ATMOS 2005 — Abstract Collection
Selected Papers from the 5th Workshop on Algorithmic Methods and Models for Optimization of Railways

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Abstract. This issue contains six papers that were presented in preliminary form at the 5th Workshop on Algorithmic Methods and Models for Optimization of Railways (ATMOS 2005), held at Palma de Mallorca, Spain, October 7, 2005 in conjunction with ALGO 2005. These papers are representative of several areas of research within the scope of ATMOS: rolling stock circulation and engine assignment, station location, line planning, railway traffic scheduling and dispatching, transfer optimization within network design, and fast traffic information systems.

Keywords. Railway traffic, networks, algorithms, optimization

Combinatorial Optimization Model for Railway Engine Assignment Problem

Illés, Tibor; Makai, Márton; Vaik, Zsuzsanna

This paper presents an experimental study for the Hungarian State Railway Company (MV). The engine assignment problem was solved at MV by their experts without using any explicit operations research tool. Furthermore, the operations research model was not known at the company. The goal of our project was to introduce and solve an operations research model for the engine assignment problem on real data sets. For the engine assignment problem we are using a combinatorial optimization model. At this stage of research the single type train that is pulled by a single type engine is modeled and solved for real data. There are two regions in Hungary where the methodology described in this paper can be used and MÁV started to use it regularly. There is a need to generalize the model for multiple type trains and multiple type engines.

Keywords: Engine assignment, circulation

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/662

Station Location – Complexity and Approximation

Mecke, Steffen; Schöbel, Anita; Wagner, Dorothea

We consider a geometric set covering problem. In its original form it consists of adding stations to an existing geometric transportation network so that each of a given set of settlements is not too far from a station. The problem is known to be NP-hard in general. However, special cases with certain properties have been shown to be efficiently solvable in theory and in practice, especially if the covering matrix has (almost) consecutive ones property. In this paper we are narrowing the gap between intractable and efficiently solvable cases of the problem. We also present an approximation algorithm for cases with almost consecutive ones property.

Keywords: Station Location, facility location, complexity, approximation

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/661

Line Planning with Minimal Traveling Time

Schöbel, Anita; Scholl, Susanne

An important strategic element in the planning process of public transportation is the development of a line concept, i.e. to find a set of paths for operating lines on them. So far, most of the models in the literature aim to minimize the costs or to maximize the number of direct travelers. In this paper we present a new approach minimizing the travel times over all customers including penalties for the transfers needed. This approach maximizes the comfort of the passengers and will make the resulting timetable more reliable. To tackle our problem we present integer programming models and suggest a solution approach using Dantzig-Wolfe decomposition for solving the LP-relaxation. Numerical results of real-world instances are presented.

Keywords: Line planning, real-world problem, integer programming, Dantzig-Wolfe decomposition

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/660

Computer-based decision support for railway traffic scheduling and dispatching: A review of models and algorithms

Törnquist, Johanna

This paper provides an overview of the research in railway scheduling and dispatching. A distinction is made between tactical scheduling, operational scheduling and re-scheduling. Tactical scheduling refers to master scheduling, whereas operational scheduling concerns scheduling at a later stage. Re-scheduling focuses on the re-planning of an existing timetable when deviations from it have occurred. 48 approaches published between 1973 and 2005 have been reviewed according to a framework that classifies them with respect to problem type, solution mechanism, and type of evaluation. 26 of the approaches support the representation of a railway network rather than a railway line, but the majority has been experimentally evaluated for traffic on a line. 94 % of the approaches have been subject to some kind of experimental evaluation, while approximately 4 % have been implemented. The solutions proposed vary from myopic, priority-based algorithms, to traditional operations research techniques and the application of agent technology.

Keywords: Decision support, railway traffic scheduling, railway traffic dispatching, overview

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/659

Analysis of the Parameters of Transfers in Rapid Transit Network Design

García, Ricardo; Garzón-Astolfi, Armando; Marín, Angel; Mesa, Juan A.; Ortega, Francisco A.

The rapid transit network design problem consists of the location of train alignments and stations in an urban traffic context. The originality of our study is to incorporate into the location model the decisions about the transportation mode and the route, to be chosen for urban trips. This paper proposes a new design model which includes transfers between train lines. The objective of the model is to maximize the number of expected users in the transit network taking limited budgets into consideration, in addition to location and allocation constraints. Furthermore, the transfer costs are considered in the generalized public costs when the users change lines. Waiting time to take the metro and walking time to transfer is included in the formulation of the costs. The analysis of transfer parameters is carried out using a test network. Some computational experience is included in the paper.

Keywords: Parameter analysis, rapid transit network design, trip choice in urban traffic

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/658

Paying Less for Train Connections with MOTIS

Müller-Hannemann, Matthias; Schnee, Mathias

Finding cheap train connections for long-distance traffic is algorithmically a hard task due to very complex tariff regulations. Several new tariff options have been developed in recent years, partly to react on the stronger competition with low-cost airline carriers. In such an environment, it becomes more and more important that search engines for travel connections are able to find special offers efficiently.

We have developed a multi-objective traffic information system (MOTIS) which finds all attractive train connections with respect to travel time, number of interchanges, and ticket costs. In contrast, most servers for timetable information as well as the theoretical literature on this subject focus only on travel time as the primary objective, and secondary objectives like the number of interchanges are treated only heuristically.

The purpose of this paper is to show by means of a case study how several of the most common tariff rules (including special offers) can be embedded into a general multi-objective search tool.

Computational results show that a multi-objective search with a mixture of tariff rules can be done almost as fast as just with one regular tariff. For the train schedule of Germany, a query can be answered within 1.9s on average on a standard PC.

Keywords: Timetable information system, multi-criteria optimization, shortest paths, fares, special offers, long-distance traffic

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/657