Professorship of Business Analytics & Intelligent Systems
TUM School of Management
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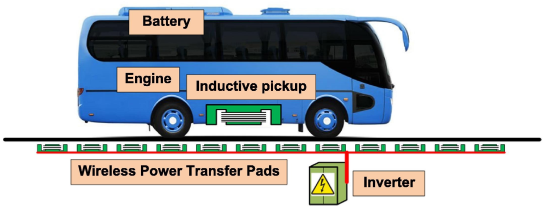
Inductive charging infrastructure for electric shuttle services

Problem Definition: Road-based public transportation, such as buses and shuttles, plays a central role in urban mobility by offering affordable, flexible, and sustainable travel options. Most current fleets still rely on combustion engines and contribute significantly to carbon dioxide emissions. On the other hand, battery-electric vehicles yield almost zero tailpipe emissions. However, their implementation poses operational challenges. Limited driving range necessitates intermediate recharging, which leads to service downtime, increased space requirements for charging infrastructure, and manual intervention through plug-in procedures.

Dynamic wireless charging, which allows vehicles to recharge while driving, can address many of these limitations. This technology enables the use of smaller and lighter batteries, improving energy efficiency and increasing the available space for passengers or cargo. It also allows vehicles to maintain continuous operation without stopping for recharging.

This research is part of a project focused on deploying autonomous shuttles equipped with inductive charging in rural areas. In a real-world testbed in the town of Bad Staffelstein in Germany, two autonomous electric shuttles are being tested under realistic service conditions. These shuttles are capable of both stationary and dynamic inductive charging, allowing them to recharge without manual intervention. This supports fully autonomous operation and extends vehicle range by enabling charging during scheduled trips.

Electric and autonomous bus



Inductive charging system

Aims and Scope of this Thesis: This thesis aims to provide an extensive literature review about microscopic studies on infrastructure planning for dynamic charging of electric vehicles. The literature review should particularly emphasize studies on application cases outside of passenger transportation, such as e.g., airpron buses or electric vehicles in the warehousing and manufacturing context. Moreover, this thesis aims to conduct a case study based on the road network in the city of Aachen, Germany. Specifically, this thesis comprises the following tasks:

1) Conducting a comprehensive literature review on inductive charging of electric vehicles, with a particular focus on applications beyond passenger transport modes such as buses and shuttles.
2) Developing a multi-process C++ implementation of the subproblem outlined in Bischoff et al. (2025).
3) Developing a case study on the bus network of Aachen, Germany, utilizing data from Dirks et al. (2022).
4) Designing an integrated method to prevent conflicts between one or more vehicles at stationary charging stations and testing the method based on the developed case study.

References

Bischoff, P. and Hammani, S. and Schiffer, M. *Infrastructure Planning for Inductive Charging in Electrified Shuttle Systems*. arXiv preprint arXiv:2505.18403, 2025.

Dirks, N. and Schiffer, M. and Walther, G. (2022) *On the integration of battery electric buses into urban bus networks*. Transportation Research Part C: Emerging Technologies, 139:103628.

Begin: As soon as possible

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