the annual savings in terms of cost and GHG emissions.

15h55 Production Routing Problem with Emission Minimization

Darvish, Maryam, Université Laval, Maryam.Darvish@cirrelt.ca

Archetti, Claudia, University of Brescia, archetti@eco.unibs.it

Coelho, Leandro C., Université Laval, leandro.coelho@cirrelt.ca

Aiming to compare the effect of operational decisions on costs and emissions, we reassess the production routing problem under new objectives. We study an integrated system of production, inventory, and routing decisions, in which the commodity produced at the plant is shipped to the customers over a finite time horizon.

16h20 A MIP Formulation For The Rapid Transit Line Design Problem

Elfilali, Souhaila, Université de Montréal, souhaila.elfilali@gmail.com
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Laporte, Gilbert, HEC Montréal, gilbert.laporte@cirrelt.ca

We propose a tight formulation of the rapid transit line location problem, which consists of positioning stations and segments between them to form a line, in the objective of maximizing O-D pair's coverage under topologic and budget constraints. We test our formulation on artificial and real-life instances.

16h45 The Limited Stop Bus Service Design Problem with Stochastic Passenger Assignment

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The solution of this non-linear problem must account for bus capacity and reflect user behavior. Using a bi-level approach, we improve the solution time of a previous algorithm and allow for stochastic assignment, which is arguably more realistic and robust than the commonly used deterministic assignment.

M7 Planification et gestion des opérations hydroélectriques 2 / Hydropower Operations Planning and Management 2

Salle: St-Hubert
Président: Séguin, Sara, Université Laval

15h30 A Hybrid Stochastic Dynamic Programming - Tabu Search Approach for Long-Term Energy Planning

Mbeutcha, Yves Alain, Polytechnique Montréal, yves.mbeutcha@polymtl.ca
Gendreau, Michel, Polytechnique Montréal, Michel.Gendreau@cirrelt.ca
Émiel, Grégory, Hydro-Québec, emiel.gregory@hydro.qc.ca

The long-term Energy planning can be modeled and solved using classical Stochastic Dynamic Programming (SDP). However, SDP fails to represent adequately the risk brought by some inflows hypothesis on energy reliability of the Hydro-Quebec's power system. We propose a Tabu-Search approach to improve SDP policies performance.

15h55 A Least Square Monte Carlo Method Applied to the Kemanu System

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Denault, Michel, HEC Montréal, michel.denault@hec.ca
Côté, Pascal, Rio Tinto, pascal.cote@riotinto.com

A hydropower management policy is built using a Least Square Monte Carlo method. The inflows are simulated by the corporate partner Rio Tinto, using a hydrological model. Numerical experiments are conducted on the Kemanu system in British Colombia.

16h20 A Q-Learning Approach for Short-Term Hydropower Generation

Zarghami, Mahdi, École de technologie supérieure, zarghami_mahdi@yahoo.com
Errico, Fausto, École de technologie supérieure, fausto.errico@etsmtl.ca

Stochastic dynamic programming (SDP) has been widely applied to hydropower optimization. However, space-state discretization and the course of modeling might significantly deteriorate the SDP performances. In this study we explore the Q-learning algorithm for the short-term management of a multi-reservoir system. Computational results prove the efficiency of the proposed algorithm.

MD8 Problèmes de transport en santé / Transportation Problems in Healthcare

Salle: TAL Gestion globale d'actifs inc.

Président: Thoux, Anne Laurence, Cirrelt - Hanalog

15h30 A Review of Health Logistics in War Zones

Santa Gonzalez, Rosemarie, Université du Québec à Montréal,

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Rancourt, Marie-Eve, HEC Montréal, marie-eve.rancourt@hec.ca

Cherkesly, Marilène, Université du Québec à Montréal, cherkesly.marilene@uqam.ca

Crainic, Teodor Gabriel, Université du Québec à Montréal,

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Healthcare access is limited in a war zone. Thus, mobile clinics are employed to serve as a temporary solution. These are customized vehicles from which healthcare practitioners may provide services. This presentation reviews relevant literature on mobile clinics and highlights the gap related to operations research and operations management.

15h55 A Support Decision Tool to Choose Patient Transportation and Accompanying

Petitdemange, Eva, Hanalog, eva.petitdemange@gmail.com

Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca

Rousseau, Louis-Martin, Polytechnique Montréal, louis-martin.rousseau@polymtl.ca

Patient external transportation is a major portion of the budget of logistics in health care facilities in Quebec. These organizations have decided uniformize their decision process regarding the booking and the choice of patient external transportation. In order to standardize, we design a support decision prototype to help choose the right type of transportation and accompanying for patients.

16h20 Simulation Model for Patient External Transportation in Montreal

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Rousseau, Louis-Martin, Polytechnique Montréal, louis-martin.rousseau@polymtl.ca

Patient external transportation is a major portion of the budget of logistics in health care facilities in Quebec. The institutions are currently uniformizing their decision process regarding the organization of patient external transportation. Different strategies for booking are tested using a simulation model. We also take advantage of the model to test routing scenarios, introduce new vehicles, and finally test levels of centralization.

16h45 Planning a Unified Transport System for Healthcare Institutions

Thoux, Anne-Laurence, Polytechnique Montreal, anne-laurence.thoux@polymtl.ca

Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca

Rousseau, Louis-Martin, Polytechnique Montréal, louis-martin.rousseau@polymtl.ca

Since April 2015, Montreal's healthcare facilities have been merged into CIUSSSs to reduce the operating costs. We can wonder if a unified transportation system to serve the patients

of all CIUSSSs could allow additional savings. To verify this hypothesis, we propose a clustering model to solve the daily patient's transportation problem.

17h15 Salon l'Oréal : Réception vins et fromages

Mardi 9 mai 2017, Tuesday May 9, 2017

TA1 Séance plénière 3 / Plenary Session 3

Salle: Amphithéâtre Banque Nationale

Président: Lahrichi, Nadia, Polytechnique Montréal

09h00 Using Second-Order Information in Training Large-Scale Machine Learning Models

Scheinberg, Katya, Lehigh University, katyas@lehigh.edu

We will give a broad overview of the recent developments in using deterministic and stochastic second-order information to speed up optimization methods for problems arising in machine learning. Specifically, we will show how such methods tend to perform well in convex setting but often fail to provide improvement over simple methods, such as stochastic gradient descent, when applied to large-scale nonconvex deep learning models. We will discuss the difficulties faced by quasi-Newton methods that rely on stochastic first order information and Hessian-Free methods that use stochastic second order information.

TB1 Exposé magistral 2 / Tutorial 2

Salle: Banque CIBC

Président: Trépanier, Martin, Polytechnique Montréal

10h30 Forecasting Demand in Networks Using Path Choice Data

Frejinger, Emma, Université de Montréal, frejinge@iro.umontreal.ca

In many applications, for example, revenue management and traffic simulation, it is important to forecast demand. In this talk we focus on models that allow to forecast users' path choices in networks. Discrete choice models are often used for this purpose and they specify the probability that a given individual chooses an option among a set of alternatives as a function of attributes. The parameters of the models can be estimated by maximum likelihood using data on observed path choices. An important challenge associated with predicting path choices in networks is the large number path alternatives connecting each node pair. In this talk we first provide an introduction to discrete choice modeling and maximum likelihood estimation. Second, we present how the path choice problem can be conveniently modeled as a parametric Markov decision process where the transition probabilities are given by a discrete choice model. The resulting model is based on arcs and does not require any sampling of path alternatives. In some cases, the choice probabilities can be computed by solving linear systems which makes the model computationally attractive. We provide illustrations using several different real data sets. This talk is based on joint work with Fabian Bastin, Mogens Fosgerau, Anders Karlström, Tien Mai and Maëlle Zimmermann.

TB2 Optimization sans dérivées / Derivative-Free Optimization

Salle: Gérard-Parizeau

Président: Amaïoua, Nadir, Polytechnique Montréal

10h30 Parameter Tuning: Runge-Kutta Case Study

Audet, Charles, Polytechnique Montréal, charles.audet@gerad.ca

The Runge-Kutta class of iterative methods is designed to approximate solutions of a system of ordinary differential equations (ODE). The second-order class of Runge-Kutta methods is determined by a system of 3 nonlinear equations and 4 unknowns, and includes the modified-Euler and mid-point methods. The fourth-order class is determined by a system of 8 nonlinear equations and 10 unknowns. This work formulates the question of identifying

good values of these 8 parameters for a given family of ODE as a blackbox optimization problem. The objective is to determine the parameter values that minimize the overall error produced by a Runge-Kutta method on a training set of ODE. Numerical experiments are conducted using the Nomad direct-search optimization solver.

10h55 Order-Based Error for Managing Ensembles of Surrogates in Derivative-Free Optimization

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Kokkolaras, Michael, Université McGill, michael.kokkolaras@mcgill.ca

We investigate surrogate-assisted strategies for derivative-free optimization using the mesh adaptive direct search (MADS) blackbox optimization algorithm. In particular, we build an ensemble of surrogate models to be used within the search step of MADS, and examine different methods for selecting the best model for a given problem at hand. To do so, we introduce an order-based error tailored to surrogate-based search. We report computational experiments for analytical benchmark problems and engineering design applications. Results demonstrate that different metrics may result in different model choices and that the use of order-based metrics improves performance.

11h20 Handling Infeasibility in Blackbox Optimization using Supervised Classification

Jacquet, Stéphane, Polytechnique Montréal, stephane.jacquet@gerad.ca

Blackbox optimization problems, where the objective function and the constraints have unknown analytic expressions, lead to multiple difficulties such as no access to the gradient and long CPU time. Moreover, since the functions can sometimes be given by simulations or experiments, some of the computations can crash and give unreliable results. The MADS algorithm deals with constrained blackbox optimization problems. Since its introduction in 2006, it has known several improvements to manage constraints. However, binary constraints are currently managed the same way as the other constraints. Considering the lack of information given by binary constraints, they would benefit from a specific treatment. That presentation proposes a way to manage binary constraints using tools from supervised classification. Our work includes the case with a single constraint, which will be binary, since it offers a way to manage the case when simulations or experiments crash.

11h45 A New Variable Selection Strategy for the Parallel Space Decomposition in Derivative-Free Optimization

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The current parallel space decomposition of the Mesh Adaptive Direct Search algorithm (PSD-MADS) is an asynchronous parallel method that uses a simple generic strategy to decompose a problem into smaller dimension subproblems. The present work explores new strategies for selecting the subset of variables defining subproblems to be explored in parallel. These strategies are based on ranking the variables using statistical tools to determine the most influential ones. The statistical approach improves the decomposition of the problem into smaller more relevant subproblems. This work aims to improve the use of available processors.

TB3 Marchés et compétition / Market and Competition

Salle: Marie-Husny

Président: Chakraborty, Tulika, Concordia University

10h30	<p>Economic and Environmental Impact of Vertical Decisional Sequences under Horizontal Competition and Integration</p> <p>El Ouardighi, Fouad, ESSEC Business School, elouardighi@essec.fr Sim, Jeong Eun, KAIST Business School, Kim, Bowon, KAIST Graduate School of Management, Korea, BowonKim@business.kaist.ac.kr</p> <p>This study seeks to characterize both market structures and vertical decision sequences that are most effective in terms of economic competitiveness and environmental sustainability. The following research questions are addressed: - Which decision sequence between manufacturer's abatement effort and retailer's price is most favorable in terms of net emissions and firms' profits in vertically integrated markets? - Which vertical leadership is most favorable in terms of net emissions and firms' profits in vertically competitive markets? - How do horizontal competition and integration modify the relative impact of the decision sequence between abatement effort and price in vertically integrated markets, on the one hand, and the vertical leadership in vertically competitive markets, on the other hand, on net emissions and firms' profits?</p>
10h55	<p>Price Competition Induced by Partially Green -Sensitive Consumer Market</p> <p>Mukherjee, Arka, Université Concordia, ar_mukh@live.concordia.ca</p> <p>Contemporary research shows that a fully green consumer market is not a close reality. This paper studies the price competition between green and non-green products in a some specific marketing channels with different power structures. We analyze the optimal strategies for different players and find the conditions for profit maximization.</p>
11h20	<p>Price Competition and Quality Competition: National Brand vs. Store Brand</p> <p>Chakraborty, Tulika, Concordia University, jum.tulika@gmail.com Chauhan, Satyaveer S., Concordia University, satyaveer.chauhan@concordia.ca Huang, Xiao, Concordia University, xiao.huang@concordia.ca</p> <p>We consider a supply chain in a market segment where a national brand competes with a retailer's private label product with respect to not only price but also quality. We use the game theoretic model to focus the impact of different channel leadership of quality-setting stage on optimal decisions.</p>
TB4	<p>Optimisation axée sur les données / Data Driven Optimization</p> <hr/> <p>Salle: Meloche Monnex Président: Jena, Sanjay Dominik, Université du Québec à Montréal</p>
10h30	<p>Preference-Based Customer Segmentation for Assortment Planning</p> <p>Gauthier Melancon, Gabrielle, JDA Software, gabe.gma@gmail.com</p> <p>In the data science team at JDA, we developed a preference-based customer segmentation tool that helps in the assortment planning problem, during which a retailer select what products to put in each store. For that, we analyze products' attributes to discover customers' motivation and preferences, and then find patterns and similarities between different purchases to group shoppers together.</p>
10h55	<p>Data-Driven Distributionally-Robust Facility Location Problems</p> <p>Saif, Ahmed, HEC Montreal, ahmed.saif@hec.ca Delage, Erick, HEC Montreal, erick.delage@hec.ca</p>

We consider two classical facility location problems and show how they can be robustified against the distributional ambiguity that arise when using data. We also show that one can improve the worst-case expected performance by “randomizing” over different subsets of locations and devise an efficient algorithm to identify such solutions.

11h20 Learning Consumer Preferences for Data-Driven Large-Scale Assortment Optimization

Jena, Sanjay Dominik, Université du Québec à Montréal, sanjay.jena@cirreil.ca

Lodi, Andrea, Polytechnique Montréal, andrea.lodi@polymtl.ca

Palmer, Hugo, Polytechnique Montréal, hugo.palmer@polymtl.ca

We propose a new representation for rank-based choice models that generalizes classical representations. The model allows for subsets of products on which the consumer does not have a strict preference and enables us to efficiently train the consumer preferences. This is exemplified on large artificial and industrial data sets.

TB5 Méthodes statistiques / Statistical Methods

Salle: Nancy et Michel-Gaucher

Président: Cousineau, Martin, McGill University

10h30 Dynamic Programming for Valuing American Options under Variance-Gamma Process

Cherif, Rim, HEC Montréal, Rim.Cherif@hec.ca

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Rémillard, Bruno, HEC Montréal, bruno.remillard@hec.ca

Lévy processes provide a solution to overcome the shortcomings of the lognormal hypothesis. A growing literature proposes the use of pure-jump Lévy processes such the variance-gamma model. In this setting, explicit solutions for derivative prices are unavailable, for instance for the valuation of American options. We propose a dynamic programming approach coupled with finite elements for valuing American-style options under an extended variance-gamma model. Our numerical experiments confirm the convergence and show the efficiency of the proposed methodology. We also conduct a numerical investigation that focuses on American options on the S&P 500 futures contracts.

10h55 A QR-Factorization-Based Algorithm for Constrained Least-Squares Problems

Lambe, Andrew, Polytechnique Montréal, andrew.lambe@polymtl.ca

Orban, Dominique, Polytechnique Montréal, dominique.orban@gerad.ca

We present an interior-point method for linear least-squares problems with both equality and inequality constraints. The algorithm is based on a QR factorization of the least-squares operator rather than a symmetric indefinite factorization of the KKT matrix to improve numerical stability. We show several formulations of the KKT system and their solution using QR factorization. Numerical results demonstrate the effectiveness of the method.

11h20 Kernel Mean Matching for Causal Inference

Cousineau, Martin, McGill University, martin.cousineau@mail.mcgill.ca

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Pineau, Joelle, McGill University, jpineau@cs.mcgill.ca

Verter, Vedat, McGill University, vedat.verter@mcgill.ca

We propose the use of kernel mean matching to compute a causal effect from observational data. We also propose an improved tuning procedure for kernel mean matching.

Salle: CPA du Québec

Président: Gauthier, Geneviève, HEC Montréal

10h30 Idiosyncratic Jump Risk Matters: Evidence from Equity Returns and Options

Bégin, Jean-François, Simon Fraser University, jbegin@sfu.ca

Dorion, Christian, HEC Montreal, christian.dorion@hec.ca

Gauthier, Geneviève, HEC Montreal, genevieve.gauthier@hec.ca

This paper sheds new light on the relationship between idiosyncratic risk and equity returns by exploiting the richness of option data. To this end, we develop a jump-diffusion model in which a firm's systematic and idiosyncratic risk have both a normal and a tail component. We show that the contribution of idiosyncratic risk arises exclusively from the jump risk component.

10h55 Solving Optimal Portfolio Choice Problems with Forward Dynamic Programming

Wu, Siyang, HEC Montréal, si-yang.wu@hec.ca

Denault, Michel, HEC Montréal, michel.denault@hec.ca

We develop a forward dynamic programming algorithm to solve optimal portfolio choice problems with CRRA utility function and finite horizon. The method is based on simulations and thus offers great flexibility for modeling the returns. It is a "forward" method in that the choice of decision for any scenario is effectively done from time 0 to the end of horizon, in opposition to traditional D.P. The resulting algorithm is an application of artificial intelligence techniques in Financial Engineering, and thus establishes a bridge between the two fields. Furthermore, there are indications that the method could naturally be extended to include other features such as transaction costs and inter-temporal consumption.

11h20 Dynamic Programming and Parallel Computing for Valuing Two-Dimensional Financial Derivatives

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Ben Ameer, Hatem, HEC Montréal, hatem.ben-ameur@hec.ca

Rémillard, Bruno, HEC Montréal, bruno.remillard@hec.ca

We propose a dynamic program coupled with finite elements for valuing two-dimensional American-style options. To speed-up our procedure, we use parallel computing at every step of the recursion. Our model is flexible because it accommodates a large family of option contracts signed on two underlying assets that move according to a lognormal vector process. The same procedure can be adapted to accommodate a larger family of derivative contracts and state-process dynamics. Our numerical experiments show convergence and efficiency, positioning our method as a viable alternative to traditional methodologies based on trees, finite differences, and Monte Carlo simulation.

11h45 Extracting Latent States from High Frequency Option Prices

Gauthier, Geneviève, HEC Montreal, genevieve.gauthier@hec.ca

Amaya, Diego, Wilfrid Laurier University, damaya@wlu.ca

Bégin, Jean-François, Simon Fraser University, jbegin@sfu.ca

We propose the realized option variance as a new observable variable to integrate high frequency option prices in the inference of option pricing models. Using simulation and empirical studies, this paper documents the incremental information offered by this realized measure. Our empirical results show that the information contained in the realized option variance improves the inference of model variables such as the instantaneous variance and variance jumps of the S&P 500 index. Parameter estimates indicate that the risk premium breakdown between jump and diffusive risks is affected by the omission of this information.

Salle: St-Hubert

Président: Bruck, Bruno, Université de Montréal

10h30

Reducing Hazardous Materials Releases from Railroad Freights through Dynamic Trip Plan Policy**AbuObidAlla, Omar**, Université Concordia, awniomar@gmail.com

Railroad transportation of hazardous materials freights is important to the North America economics that support the national's supply chain. This paper introduces various extensions of the dynamic hazardous materials trip plan problems. The problem captures most of the operational features of a real-world railroad transportations systems that dynamically initiates a set of blocks and assigns each shipment to a single block path or multiple block paths. The dynamic hazardous materials trip plan polices have distinguishing feature that are integrating the blocking plan, and the block activation decisions. We also present a non-linear mixed integer programming formulation for each variant, and present managerial insights based on a hypothetical railroad network. The computation results reveal that the dynamic car scheduling policies are not only able to take advantage of the capacity of the network but also capable to diminish the population, and environment risks by rerouting the active blocks along the least risky train services without sacrificing the cost advantage of the railroad. The empirical results of this research illustrate that the issue of integrating the blocking plan, and the train-makeup of the hazardous materials freights must receive closer attentions.

10h55

Railway Transprtation of Hazmats, MILP, Multi-Order, Multi-Commodity Problem**Borna, Bahman**, Université Concordia, bahman_bmb@yahoo.com

Transportation of hazardous materials is one of the most significant research areas in the realm of supply chain, mainly, in North America. Most of the papers, however, have focused on the highway transportation of Hazmats. Yet, there have been some papers concentrating on the railway transportation of dangerous goods. In our paper, we are focusing on the railway transportation of both Hazmats and regular commodities. Yards and tracks are the constituents of our network. Orders are made at various nodes and are to be shipped towards destination yards. We are solving a mixed integer, multi-objective, multi-order, multi-commodity problem with constraints on both Hazmat commodities as well as regular commodities. We assume each OD order can be placed containing both regular commodity, and Hazmats pertaining to two different categories, Toxic Inhalation Hazards (TIH), and explosives which present no significant blast hazards as well as extremely insensitive explosive commodities which do not have a mass explosion hazards. Orders are to be shipped from origin yards to their destination yards using a single path or Itinerary, non-bifurcated flows. As well, we have modeled a real network using two approaches: 1) bifurcation of flows is allowed, and 2) bifurcation of flow is not allowed. Then, we have compared the results and drawn conclusions about the pros and cons of each modeling approach and viability situation of each.

11h20

A Practical Time Slot Management and Routing Problem in Attended Home Delivery**Bruck, Bruno**, Université de Montréal, bruno.p.bruck@gmail.com**Cordeau, Jean-François**, HEC Montréal, jean-francois.cordeau@hec.ca**Iori, Manuel**, Università di Modena e Reggio Emilia, manuel.iori@unimore.it

We describe the solution methodology to approach an attended home delivery problem faced by an Italian service provider. We propose an LNS heuristic that creates time slot tables by relying on various simulation strategies to represent customer behavior and on an integer linear program to optimize the routing of technicians.

