Combinatorial Optimization and Applications 2017

THE UNIVERSITY of EDINBURGH
School of Mathematics

Date

Friday 10 February, 2017.

Plenary speakers

Horst W. Hamacher (TU Kaiserslautern, Germany)

Martine Labbé (Université Libre de Bruxelles, Belgium).

Marco Lübbecke (RWTH Aachen University, Germany)

Alfredo Marín (Universidad de Murcia, Spain)

Pedro Munari (Universidade Federal de São Carlos, Brazil)

François Vanderbeck (Université de Bordeaux, France)

Conference session

In addition to the presentations of the six plenary speakers, there will be one dedicated session with three conference presentations. If you are interested in presenting your work, please send an abstract of at most one page to coa2017@mlist.is.ed.ac.uk. The deadline for submitting an abstract is Friday, 9 December. Notification of acceptance will be one week later.

Location

The symposium will be held at the University of Edinburgh's George Square campus, which is within short walking distance from the city centre and Waverly train station.

Organisers

Sergio García Quiles

Jörg Kalcsics

Combinatorial Optimization and Applications

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Schedule

8:30 - 9.00	*Registration*
9:00 - 9.50	Francois Vanderbeck, *Revisiting Benders decomposition*
9.50 - 10.40	Marco Lübbecke, *On the strength of Dantzig-Wolfe reformulations*
10.40 - 11:10	*Coffee break*
11.10 - 12.00	Pedro Munari, *Solving challenging VRPs: You better follow the central path*
12:00 - 12.40	J.J. Salazar, *Flight Retiming in an Integrated Airline Scheduling Problem* Marc Goerigk, *On Scenario Aggregation to Approximate Robust Optimisation Problems*
12.40 - 14:10	*Lunch and coffee*
14:10 - 14.50	Alejandro Gutierrez-Alcoba, *A model for vessel fleet composition for maintenance operations at offshore wind farms* Paula Carroll and Mel Devine, *Smart Electricity Grid Tariff Design*
14.50 - 15.40	Martine Labbé, *Stackelberg games and bilevel bilinear optimization problems*
15.40 - 16:10	*Coffee break*
16.10 - 17.00	Horst W. Hamacher, *FlowLoc Problems and Applications*
17.00 - 17.50	Alfredo Marín, *Integer programming problems in map labeling*

Coffee and lunch are included in the registration.

Combinatorial Optimization and Applications

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Invited Presentations

Prof Horst W. Hamacher

Technische Universität Kaiserslautern, Germany

FlowLoc Problems and Applications

FlowLoc integrates the two optimization models network flow and location in a joint one. In this talk two different problem classes of FlowLoc are presented: The sink location problem in which a subset of nodes has to be selected which is best suited to receive the accumulated supply of a flow network, and the (capacity) FlowLoc problem in which facilities have to be placed such that the optimal objective value of a network flow deviates as little as possible from the optimal objective before the location decision. For both problem classes, several versions of the problem are discussed and applications in the organization of public events and evacuation planning are presented.

References:

- Hamacher, H.W., Heller, S., and Rupp, B.: “Flow location (FlowLoc) problems: dynamic network flows and location models for evacuation planning”, Annals of Operations Research 207(1), 161-180, 2013.
- Heßler, P. and Hamacher, H.W.: “Sink Location to Find Optimal Shelters in Evacuation Planning”, EURO Journal on Computational Optimization 4(3), 325-347, 2016.

Prof Martine Labbé

Université Libre de Bruxelles, Belgium

Stackelberg games and bilevel bilinear optimization problems

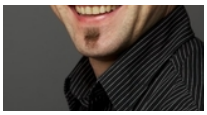
Stackelberg Games confront contenders with opposed objectives, each wanting to optimize their rewards. Decision-making parties involve a party with the capacity of committing to a given action or strategy, referred to as the leader, and a party responding to the leader's action, called the follower. The objective of the game is for the leader to commit to a reward-maximizing strategy anticipating that the follower will best respond.
Finding the optimal mixed strategy of the leader in a Stackelberg Game is NP-hard when the leader faces one out of several followers and polynomial when there exists a fixed number of followers.
Games in which the strategies of the leader consist in covering a subset of at most K targets and the strategies of the followers consist in attacking some target are called Stackelberg Security Games and involve an exponential number of pure strategies for the leader. These games present many applications such as prevention of terrorist attacks, fare evasion in public transportation and illegal extraction of forest resources, regulation control of trucks, etc.
A Stackelberg game can be modeled as a bilevel bilinear optimization problem which can be reformulated as a single level mixed integer nonlinear program (MINLP). We present different reformulations of this MINLP and compare their LP relaxations from both theoretical and computational points of view.

Prof Marco Lübbecke

RWTH Aachen University, Germany

On the strength of Dantzig-Wolfe reformulations

Abstract: tba



Prof Alfredo Marín

Universidad de Murcia, Spain

Integer programming problems in map labeling

Abstract: tba

Dr Pedro Munari

Universidade Federal de São Carlos, Brazil

Solving challenging vehicle routing problems: you better follow the central path

The vehicle routing problem (VRP) is one of the most challenging combinatorial optimization problems. In practice, it is an important tool for effective decision making in many situations that have a big impact to our day-to-day lives. In this talk, we briefly review the state-of-the-art approaches for the VRP and show the benefits of using the primal-dual interior point algorithm within column generation and branch-and-price, to solve variants of this problem. We present the different ways of doing this integration and show computational results using well-known instances from the literature as well as real-life data. One of the VRP variants includes the decision of how many service workers to assign to each route and the other is a pickup and delivery problem motivated by an application in the oil industry. We close the talk showing promising computational results for large-scale instances of a related problem, the dynamic vehicle allocation problem, using real-life data provided by a trucking company.

