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

IRSES

Ongoing Deliverable D1.2

Description of Research Seminar: Integrating routing decisions in public

transportation models

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Participants:	UGOE UNIKL DTU UOA UC
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Research Seminar

offered by Marie Schmidt (ES-UGOE-2)

in March 2011,

in Auckland, New Zealand

Subject: Optimization in public transportation - Integrating routing decisions in public transportation models

Problem: To model and solve optimization problems arising in public transportation, data about the passengers is necessary and has to be included in the models in any phase of the planning process. Many approaches assume a two-step procedure: in a first step, the data about the passengers, consisting of their origin and destination stations, is distributed over the public transportation network using traffic assignment procedures. In a second step, the actual planning of lines, timetables, etc. takes place. This approach ignores that for most passengers there are many possible ways to reach their destinations in the public transportation network, thus the actual connections the passengers will take depend strongly on the decisions made during the planning phase.

We consider the problem of aperiodic timetabling and try to integrate both steps, i.e., to determine a timetable and a routing for the passengers simultaneously, with the objective of minimizing the overall travel time of the passengers in the network. This problem is called *timetabling with routing (TTwR)*.

Main Results: We found that after some small modificatons, the concept of an *event-activity network (EAN)* often used for timetabling problems, is suitable for modelling TTwR, since the passengers' journeys can be represented as collections of paths in the EAN.

Although aperiodic timetabling is easily solvable by linear programming if the passengers' paths are known in advance, the integrated problem TTwR results to be NP-hard.

We developed four solution approaches for TTwR

1. a first integer programming formulation obtained by adding multi-commodity-flow constraints to an integer programming formulation of timetabling with fixed passenger paths,
2. a second integer programming formulation, relying on the fact that if a passenger can choose between different options to travel from his origin station to his destination station, his travel time depends only on the first and the last train taken,
3. an enumeration algorithm based on the same idea as (2.), and
4. a heuristic approach, iterating the calculations of timetables and passengers' paths in the network.

Participants: students and researchers from UOA.

Publication: -