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

10 et 11 mai 2017

1st Canadian Healthcare Optimization Workshop (CHOW)

May 10-11, 2017

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10 et 11 mai 2017

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 comprend 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/JOPT2017/fr/Programmesante

1st Canadian Healthcare Optimization Workshop (CHOW)

May 10-11, 2017

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 includes 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

Résumé du programme / Program Outline

Mercredi 10 mai / Wednesday, May 10

Heure / Hour	Séance / Session	Salle / Room
08h00 – 09h00	Inscriptions / Registration and e-mail facilities	Tata Communications
	Petit déjeuner / Breakfast	Investissement Québec
09h00 - 10h00	Séance plénière / Plenary Session **Brian Denton,** University of Michgan, *Stochastic Optimization for Scheduling in Healthcare Delivery Systems*	Amphi. Banque Nationale
10h00 – 10h30	Pause-café / Coffee Break	Investissement Québec
10h30 – 12h10	Exposé magistral / Tutorial, **Timothy Chan,** University of Toronto, tcychan@mie.utoronto.ca *Inverse optimization and healthcare applications*	Banque CIBC
12h10 - 14h30	Pause déjeuner / Lunch break	
14h30 – 15h30	Exposé magistral / Tutorial **Nadia Lahrichi,** Polytechnique Montreal, nadia.lahrichi@polymtl.ca *Stochastic tabu search: application to align physicians schedule with patient flow*	Banque de développement du Canada
15h30 – 16h30	Exposé magistral / Tutorial **Dionne Aleman,** University of Toronto, aleman@mie.utoronto.ca *Logic-based Benders decomposition approaches to collaborative operating room scheduling*	Banque de développement du Canada
17h15 – 19h00	Cocktail réception / Cocktail reception	Salon Deloitte

Jeudi 11 mai / Thursday, May 11

Heure / Hour	Séance / Session	Salle / Room
08h30 – 09h00	Petit déjeuner / Breakfast	
09h00 - 10h00	Exposé magistral / Tutorial **Peter Van Berkel,** Dalhousie university, Peter.VanBerkel@Dal.Ca *Measuring emergency care networks with location allocation models and GIS*	Banque de développement du Canada
10h00 – 10h30	Pause-café / Coffee Break	
10h30 – 11h30	Exposé magistral / Tutorial **Steven Shechter,** University of British Columbia, steven.shechter@sauder.ubc.ca *Markov Decision Processes in Health Care*	Banque de développement du Canada
11h30 - 13h00	Pause déjeuner / Lunch break	
13h00 – 14h00	Exposé magistral / Tutorial **Nicolas Chapados,** Imagia, chapados@elementai.com *Neural networks: from function approximators to trainable turing machines*	Banque de développement du Canada
14h00 – 15h00	Exposé magistral / Tutorial **Louis-Martin Rousseau,** Polytechnique Montreal, louis-martin.rousseau@polymtl.ca *Opportunities for Combined Machine Learning and Optimization in Homecare and Cancer Treatment Logistics.*	Banque de développement du Canada
15h00 – 15h30	Closing remarks	

