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Optimization and its **A**pplications in **L**earning and **I**ndustry (OptALI)

IRSES

Ongoing Deliverable D1.2

Description of Research Seminars

Start date of the Workpackage:	December 2010
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Research Seminar

offered by Jonas Harbering (University of Goettingen)

in February 2015,

in Auckland, New Zealand

Subject: Line Planning in the Scope of Integrative Public Transportation Planning

Problem: Problems lying within the area of public transportation planning have been studied thoroughly. Only in recent years, more investigation towards the integration of different subproblems has been conducted. As an example for integrative public transportation planning the presented problem tries to combine the analysis of two problems at the same time. The combined problems are line planning and delay management.

Usually, the modeling basis of the delay management assumes that delays are mainly spread within the transportation system along transferring passengers. If a train arrives with delay and there are passengers transferring towards another train, it has to be decided whether or not the second train should wait. Waiting causes the second train to take over some knock on delay from the transferring passengers. Otherwise, departing on time, means that passengers have to wait for their next connection.

Hence, the transfers of passengers are crucial in the delay management context. Looking at the line planning stage, passenger transfers can already be estimated here. Thus, the new model aims at finding a feasible line concept that minimizes the estimated passenger transfers.

Main Results: Considering the flow of the passengers within the line planning problem is a very hard problem. This is also true if the consideration only focuses on the transfers and neglects in-train travels. Hence, the IP-formulation is intractable.

Still, the analysis of a column generation approach for generating the paths of the passengers turns out to be well-posed. The sub-problem which generates promising columns results an all pairs shortest path problem which can be solved efficiently.

The performance of the column generation in comparison to the IP-formulation is presented on small instances. It shows that the gap between the best column generation solution and the optimal solution is usually very small. But, in turn, the computation time is by far smaller for the column generation algorithm.

Finally, investigating on the delay effect of the new transfer minimizing model the following computation is executed. Four different line planning models (the new passenger transfer minimization model, a cost minimization model, a direct travellers maximization model and a game theory based model) are considered for which a line concept and a timetable is generated (of similar quality in order to factor out effects of the timetable) and based on a set of delays, a disposition timetable is computed. The disposition timetable computation is conducted for 100 different delay scenarios, and upon that, average values are compared.

As the intoductory idea for the model assumed, the passenger transfers minimization line planning model achieves the best delay-resistance. Still the difference in comparison to the direct travellers and the game theory based model is rather small. In exchange for the good delay resistance the price of the new model is a very costly line concept.

Participants: Researchers and Students from the University of Auckland and researchers from the universities of Copenhagen, Kaiserslautern and Göttingen.

Publication: