5th Workshop on Algorithmic Methods and Models for Optimization of Railways

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Edited by

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ATMOS Preface: Algorithmic Methods and Models for Optimization of Railways

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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.

The authors of the papers in this volume were invited to submit extended versions of their ATMOS 2005 papers. All papers were accepted after a review process performed by members of the ATMOS 2005 Program Committee. 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.

The paper "Analysis of the Parameters of Transfers in Rapid Transit Network Design" by R. García, A. Garzón-Astolfi, A. Marín, J. A. Mesa, and F. A. Ortega considers the rapid transit network design problem that consists in the location of train alignments and stations in an urban traffic context. For the first time, they incorporate into the location model the decisions about the transportation mode and the route to be chosen for urban trips. These decisions include 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. Some computational experience is included in the paper.

In their paper "Combinatorial Optimization Model for Railway Engine Assignment Problem", T. Illés, M. Makai, and Zs. Vaik present an experimental study for the Hungarian State Railway Company (MÁV). The timetable of passenger trains of a region of Hungary is given, and engines (locomotives) must be assigned to each passenger train under some operational policies including maintenance and connection times for linking trains together. The goal is to minimize the number of engines used. The authors develop an integer programming model for the full problem and use a minimum cost flow algorithm for the problem without maintenance which reduces to a circulation problem.

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The paper "Computer-based decision support for railway traffic scheduling and dispatching: A review of models and algorithms", by J. Törnquist 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.

In their paper "Line Planning with Minimal Traveling Time", A. Schöbel and S. Scholl deal with an important strategic element in the planning process of public transportation, viz. 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 at minimizing the costs or maximizing the number of direct travelers. The authors 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 makes the resulting timetable more reliable. Their approach is based on integer programming models and uses Dantzig-Wolfe decomposition for solving the LP-relaxation. Numerical results of real-world instances are presented.

The paper "Paying Less for Train Connections with MOTIS" by M. Müller-Hannemann and M. Schnee reports on the development of 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. 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. The authors show in their paper 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.

The paper by S. Mecke, A. Schöbel, and D. Wagner on "Station Location – Algorithms and Complexity" investigates the question to add 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 $\mathcal{NP}$-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 their paper the authors are narrowing the gap between intractable and efficiently solvable cases of the problem and present an approximation algorithm for cases with almost consecutive ones property.

We would like to thank the referees for their conscientious and timely work, and the editors of the Dagstuhl Seminar Proceedings for the opportunity to publish this special issue in DROPS.