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

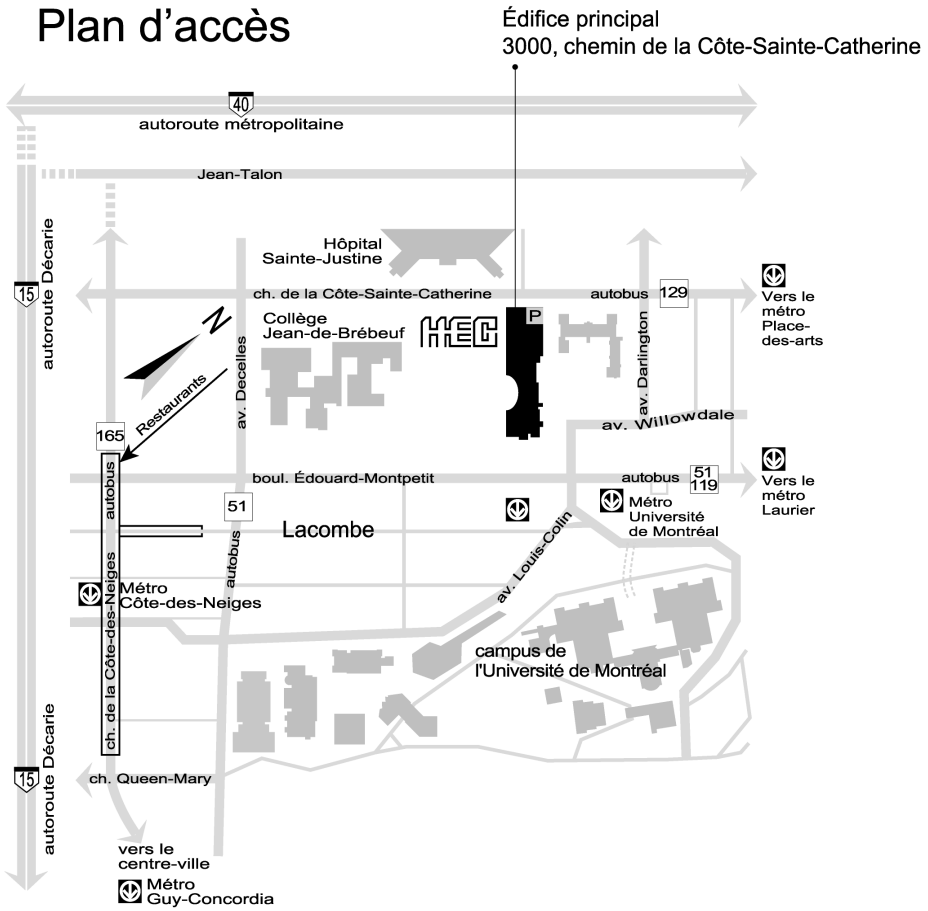
Inscriptions	Salle Tata Communications, en face de l'amphithéâtre Banque Nationale (rez-de jardin)
Petits déjeuners et pauses-café	Adjacent à la salle banque de développement du Canada (1er étage, section bleue)
Séance plénière	Amphithéâtre Banque Nationale (rez-de-jardin)
Exposés magistraux	Salle Banque CIBC (1er étage, section verte) Banque de développement du Canada (1er étage, section bleue)
Cocktail	Salon Deloitte

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	Beside Banque de développement du Canada (1st floor, blue section)
Plenary session	Banque Nationale Lecture Hall (Garden level)
Tutorials	Salle Banque CIBC (1st floor, green section) Banque de developpement du Canada (1st floor, blue section)
Cocktail	Salon Deloitte

