Abstract:
Motivated by the increasing complexity in logistics networks and hereby the rise in transportation costs, this present thesis examines a special case of the Hub Location and Routing Problem (HLRP). It is written in cooperation with the fourth-party logistics provider 4flow which supports companies in planning their transportation networks by using a combination of different heuristics. This thesis examines the practicability and improvement of an exact solution in comparison to the state-of-the-art solution at 4flow. The work is driven by the question whether modeling and solving real logistics instances by an exact algorithm is possible. Apart from that, solving the problem by exact methods using edge-based formulations was attempted by 4flow before. In contrast to the heuristic method, the inclusion of the routing option Milkrun was not possible there. In this thesis a path-based formulation, which does include Milkruns, is developed instead. In the first chapter a brief introduction to 4flow, the project RobuNet and relevant logistics terms and processes is given to understand the assumptions and constraints of the special HLRP which 4flow copes with. In chapter 2 the problem is classified among the literature of vehicle routing, location and nonlinear-cost problems. A short overview and a model formulation of every problem are given and the components, which are relevant for modeling the special transportation problem, are presented. In chapter 3 a model of the special HLRP is
developed by starting with a mathematical formulation of the logistics terms and assumptions which repeat the logistics processes mentioned in chapter 1 in a mathematical manner. Here- upon a MIP is formulated in a straightforward approach which is then improved by another formulation. By using Special Ordered Sets of type 1, introducing penalty costs to handle the problem of symmetry effects and making use of knowledge about the routing option Milkrun, performance and complexity can be improved. However the algorithm still grows exponen- tially with the input data and by additionally dealing with a usual size of more than 1,000 nodes and 10,000 edges, the problem becomes intractable. Consequently a method for solving large-scale LP’s - Column Generation - is introduced and applied to the improved modeling approach in chapter 4. To generate a feasible start solution for Column Generation a succes- sive algorithm is presented as well. Finally in chapter 5 case studies, which consist of network data deriving from customers of 4flow, are presented first. Then the exact solution method, which was developed in this thesis, is applied. A major drawback of the algorithm on the net- work instances is identified due to their special demand structure. The last chapter sums these insights up, explaining the impossibility of a solely exact solution method, and closes with a brief outlook.

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**Hochschule / Universität:** Technische Universität München

**Fakultät:** Fakultät für Mathematik

**TUM-Institution:** Zentrum Mathematik

**Ort:** Garching bei München

**Occurences:**

**entries:**