



At the Chair of Logistics and Supply Chain Management of TUM School of Management, we are looking for an interested and qualified student to conduct his/her

Master thesis

on the topic

Decomposition-Based Optimization in Two-Echelon VRPs

The Two-Echelon Vehicle Routing Problem (2E-VRP) models a distribution system in which goods are transported from a central depot to end customers via intermediate satellite facilities (Sluijk et al., 2023). Solving the 2E-VRP in an integrated manner is computationally demanding due to the strong interdependence between the two routing levels.

This thesis explores a decomposition-based solution strategy, where the first echelon (depot to satellites) and the second echelon (satellites to customers) are optimized separately. Coordination mechanisms are applied to ensure consistency and feasibility between the subproblem solutions. As an example, the second echelon can be formulated as a limited set of multi-depot capacitated vehicle routing problems with side constraints (Baldacci et al., 2013). The aim of this thesis is to evaluate the proposed decomposition method in terms of both solution quality and computational efficiency.

Key project tasks

- Literature review on relevant fields of study
- Design and implement a decomposition-based solution framework
- Develop (meta-)heuristics for solving each echelon independently, incorporating satellite capacity and demand balancing constraints
- Evaluate the performance of the decomposition approach on benchmark instances

Requirements

The thesis is suitable for Master in Management and Technology students with a major in operations and supply chain management. The ability to work independently as well as analytical skills are required. Knowledge of one general-purpose programming language (e.g., Python, Julia) is required. Knowledge of mathematical programming and optimization is preferred.

Earliest begin: November 2025

Supervisor: Nicolas Kuttruff

Application: Email with curriculum vitae and transcript of records to logtheses.log@mgt.tum.de.

References

- Baldacci, R., Mingozzi, A., Roberti, R., Calvo, R.W., 2013. An exact algorithm for the two-echelon capacitated vehicle routing problem. *Operations Research* 61, 298–314. doi:10.1287/opre.1120.1153.
- Sluijk, N., Florio, A.M., Kinable, J., Dellaert, N., van Woensel, T., 2023. Two-echelon vehicle routing problems: A literature review. *European Journal of Operational Research* 304, 865–886. doi:10.1016/j.ejor.2022.02.022.