Plan du quartier / Area Map

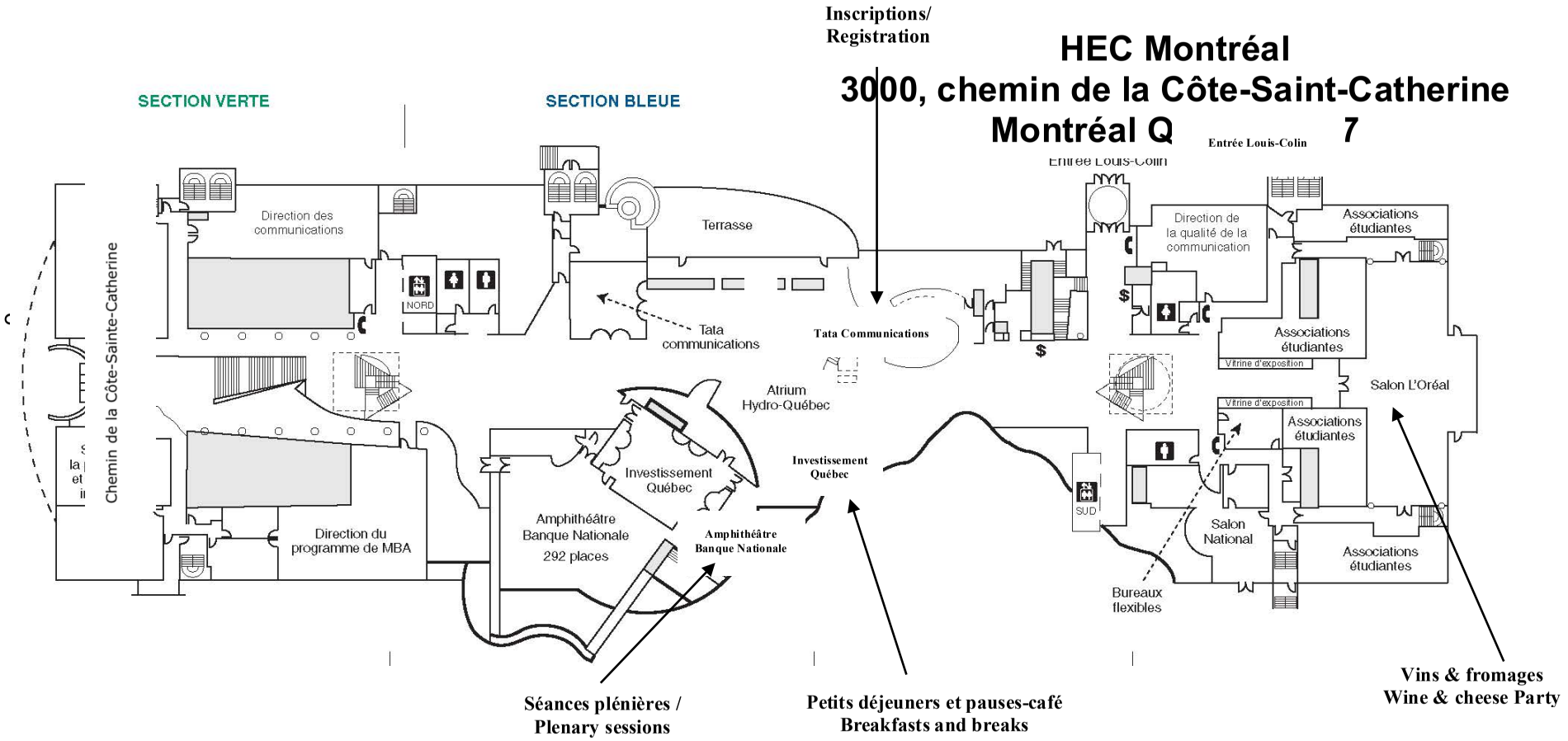


On peut trouver des restaurants sur la rue Lacombe (entre Decelles et Côte-des-Neiges) et sur le chemin Côte-des-Neiges. On peut également déjeuner au Cercle HEC (club facultaire, avec réservation seulement) au 6e étage ou à la cafétéria de HEC Montréal (rez-de-jardin).

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).

REZ-DE JARDIN / GARDEN LEVEL

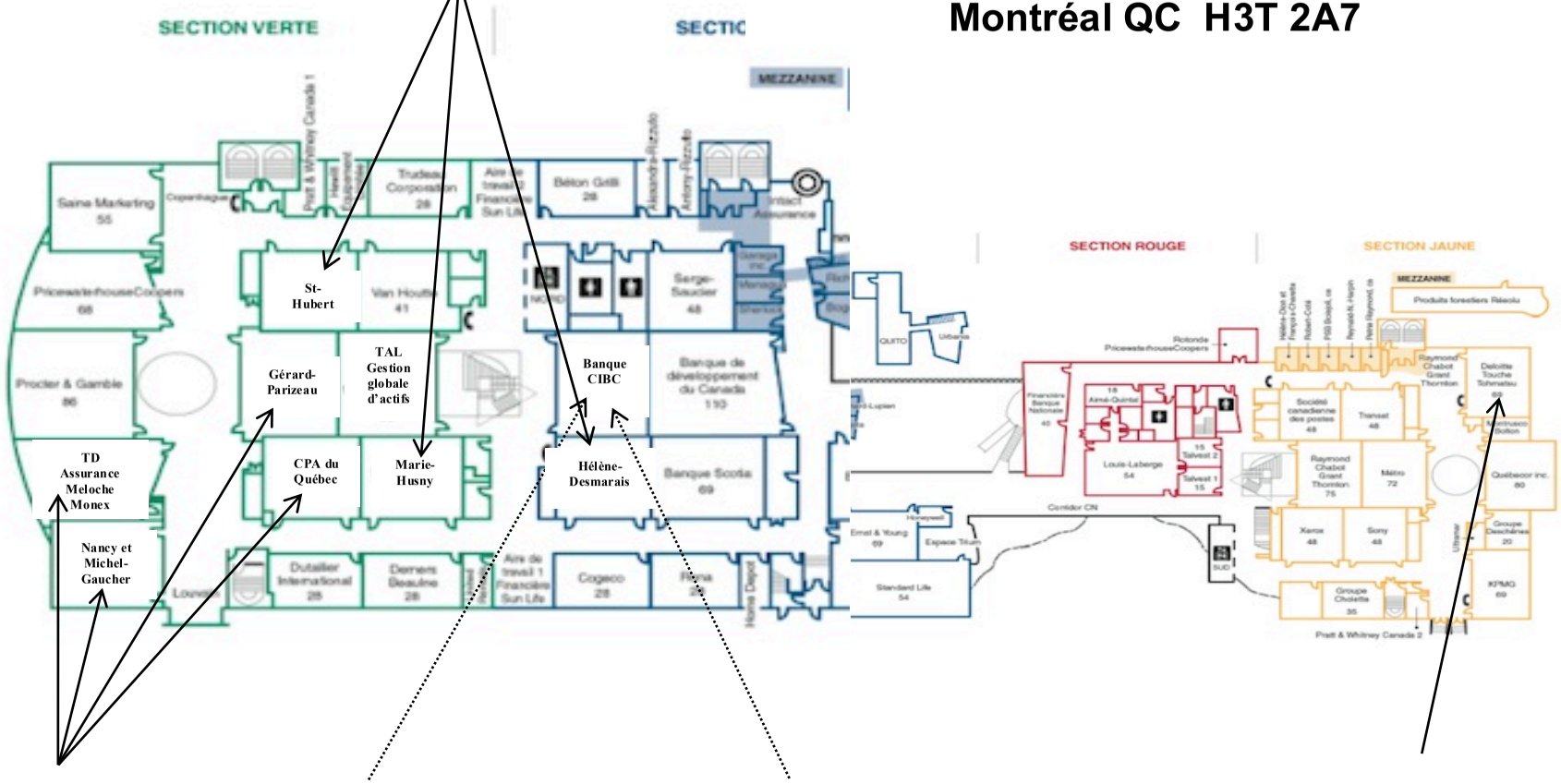
HEC Montréal
3000, chemin de la Côte-Saint-Catherine
Montréal Q 7