TB8	Ordonnancement en santé / Scheduling in Healthcare
	<p>Salle: TAL Gestion globale d'actifs inc.</p> <p>Président: Ben Tayeb, Dina, Polytechnique Montréal</p>
10h30	<p>Chemotherapy Outpatient Scheduling Problem - A Practical Case</p> <p>Benzaid, Menel, Polytechnique Montréal, menel.benzaid@polymtl.ca Rousseau, Louis-Martin, Polytechnique Montréal, louis-martin.rousseau@polymtl.ca Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca</p> <p>In this project, we study the practical case of the Outpatient Oncology Center of Notre-Dame Hospital in Montreal. Observations have been made to extricate which elements of the real process (cyclic nature of treatment plans, variability in resource requirements, patient characteristics, uncertainty due to cancellations, arrival time, add-ons, treatments duration, staff satisfaction, overtime) need to be integrated in a mathematical model which includes workload features to solve the Chemotherapy Scheduling Problem. We focus on determining the best scheduling for patients in order to allow chemotherapy caregivers to add extra capacity without compromising on staff satisfaction, and on the quality of care offered.</p>
10h55	<p>Modeling and Optimization of Patient Flows in Radiotherapy Centers</p> <p>El Abed, Yosra, Polytechnique Montréal, yosra.elabed@polymtl.ca Rousseau, Louis-Martin, Polytechnique Montreal, louis-martin.rousseau@cirreht.net Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca</p> <p>The objective of this work is to develop a flexible simulation platform that model several trajectories of patients in a radiotherapy center. Their interactions with resources are detailed and all processes are described. We aim to evaluate several organisation strategies: booking of patients, scheduling of resources and prioritization of tasks.</p>
11h20	<p>Patient Classification for Appointment Scheduling in Ambulatory Clinics</p> <p>Ben Tayeb, Dina, Université de Montréal, dina.bentayeb@gmail.com Rousseau, Louis-Martin, Polytechnique Montreal, louis-martin.rousseau@cirreht.net Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca</p> <p>The main objective of this work is to design a patient scheduling algorithm for a radiotherapy center. In this project, we use machine learning techniques to estimate the time required to complete each treatment and possibly to classify patients. The objective is to maximize the number of patients served per day, i.e improve patient access to healthcare.</p>
TC1	Séance plénière 4 / Plenary Session 4
	<p>Salle: Amphithéâtre Banque Nationale</p> <p>Président: Gendron, Bernard, Université de Montréal</p>
14h00	<p>Intelligent Decisions</p> <p>Sellmann, Meinolf, General Electric, meinolf@gmail.com</p> <p>At its best intelligence creates aesthetic and beauty, yet from a utilitarian perspective intelligence primarily serves the purpose of making better decisions. Recent technological advances have revived the vision of cooperative decision support systems that can automatically create and manage self-learning adaptive decision support models. In this talk I will highlight some of these technologies and their applications.</p>
TD1	Exposé magistral 3 / Tutorial 3
	Salle: Banque CIBC

Président: Coelho, Leandro, Université Laval

15h30 Modeling and Optimizing Operations Research Problems with LocalSolver

Darlay, Julien, Local Solver, jdarlay@localsolver.com

In this tutorial, we introduce LocalSolver, a heuristic solver for large-scale optimization problems. The optimization model can be provided as a classic mathematical problem as LocalSolver is not restricted to a specific structure and supports most of the common mathematical operators. Decisions can be booleans, integers or continuous. The solver is designed to find good solutions for large problems in short running times. The main part of the tutorial deals with the new features of LocalSolver 7. LocalSolver 6.5 introduced high level decisions based on sets that allow users to write simpler models. These decisions are based on the notion of list inspired from Constraint Programming Set-Based Variables. The new models are more compact for the solver and solutions can be found for larger instances. LocalSolver 7 adds new features to simplify the usage of variable length lists so that fixed arrays and variable lists are similar for the user. These new features are particularly useful to model routing and scheduling problems in just a few lines. LocalSolver 7 also introduces new large neighborhood for numerical optimization based on a better exploitation of the model. These new intensification moves accelerate the convergence speed to local optima in nonlinear continuous optimization and leave more time for diversification. The conclusion of the tutorial is about the future developments of LocalSolver, namely the extensions of set based models, the computation of lower bounds on generic models and the detection of global structures.

TD2 Activité de Speed-networking / Speed Networking Event

Salle: Salon Deloitte

Présidents: Cherkesly, Marilène, Université du Québec à Montréal
Zétina, Carlos, Université Concordia

15h30 La RO en pratique / OR in Practice

Lors de cette activité, les étudiants aux cycles supérieurs auront l'occasion de discuter avec des représentants de compagnies qui développent des outils basés sur la recherche opérationnelle. Les étudiants en apprendront davantage sur les méthodologies utilisées et sur les logiciels développés. Ils auront également un aperçu des différences entre la recherche académique et la pratique industrielle. Pour débiter l'activité, chaque représentant présentera la compagnie pour laquelle il travaille et décrira son travail. Puis, les étudiants seront jumelés en équipe. Chaque équipe aura une dizaine de minutes avec chacun des représentants pour une période de questions et réponses. During this activity, graduate students will have the opportunity to discuss with representatives of companies developing and applying OR tools. They will learn of what methodologies and software are being developed and get a peak of how OR is approached in industry versus how it's approached in academia. The event starts with each representative giving a brief presentation to all participants about their company and what they do. Then, participants will be grouped in small teams. Each team will have approximately ten minutes with each of the representatives for a Q & A exchange.

TD3 Développements méthodologiques / Methodological Developments

Salle: Marie-Husny

Président: Vidal, Thibaut, Pontifical Catholic University of Rio de Janeiro

15h30

Benders Decomposition for Binary Programs

Poggi, Marcus, Pontifícia Universidade Católica do Rio de Janeiro, poggi@inf.puc-rio.br

We adapt the work of Zou, Ahmed and Sun, 2016, on Benders decomposition for stochastic problems to pure binary programs with no specific structure. The resulting algorithm makes use of standard Benders cuts from the subproblem linear relaxation. Combinatorial Benders cuts from the binary subproblem are also added, both when infeasible and when optimal. Automatic decomposition strategies are presented. Computational experiments are carried on literature instances. Results suggest high sensitivity to the decomposition strategies.

15h55

Using Variables Aggregation and Benders Decomposition for Solving Large-Scale Extended Formulations

Fortz, Bernard, Université Libre de Bruxelles, bernard.fortz@ulb.ac.be

Leitner, Markus, University of Vienna, markus.leitner@univie.ac.at

Many optimization problems involve simultaneous decisions on high-level strategic decisions such as the location and/or dimensioning of facilities or devices, as well as operational decisions on the usage of these facilities. Moreover, these decisions often have to be taken for multiple demand sets over time or in an uncertain setting where multiple scenarios have to be considered. Hence, a large number of variables (and constraints) is often necessary to formulate the problem. Although sometimes more compact formulations exist, usually their linear relaxations provide much weaker lower bounds, or require the implementation of problem-specific cutting planes to be solved efficiently. A lot of research has focused in recent years on strong extended formulations of combinatorial optimization problems. These large-scale models remain intractable today with traditional solvers, but Benders decomposition gained attention as successful applications of it have been reported. An alternative to these large-scale models is to use more compact formulations, often based on variable aggregations. We propose an intermediate strategy that consists of projecting the extended formulation on the space of aggregated variables with a Benders decomposition scheme, applicable to a large class of problems.

16h20

Fast Approximate Solution of Very Large Linear Programs

Chinneck, John, Carleton University, chinneck@sce.carleton.ca

It is often useful to find an approximate solution quickly for a very large linear program, e.g. for screening many possible solution options, or for providing an advanced start for an accurate solver. I present a new method that optimizes a combined objective function that includes a quadratic penalty term for constraint violations, and that uses a movement direction based on a simultaneous projection method (constraint consensus), and a quadratic approximation to the combined objective function surface. The algorithm is concurrent and uses random initial points scattered over a gradually shrinking box surrounding the current best solution. Extensive empirical results are given, showing that the method often provides good approximate solutions in seconds for models which require hours of computation for an accurate solution via commercial LP solvers.

16h45

On a Convex Resource Allocation Problem with Nested Lower and Upper Constraints

Vidal, Thibaut, Pontifical Catholic University of Rio de Janeiro, vidalt@inf.puc-rio.br

Gribel, Daniel, Pontifical Catholic University of Rio de Janeiro, dgribel@inf.puc-rio.br

Jaillet, Patrick, Massachusetts Institute of Technology, jaillet@mit.edu

We study a convex resource allocation problem in which lower and upper bounds are imposed on partial sums of allocations. This model is linked to a large variety of applications, including production planning, lot sizing, speed optimization, stratified sampling, support vector machines, portfolio management, and telecommunications. We introduce a gradient-free divide-and-conquer algorithm, which uses monotonicity arguments to generate valid

bounds from the recursive calls, and eliminate linking constraints based on the information from sub-problems. These principles are quite unusual: the algorithm is not based on greedy steps and scaling, or even flow propagation, as it is often the case for this family of problems. It also does not need strict convexity or differentiability, and improves upon the best known complexity for this problem, producing a solution to the integer version of the problem (or an epsilon-approximate solution to the continuous version) in linearithmic time as a function of the problem size. Our experimental analyses confirm the practical performance of the method, which produces optimal solutions for problems with up to one million variables in a few seconds. Promising applications to the support vector ordinal regression problem, for machine learning, are also investigated.

TD4 Apprentissage et diagrammes de décision / Learning and Decision Diagrams

Salle: Meloche Monnex

Président: Cire, Andre Augusto, University of Toronto

15h30 Optimization Methods for Neural Networks Training

Papadimitriou, Dimitri, Bell Labs, dimitri.papadimitriou@nokia-bell-labs.com

Given a set of labeled data points, the optimization problem associated to the training of neural networks aims at determining the parameters, e.g., synaptic weights, which minimize the empirical loss between the true output to the given input and the predicted output. The (regularized) problem is nonconvex even when the loss (and the regularization) function is convex. We analyze and compare extended bundle and trust region methods for nonconvex loss and non/convex non/smooth regularization term.

15h55 A Hybrid Decision Diagram Approach for the Job Shop Scheduling Problem

Gonzalez, Jaime, Polytechnique Montréal, jaime.gonzalez@polymtl.ca

Rousseau, Louis-Martin, Polytechnique Montréal, louis-martin.rousseau@polymtl.ca

Cire, Andre A., University of Toronto Scarborough, andre.cire@rotman.utoronto.ca

Lodi, Andrea, Polytechnique Montréal, andrea.lodi@polymtl.ca

We propose an optimization framework which integrates mixed-integer programming (MIP) and multivalued decision diagrams (MDDs) for optimization. A MDD representation of the problem identifies parts of the search space that can be efficiently explored by MIP technology, while the MIP results are iteratively used to refine the MDD.

16h20 Decompositions Based on Decision Diagrams

Cire, Andre Augusto, University of Toronto, acire@utsc.utoronto.ca

Bergman, David, University of Connecticut, david.bergman@uconn.edu

This talk describes a new decomposition approach where small-sized decision diagrams exactly represent different portions of a discrete optimization problem, all of which are linked through special constraints. We discuss potential techniques to solve the underlying decomposition problem and show a number of applications of this method.

TD5 Optimisation stochastique / Stochastic Optimization

Salle: Nancy et Michel-Gaucher

Président: Bürgy, Reinhard, Polytechnique Montreal

15h30 A Reduced Cost Based Heuristic Approach for Stochastic Network Design Problems

Sarayloo, Fatemeh, Université de Montréal, saraylof@iro.umontreal.ca

Crainic, Teodor Gabriel, Université du Québec à Montréal,

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Rei, Walter, Université du Québec à Montréal, rei.walter@ugam.ca

This paper proposes a solution approach for the stochastic fixed-charge network design problem where the uncertain demands are considered as the set of scenarios. We develop a heuristic procedure which extracts and makes effective use of valuable information provided by reduced cost of out-of-basis variables to identify the collection of non-promising design variables. The proposed approach exploits the obtained information to consecutively solve the restricted problems, constructed by fixing the set of non-promising variables to zero, using a MIP solver. Extensive computational experiments demonstrate the efficiency of proposed approach in obtaining high-quality solutions and computational efforts.

15h55

The Vehicle Routing Problem with Stochastic and Correlated Travel Times

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Errico, Fausto, École de technologie supérieure, fausto.errico@cirrelt.ca

In this paper we study an extension of the vehicle routing problems (VRP) in which the travel times are stochastic and correlated. Routes with high travel time variability are penalized through a mean-variance approach which requires the introduction of a quadratic component into the model. We propose two alternative formulations and develop a Branch-cut-and-price algorithm for both formulations. According to the formulation at hand, the quadratic component is dealt with either in the master problem of the column generation or in the subproblem. Preliminary computational results indicate that our algorithms reasonably efficient and that density of the covariance matrix impacts differently the performance of the two algorithms.

16h20

An Exact Solution Approach for the Vehicle Routing Problem with Stochastic Demands under an Optimal Restocking Recourse Policy

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In this talk, we study the Vehicle Routing Problem with Stochastic Demands (VRPSD), where actual demands are only known through probability distributions. A planned route may fail at a specific customer due to an excessive demand. To regain routing feasibility, extra decisions must be taken in the form of return trips to the depot. We examine the VRPSD under an optimal restocking policy in which preventive returns are prescribed. We also present an exact solution approach to solve the VRPSD.

16h45

A Stochastic Online Algorithm for Unloading Boxes from a Conveyor Line

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We discuss the problem of unloading a sequence of boxes from a single conveyor line with a minimum number of moves. The problem under study is efficiently solvable with dynamic programming if the complete sequence of boxes is known in advance. In practice, however, the problem typically occurs in a real-time setting where the boxes are simultaneously placed on and picked from the conveyor line. Moreover, a large part of the sequence is often not visible. As a result, only a part of the sequence is known when deciding which boxes to move next. We develop an online algorithm that evaluates the quality of each possible move with a scenario-based stochastic method. Two versions of the algorithm are analyzed: in one version, the quality of each scenario is measured with an exact method, while a heuristic technique is applied in the second version. Numerical results show that the proposed approach consistently provides high-quality results, and compares favorably with the best known deterministic online algorithms.

TD6

Tournées de véhicules et ordonnancement / Routing & Scheduling

Salle: CPA du Québec

Président: Grenouilleau, Florian, Polytechnique Montréal

15h30 A GVNS Heuristic for the Traveling Salesman problem with Time Windows - Minimizing Completion Time

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We use a GVNS (General Variable Neighborhood Search) heuristic for the traveling salesman problem with time windows where the objective is to minimize the completion time. We use efficient methods for checking the feasibility and the profitability of a movement, and for exploring the neighborhoods. The results indicate that our method is very competitive with the state-of-the-art.