Prof François Vanderbeck

Université de Bordeaux, France

Revisiting Benders decomposition

Abstract: tba

Conference Presesentations

Prof Juan José Salazar González

Universidad de La Laguna, Spain

Flight Retiming in an Integrated Airline Scheduling Problem

In this work, we integrate three stages of the airline scheduling problem, namely fleet assignment, aircraft routing, and crew pairing, and combine the integrated problem with flight retiming. Fleet assignment is solved to decide which fleet must be assigned to each flight, aircraft routing to determine minimum-cost aircraft routes so that each flight is operated by an aircraft and maintenance requirements are satisfied, and crew pairing to find minimum-cost crew routes so that each flight is operated by one crew and the work rules are respected. The problem is motivated by a real-world application of an airline company flying in Canary Islands. The application is described in [1], where a heuristic approach is described for the problem without the retiming. Also for the problem without retiming, an optimal approach is described in [2]. In this talk we extend the original airline problem by considering flight retiming, i.e. we allow a given discrete set of alternative departure times for each flight. Our goal is twofold: we want to determine solutions that are, on one hand, robust against delays, and, on the other hand, efficient in terms of cost

minimization. Achieving robust solutions is very important in airline scheduling, as delay propagation can make the planned solution infeasible and lead to additional costs for the company (e.g. the need of additional crew or the expenses for the passengers), and also creates inconvenience to the passengers.
It is a join work with Valentina Cacchiani (University of Bologna, Italy) and partially funded by the Spanish research project MTM2015-63680-R (MINECO/FEDER).

References

[1] Salazar-González, J.-J., Approaches to solve the fleet-assignment, aircraft-routing, crew-pairing and crew-rostering problems of a regional carrier, (2014) Omega (United Kingdom), 43, pp. 71-82.

[2] Cacchiani, V., Salazar-González, J.-J., Optimal Solutions to a Real-World Integrated Airline Scheduling Problem, Transportation Science (2016), in press

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Marc Goerigk

Lancaster University, United Kingdom

On Scenario Aggregation to Approximate Robust Optimisation Problems

Abstract

Paula Carroll and Mel Devine

University College Dublin & The Economic and Social Research Institute, Ireland

Smart Electricity Grid Tariff Design

Pricing incentives for residential electricity usage are seen as key factors for success to achieve reductions in greenhouse gases and increases in the use of re- newable energy sources. Effective rate design could facilitate these objectives. Demand side management programmes aim to modify patterns of consumer de- mand for energy and, for example, to shift demand from peak hours to off-peak hours and so make markets more exible and facilitate the integration of renewable energy sources. Information on electricity can be delivered in-home and real-time via Smart Meters, to help consumers reduce their overall energy use and bills. Tariffs can be communicated but increases in the number of variables in the tariff may confuse consumers.
We assume consumers wish to minimise their usage costs while suppliers wish to maximise their revenues (and possibly minimise their risk in certain markets). In parallel, national energy market regulators wish to protect consumers, ensure a level playing eld between suppliers, protect the environment and ensure energy is supplied safely. The Commission for Energy Regulation (CER) is the independent energy regulator in Ireland. CER wish to ensure value-for-money for consumers and that it is easy for consumers to be able to understand and compare tariffs in any Smart Meter programme.
The single biggest component of electricity costs are generation costs, which are primarily determined by the market. Currently, the Irish electricity market is undergoing a reorganisation to ensure greater integration with other markets in the European Union. The new market will be called the Integrated Single Electricity Market (I-SEM). Suppliers may buy from I-SEM at the System Marginal Price (SMP) to meet the estimated demand of their clients (consumers).
In this paper we describe a case study taking the perspective of an individ- ual supplier operating in the Irish market. We ask if Time-of-Use tariffs can be designed to maximise revenue while accounting for the resulting impact on con- sumer electricity usage behaviour. We set up the problem as a Stackelberg leader game. The leader is the supplier who decides the tariff plan prices and structure. They do so in order to maximise their prots but subject to the consumer also minimising their costs. Given these prices the consumer (i.e., the follower) must choose their consumption level in each time period. The problem is converted to a bilevel stochastic programming problem. The uncertainty in the SMP and consumer usage are addressed using Stochastic Programming. Historic market data allows models of the SMP to be created but there is considerable uncertainty about the impact of the new market structure. Previous CER consumer behaviour trials give an indication of the responsiveness of consumers to price incentives and allow consumer usage to be modelled.

Alejandro Gutierrez-Alcoba

Universidad de Málaga, Spain

A model for vessel fleet composition for maintenance operations at offshore wind farms

With Gloria Ortega and Eligius M.T. Hendrix Chartering a vessel fleet to support maintenance operations at offshore wind farms (OWF's) constitutes one of the major costs of maintaining this type of installations. We present a discrete optimization model that chooses an optimal fleet of vessels to support maintenance operations. These operations can be classified as preventive and corrective activities. The first type aims at reducing the likelihood of breakdowns and to prolong the life of turbine components. Corrective activity types are needed to fix stochastic breakdowns in turbines when they occur.
The model is presented as a bi-level problem. On the first (tactical) level, decisions are made on the fleet composition for a certain time horizon. On the second (operational) level, the fleet is used to optimise the schedule of operations needed at the OWF, given random events of failures and weather conditions. The question is what is the best way to solve such a model that consists basically of tens of thousands of discrete variables and constraints. We are experimenting at the moment with a large branch and bound in CPLEX and the option to try to solve the problem in a bi-level way, where the operational scheduling for each scenario can be solved in parallel for the set of scenarios.