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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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Participants:	UGOE UNIKL DTU UOA UC
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Research Seminar

offered by Olga Perederieieva (UOA)

in April 2014,

in Göttingen, Germany

Subject: Bi-objective Shortest Path Problem in the Context of Traffic Assignment

Problem: Traffic congestion is an issue in most cities worldwide. Transportation engineers and urban planners develop various traffic management projects in order to solve this issue. One way to evaluate such projects is traffic assignment (TA). The goal of TA is to predict the behaviour of road users for a given period of time (morning and evening peaks, for example). Once such a model is created, it can be used to analyse the usage of a road network and to predict the impact of implementing a potential project. The most commonly used TA model is known as user equilibrium, which is based on the assumption that all drivers minimise their travel time or generalised cost, which usually represents a linear combination of time and monetary cost. This approach is not general. It allows to find only a subset of all equilibrium solutions. We propose to use a conceptually different approach inspired by the multi-objective definition of optimality – the bi-objective user equilibrium (BUE). It considers two objectives separately and allows multiple solutions. In particular, we assume that all drivers minimise their travel time and toll.

In order to find one of the solutions that satisfy the BUE condition, a non-linear scalarisation technique can be applied. This non-linear scalarisation involves solving non-additive shortest path problem (NSPP) which is closely related to bi-objective shortest path problem. In fact, the solution to NSPP is one of the efficient solutions of the corresponding bi-objective shortest path. Because of this, NSPP is usually solved

by solving the bi-objective problem first and then choosing one of the efficient solutions that minimises non-additive path cost function.

Solving NSPP is a bottleneck operation of the algorithms for solving BUE, i.e. it takes the majority of the computational time of the algorithms. This motivates us to find better approaches to solve NSPP that will allow to significantly reduce computational time of the algorithms. In order to achieve this goal we want to exploit a specific problem structure of the traffic assignment problem. In particular, a fixed transportation graph requires many point-to-point non-additive shortest path calculations. Non-additive path cost function is based on two criteria: travel time and toll. All tolls are fixed integer numbers. Typically there are only a few tolled links in the transportation network. Link travel times depend on link flow (i.e. they slightly change from iteration to iteration) and are real numbers.

Main Results: The seminar was a discussion of this open problem. In collaboration with Marie Schmidt we explored several ways of how we can improve the performance of the algorithms for non-additive shortest path problem. It is on-going research. At the current stage we work on implementation of the proposed speed-up techniques and on the development of a new method based on a different dominance relation.

Participants: researchers from UGOE

Publication: -