15h55 A Tabu Search Heuristic for a Multi-Attribute Technician Routing and Scheduling Problem

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We propose a tabu search heuristic for a technician routing and scheduling problem. Our tabu search includes an adaptive memory that contains the best solutions visited during the search, as measured by their cost and the diversity they bring to the memory. The performance of this tabu search heuristic will be evaluated on instances with different characteristics. A comparison with an exact branch-and-price algorithm will also be reported.

16h20 Integrated Shift Scheduling and Load Assignment Optimization for Attended Home Delivery

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We study 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 packages to deliver. In the operational planning, delivery orders are allocated to couriers in real-time. The stochastic and dynamic nature of customer orders is included in the tactical and operational decision levels, respectively. Results 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 to the use of external couriers to satisfy all delivery requests.

16h45 An ALNS for the Home Health Care Routing and Scheduling Problem

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The Home Health Care Routing and Scheduling Problem consists of scheduling, over a week, a given set of home visits and deciding which health resource will be used to perform each visit in which sequence. This problem can be seen as a mix between an assignment problem, with the visit allocation decision, and a vehicle routing problem with time windows for the scheduling part. In our study, we try to take into account a maximum of practical constraints. These constraints are partly linked to the assignment component of the problem, such as assuring the qualifications and availabilities of each nurse for each visit. We also

consider, for the scheduling part, the time-dependent aspect of the travel times and the maximum amount of work hours per nurse over the week and over each workday. To solve this problem, we use a well-known method calls Adaptive Large Neighborhood Search (ALNS) which, starting from an initial solution, iteratively reconstruct some parts of this solution and try to produce a better one. To do so, we have developed problem-specific ALNS' destroy and repair operators coupled with classic ones. To test our method, we have used real data provided by the Alayacare Company, a Canadian company which has created software for the home health care management. The results show that our metaheuristic permits to dramatically improve the Alayacare's solutions, by reducing the travel time by 30% and improving the patient-nurse fidelity by more than 6%.

TD7 Modèles d'optimisation appliqués au secteur énergétique / Optimization Models for Applications in Energy

Salle: St-Hubert

Président: Tanneau, Mathieu, Polytechnique Montréal

15h30 Ambitious GHG Reduction Targets in Canada: Insights from an Optimization Energy Model

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Frenette, Erik, HEC Montréal, erik.frenette@gmail.com

Sigvaldason, Oskar, SCMS Global, oskar@sigvaldason.com

The objective of this presentation is to explore deep decarbonization pathways for the Canadian energy sector. Our approach consists in deriving minimum cost solutions for achieving progressive emission reductions up to 2050 using the North American TIMES Energy Model, a detailed multi-regional and integrated optimization energy model.

15h55 Robust Self-Scheduling for a Price-Maker Energy Storage Facility in the New-York State Electricity Market

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Delage, Erick, HEC Montréal, erick.delage@hec.ca

Recent progress in energy storage have contributed to create large-scale storage facilities and to decrease their costs. This may bring economic opportunities for storage operators, especially via energy arbitrage. However, storage operation in the market could have significant impact on electricity prices. This work aims at evaluating jointly the potential operating profit for a price-maker storage facility and its impact on the electricity prices in New-York state. Based on historical data, lower and upper bounds on the supply curve of the market are constructed. These bounds are used as an input for the robust self-scheduling problem of a price-maker storage facility.

16h20 ESCOF: an Energy Storage based Co-Optimization Framework in Smart Grid

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Anjos, Miguel F., Stanford University, anjos@stanfordalumni.org

In this presentation, we will motivate the importance of studying the interactions between all parts of electrical power transmission (T) and distribution (D) networks including storage, distributed generation, electric vehicles, and loads. We will present a co-optimization

framework based on energy storage batteries connected at the distribution level enabling a transversal study. As a proof of concept, the Optimal Power Flow is adopted as an analysis tool in T&D co-optimization with the aim of maximizing the sparsity of the matrix modelling the control decisions and at the same time minimizing the deviation from the previous day's operation schedule. A distributed optimization algorithm is designed to synchronize the decision flows. We will conclude with open research questions.

16h45 Aggregation models for the grid integration of distributed energy storage

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Lodi, Andrea, Polytechnique Montréal, andrea.lodi@polymtl.ca

Although challenging, successfully integrating distributed energy storage could prove highly valuable to the electric grid. We formulate the aggregation problem for distributed storage, and propose a novel resolution method, aiming at practical, real-time implementation. The proposed approach leverages the problem's structure through decomposition and constraint aggregation, naturally addressing resources' heterogeneity.

TD8 Ordonnancement robuste / Robust Scheduling

Salle: TAL Gestion globale d'actifs Inc.

Président: Ripsman, Danielle, University of Waterloo

15h30 Robust Multi-Class Multi-Period Scheduling of MRI Services with Wait Targets

Mirahmadi shalamzari, Akram, University of Waterloo, amirahma@uwaterloo.ca

Scheduling MRI services are challenging due to limited capacity, uncertain demand, and waiting time targets based on different patient priorities. We develop a mixed-integer robust optimization method to schedule multi-priority patients over a multi-period finite horizon while considering demand uncertainty and respecting waiting time targets for each priority.

15h55 Robust Radiotherapy Appointment Scheduling

Hajipour, Farnaz, Université Concordia, h.farnaz91@gmail.com

Optimal scheduling of patients waiting for radiation treatments is a quite challenging operational problem in radiotherapy clinics. Long waiting times for radiotherapy treatments is mainly due to imbalanced supply and demand of radiotherapy services, which negatively affects the effectiveness and efficiency of the healthcare delivered. On the other hand, variations in the time required to set-up machines for each individual patient as well as patient treatment times make this problem even more involved. Efficient scheduling of patients on the waiting list is essential to reduce the waiting time and its possible adverse direct and indirect impacts on the patient. This research is focused on the problem of scheduling patients on a prioritized radiotherapy waiting list while the rescheduling of already booked patients is also possible. The aforementioned problem is formulated as a mixed-integer program that aims for maximizing the number of newly scheduled patients such that treatment time restrictions, scheduling of patients on consecutive days on the same machine, covering all required treatment sessions, as well as the capacity restriction of machines are satisfied. Afterwards, with the goal of protecting the schedule against treatment time perturbations, the problem is reformulated as a cardinality-constrained robust optimization model. This approach provides some insights into the adjustment of the level of robustness of the patients schedule over the planning horizon and protection against uncertainty. Further, three metaheuristics, namely Whale Optimization Algorithm, Particle Swarm Optimization, and Firefly Algorithm are proposed as alternative solution methods. Our numerical experiments are designed based on a case study inspired from a real radiotherapy clinic. The first goal of experiments is to analyze the performance of proposed

robust radiotherapy appointment scheduling (ASP) model in terms of feasibility of schedule and the number of scheduled patients by the aid of Monte-Carlo simulation. Our second goal is to compare the solution quality and CPU time of the proposed metaheuristics with a commercial solver. Our experimental results indicate that by only considering half of patients treatment times as worst-case scenario, the schedule proposed by the robust RAS model is feasible in the presence of all randomly generated scenarios for this uncertain parameter. On the other hand, protecting the schedule against uncertainty at the aforementioned level would not significantly reduce the number of scheduled patients. Finally, our numerical results on the three metaheuristics indicate the high quality of their converged solution as well as the reduced CPU time comparing to a commercial solver.