1er ÉTAGE / 1st FLOOR

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

Séances en parallèle/
Parallel Sessions



Chemin de la Côte-Sainte-Catherine

Séances en parallèle/
Parallel Sessions

Exposés magistraux /

Anniversaire Chapitre étudiant/Montreal Chapter

Activité Speed-Networking /Speed-Networking Activity

Special sessions dedicated to healthcare, Optimization Days program

Lundi 8 mai 201 / Monday, May 8, 2017

MB8 Applications en santé / Healthcare Applications

Salle: TAL Gestion globale d'actifs inc.
Président: Sabouri, Alireza, University of Calgary

10h30 **Middlware 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**

Sabouri, Alireza, University of Calgary, alireza.sabouri@haskayne.ucalgary.ca
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.

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, rosemarie.santa@gmail.com
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, TeodorGabriel.Crainic@cirrelt.ca

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

Dubois, Elisa, Polytechnique Montréal, elisa.dubois@polymtl.ca
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. 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.

Mardi 9 mai 2017, Tuesday May 9, 2017

TB8 Ordonnancement en santé / Scheduling in Healthcare

Salle: TAL Gestion globale d'actifs inc.
Président: Ben Tayeb, Dina, Polytechnique Montréal

10h30 Chemotherapy Outpatient Scheduling Problem - A Practical Case

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

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.

10h55 Modeling and Optimization of Patient Flows in Radiotherapy Centers

El Abed, Yosra, Polytechnique Montréal, yosra.elabed@polymtl.ca
Rousseau, Louis-Martin, Polytechnique Montreal, louis-martin.rousseau@cirrelt.net
Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca

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.

11h20 Patient Classification for Appointment Scheduling in Ambulatory Clinics

Ben Tayeb, Dina, Université de Montréal, dina.bentayeb@gmail.com
Rousseau, Louis-Martin, Polytechnique Montreal, louis-martin.rousseau@cirrelt.net
Lahrichi, Nadia, Polytechnique Montréal, nadia.lahrichi@polymtl.ca

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.

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**

Ripsman, Danielle, University of Waterloo, daripsma@uwaterloo.ca
Mahmoudzadeh, Houra, University of Waterloo, houra.mahmoudzadeh@uwaterloo.ca
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.

For registration and additional information, refer to the website
https://symposia.cirrelt.ca/JOPT2017/en/home