16h20

Robust Mixed Integer Optimization for Radiation Therapy Treatment Planning with Delivery Constraints

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Purdie, Thomas, Princess Margaret Cancer Centre, tom.purdie@rmp.uhn.ca

Chan, Timothy C.Y., University of Toronto, tcychan@mie.utoronto.ca

Radiation therapy can be high-risk for breast cancer patients due to the presence of adjacent sensitive organs that deform with irregular breathing patterns throughout treatment delivery. We propose a mixed-integer robust optimization methodology that immunizes treatments against motion uncertainty while considering delivery limitations often neglected in initial stages of planning.

Mercredi 10 mai 2017 / Wednesday, May 10, 2017

WA1 Séance plénière 5 / Plenary Session 5

Salle: Amphithéâtre Banque Nationale

Président: Lahrichi, Nadia, Polytechnique Montréal

09h00 Stochastic Optimization for Scheduling in Healthcare Delivery Systems

Denton, Brian, University of Michigan, btdenton@med.umich.edu

Optimization of planning and scheduling decisions under uncertainty is important in many service industries to increase the utilization of resources, match workload to available capacity, and smooth the flow of customers through the system. It is particularly important for healthcare delivery where applications include scheduling of patients to outpatient clinics, design of operating room schedules, and allocation of resources within healthcare facilities. In this talk I will discuss stochastic optimization models for scheduling services in outpatient procedure centers and hospitals. I will discuss three related problems. The first involves setting individual procedure start times for a single operating room (OR) given uncertainty in the duration of procedures. The objective of this problem is to minimize a weighted sum of three competing criteria: patient and OR team waiting time, OR idle time, and overtime. The second problem involves the allocation of surgeries across multiple ORs with the goal of balancing the fixed cost of opening ORs with the expected cost of total overtime. The third problem involves setting optimal arrival times for patients to an outpatient procedure center comprising multiple activities including: intake processes, surgery, and recovery. For each problem I will describe the model, stochastic optimization methods that can be applied, and numerical results based on real data to illustrate the potential impact of the model. I will also discuss open questions and future research opportunities related to optimization of health care delivery systems.

WB1 Exposé magistral 4 / Tutorial 4

Salle: Banque CIBC

Président: Rousseau, Louis-Martin, Polytechnique Montréal

10h30 Inverse Optimization and Healthcare Applications

Chan, Timothy C.Y., University of Toronto, tcychan@mie.utoronto.ca

In this tutorial, we review methods in inverse optimization, with a focus on recent approaches to dealing with noisy data. We present inverse optimization as a tool for optimization model parameter estimation and discuss issues related to goodness of fit. Finally, we present applications of inverse optimization for parameter estimation in healthcare decision making problems.

WB2 Transport collaboratif / Collaborative Transportation

Salle: Gérard-Parizeau

Président: Coelho, Leandro, Université Laval

10h30 Enhancing Air Traffic Management through Collaboration

Ichoua, Soumia, Embry-Riddle Aeronautical University, ichouas@erau.edu

Under the concept of Collaborative Air Traffic Management, traffic managers and flight operators/planners share data and collaborate to enhance the NAS overall operational efficiency. We propose an optimization procedure that seeks to achieve a good trade-off

between overall system efficiency, optimal individual stakeholders' goals and a good level of equity.

10h55 Combinatorial Bid Generation for Transportation Procurement Auctions Taking into Account Carrier's Risk Behaviour

Mhamdi, Waddhah, Polytechnique Montréal, wadhah.mhamdi@gmail.com

For a carrier, the construction of a bid to submit into a transportation procurement combinatorial auction can be of a great difficulty. This latter is even more critical when the carrier should take into account the previous engagements he's enrolled with. In this project, we developed an advisor that helps the carrier to generate two OR bids B1 and B2 (different one from another) in a way to maximize his expected profits if he is to face the cases: win B1, win B2 or win both

11h20 A Large Neighbourhood Search Heuristic for Bid Construction Problem in Total Truckload Transportation Procurement Auctions

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Coelho, Leandro C., Université Laval, leandro.coelho@cirrelt.ca

This work deals with the Bid Construction Problem in total Truckload Combinatorial Auctions. We formulate it as a mathematical model maximizing the profit. Results are compared to those obtained for a developed LNS heuristic and tested on randomly generated instances. Computational results show that the LNS heuristic performs well in terms of CPU time and solution quality.

11h45 Cooperation Between Shippers to Reduce LTL Shipping Cost and GHG Emissions

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In this article we present how collaboration between local enterprises can be managed to reduces LTL shipping costs and GHG emissions. Based on the data of here local enterprises we developed models to optimize either the shipping cost or the GHG emissions. By large simulation experiments we show under which conditions such a collaboration can be profitable.

WB3 Méthodes d'optimisation / Optimization Methods

Salle: Marie-Husny

Président: Caverly, Ryan, University of Michigan

10h30 Service Systems with Adjustable Speed

Almehdawe, Eman, University of Regina, eman.almehdawe@uregina.ca

We investigate a fluid model of a service system, in which customers are discharged at an adjustable speed, which influences the proportion of customers that require rework after a delay. We formulate the model as a delay-differential equation. We study the transient and steady-state behavior of the system occupancy in four different regimes and we obtain conditions under which speedup reduces average occupancy.

10h55 Factorization-Free Methods for Computed Tomography

Mclaughlin, Maxime, Polytechnique Montréal, maxime.mcl@gmail.com

Orban, Dominique, Polytechnique Montréal, dominique.orban@gerad.ca

We study a tomographic reconstruction problem in cylindrical coordinates. A change of variables involving a Fourier matrix attempts to improve the conditioning of the Hessian but introduces linear inequality constraints. The scale and density of the problem call for factorization-free methods. We argue that projections into the feasible set can be computed efficiently by solving a bound-constrained least-squares problem with a fast linear operator. In this talk, we focus on a Barzilai-Borwein projected gradient method and a trust-region projected Newton method. We compare two solvers for the projection subproblem: a two-metric projection algorithm and a trust-region projected Newton method. The performance of several combinations is assessed using synthetic data on the reconstruction problem.

11h20 Extremum-Seeking Guidance on SO(3) Using a Kalman Filter

Walsh, Alex, University of Michigan, aexwalsh@umich.edu
Forbes, James Richard, McGill University, james.richard.forbes@mcgill.ca

Extremum-seeking guidance endeavours to drive the output of a system to the extremum of an unknown objective function. This paper proposes an extremum-seeking guidance algorithm for constrained subsets of SO(3). The algorithm is enabled by a novel constrained Kalman filter, and is demonstrated on a spacecraft attitude guidance problem.

11h45 Controller Design for Regional Pole and Zero Placement using Linear Matrix Inequalities and the Modified Minimum Gain Lemma

Caverly, Ryan, University of Michigan, caverly@umich.edu
Forbes, James Richard, McGill University, james.richard.forbes@mcgill.ca

This talk presents controller synthesis methods involving linear matrix inequalities that place closed-loop zeros in the open left-half complex plane. This prevents nonminimum phase closed-loop behaviour, often characterized by a response that initially moves in the opposite direction from a desired set point before asymptotically reaching the desired set point.

WB4 Optimisation combinatoire 2 / Combinatorial Optimization 2

Salle: Meloche Monnex
Président: Desrosiers, Jacques,

10h30 A k-Medians Model for Semi-Supervised Clustering

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Mladenovic, Nenad, Mathematical Institute SANU, nenad@mi.sanu.ac.rs

Clustering is a powerful tool for automated analysis of data. It addresses the following general problem: given a set of entities, find subsets, or clusters, which are homogeneous and/or well separated. The biggest challenge of data clustering is to find a criterion to present good separation of data into homogeneous groups, so that these groups bring useful information to the user. To mitigate the importance of this decision, it is suggested that the expert could provide some a priori information about the data set. Clustering under this assumption is called semi-supervised clustering. This work explores semi-supervised clustering using the k-medians model. Results shows that (i) the model presents classification accuracy compared to that of the typical k-means approach, and (ii) it allows to efficiently explore dual information in order to guide cluster analysis.

10h55 The Carousel Scheduling Problem

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Scheduling problems on which constraints are imposed with regard to the temporal distances between successive executions of the same task have numerous applications, ranging from task scheduling in real-time systems to automobile production on an assembly line. In this work, we introduce a new NP-hard optimization problem belonging to this class of scheduling problems, namely the Carousel Scheduling Problem (CSP). Our work presents a mathematical formulation based on mixed-integer linear programming (MILP) for the CSP and a series of cuts to improve its resolution via exact methods. Finally, we propose an iterative solution method which greatly reduces the number of variables in the CSP formulation. The reported computational experiments show that, for a given time horizon, the iterative method actually increases the number of instances solved up to optimality when compared to their direct solution via a MILP solver.

11h20 Global Solution Analysis of a Simple Pooling Problem with Application in the Feed Industry

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We present a specific pooling model which uses bi-linear objective and constraints. An absolute lower bound is available for this model. We conjecture that any local solution is a global minimizer for this simple instance and we will present several experiments to support it, motivated within a feed industry application.

11h45 Linear Fractional Approximations for Master Problems in Column Generation

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Successive approximations of the master problem are created to converge to optimality. For every approximation except the last one, the cost of the solution decreases whereas the sum of the variable values increases. Moreover, the minimum reduced cost also increases and converges to zero with a super-geometric growth rate.

WB5 Logistique Humanitaire / Humanitarian Logistics

Salle: Nancy et Michel-Gaucher
Président: Rancourt, Marie-Ève, HEC Montréal

10h30 Price Flexible Transportation Procurement Contracts for Aid Delivery in Developing Countries

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Verter, Vedat, McGill University, vedat.verter@mcgill.ca

In Africa, managing freight transportation of the food aid supply chain is challenging due to poor infrastructure, security risks, and volatile markets. We develop an econometric model that identifies the determinants of transportation prices and a real options approach to design price-flexible contracts that improves the response rate of transporters.

10h55 Community Healthcare Network in Underserved Areas: Design, Mathematical Models, and Analysis

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Smilowitz, Karen, Northwestern University, ksmilowitz@northwestern.edu

In this presentation, we design community healthcare networks in underserved areas. The problem consists of determining the number of community health workers and supervisors, as well as the routing and scheduling of the supervisors. We propose four set-partitioning mathematical models. Computational results are presented for a real-life case study.

11h20 Strengthening Local Humanitarian Networks to Ensure Efficient Response and Improve Resilience in Disaster-Prone Areas

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The Global Partnership for Emergency Preparedness Project of the WFP aims to determine sustainable options for reinforcing local capacities in high disaster-risk areas. To support it, this study proposes an optimization tool to identify where to strengthen the current response network to bridge the gaps. The methodological framework is presented.

11h45 Logistics Service Network Design for Humanitarian Response in East Africa

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Dufour, Emilie, emilie.dufour.2@gmail.com

This research project aims to analyze the potential benefits of adding a regional distribution center in Kampala to UNHRD's existing depot network. To this end, we used fieldwork, simulation, optimization and statistical analyses to assess the costs of prepositioning relief items in Kampala and to propose a robust stocking solution.

WB6 Véhicules électriques et gestion de la congestion / Electric VRP and Traffic Management

Salle: CPA du Québec
Président: Pelletier, Samuel, HEC Montréal

10h30 Vehicle Routing Problems Considering Traffic and Congestion

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Renaud, Jacques, Université Laval, jacques.renaud@fsa.ulaval.ca

Advances in communications and real-time data acquisition is changing the way we solve many of today's transport problems. In fact, lately much attention is devoted to traffic information and congestion. A lot of data are generated taking into account the underlying street network and dynamic traffic conditions. Traditional solutions for the VRP falls short when it comes to traffic and congestion. Incorporating new technologies into the classical VRP creates new challenges in different areas such as the way we process data, create benchmarks, conceive and develop heuristics. In this talk we exploit some of these opportunities and discuss future research opportunities.

10h55 Arc-based MILP Reformulation of a Traffic Control Bi-Level Program

Morin, Léonard Ryo, Université de Montréal, leonard.ryo.morin@gmail.com
Frejinger, Emma, Université de Montréal, frejinge@iro.umontreal.ca
Gendron, Bernard, Université de Montréal, bernard.gendron@cirrelt.ca

In this talk, we focus on a traffic control application. It consists of a transportation network manager who wants to allocate resources to control traffic flow on arcs in a network. The network manager has to take into account that there are several classes of users including those who have objectives that are antagonistic to his own. We present a bi-level programming formulation of this problem where an arc-based logit model predicts the path choices. We then reformulate it as a mixed integer linear program with a sample average approximation of the logit model over the scenarios sampled from the distribution of the latter.

11h20 A Matheuristic Approach for Solving the Electric Vehicle Routing Problem with Time Windows and Different Charges

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Çatay, Bülent, Sabanci University, catay@sabanciuniv.edu

We model the Electric Vehicle Routing Problem with Time Windows by allowing partial recharges using three charger types with different powers and propose a matheuristic approach to solve it. Our matheuristic couples the Adaptive Large Neighborhood Search with a MIP solver which post-optimizes the station selection and charging decisions.

11h45 Some Recent Research on Electric Vehicle Routing

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Jabali, Ola, Politecnico di Milano, ola.jabali@polimi.it

We introduce a problem in which electric vehicles must deliver goods to a set of customers over multiple days. The charging schedule and infrastructure at the depot must be determined such as to allow them to complete their routes. We model a non-linear charging function and integrate battery health considerations.

WB7 Processus de Markov / Markov Decision Processes

Salle: St-Hubert
Président: Moisan, Thierry, JDA Software

10h30 Renewal Theory Based Reinforcement Learning for Markov Processes with Controlled Restarts

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Markov processes with controlled restarts arise in networked control systems. Under a threshold based strategy, such processes are regenerative. Therefore, the optimal performance can be written in terms of the performance during a regenerative cycle. We exploit this relationship to develop a sample-path based policy gradient algorithm.

10h55 A Markov-Modulated End-to-end Delay Analysis of Large-scale RF-Mesh Networks with Time-slotted ALOHA and FHSS

Malandra, Filippo, Politecnico di Milano, filmal2000@yahoo.it
Sansò, Brunilde, Polytechnique Montreal, brunilde.sanso@polymtl.ca

A new mathematical model and a methodology are proposed to evaluate the performance of large scale RF-Mesh Networks that use time-slotted ALOHA with Frequency Hopping Spread Spectrum. An analytic formulation for the delay, based on Markov-modulated modelling of the system, is derived. The formula can be extended to evaluate other important performance metrics. The proposed methodology is applied to a large scale network of several thousands of nodes, and numerical results are reported to show the wide variety of

performance evaluations that are enabled. The usefulness of the assessment of the feasibility of different types of applications (e.g., smart-metering, sensor networks, IoT) is shown. An analysis of the scalability of this methodology and a comparison with simulation results are also presented.

11h20

Global Inventory Planning with Loosely Coupled Markov Decision processes

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We present a general approach to plan the inventory level of slow-moving items where service level targets are applied on a set of items. Loosely coupled Markov decision processes are used within a column generation algorithm with the objective of minimizing overall costs while satisfying service level targets.