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Enhancing Commuter Mobility: A Methodology for Deriving and Optimizing Mobility Services

17.06.2024 MATSim User Meeting

Situation

Commuter traffic

Impact

20% of traffic caused by commuters

74% commuting distance covered by private car

Chances

Plannable, **repeating** trips

- Efficient services, stable profit and impact

Interests from **sub-urban/rural regions and companies**

- Accessibility and utilisation of PT, incentives for employees

Network effects from **high trip density** and **cooperation with companies**

- High efficiency pooling and public transport options due to same commuting time (and destination)

Problem : „Unlimited“ possibilities

Multiple different **Mobility Modes**

Multimodal and **Intermodal use** of mobility modes

Existing Infrastructure and **Policy measures**

Constraints and Objectives

Methodology

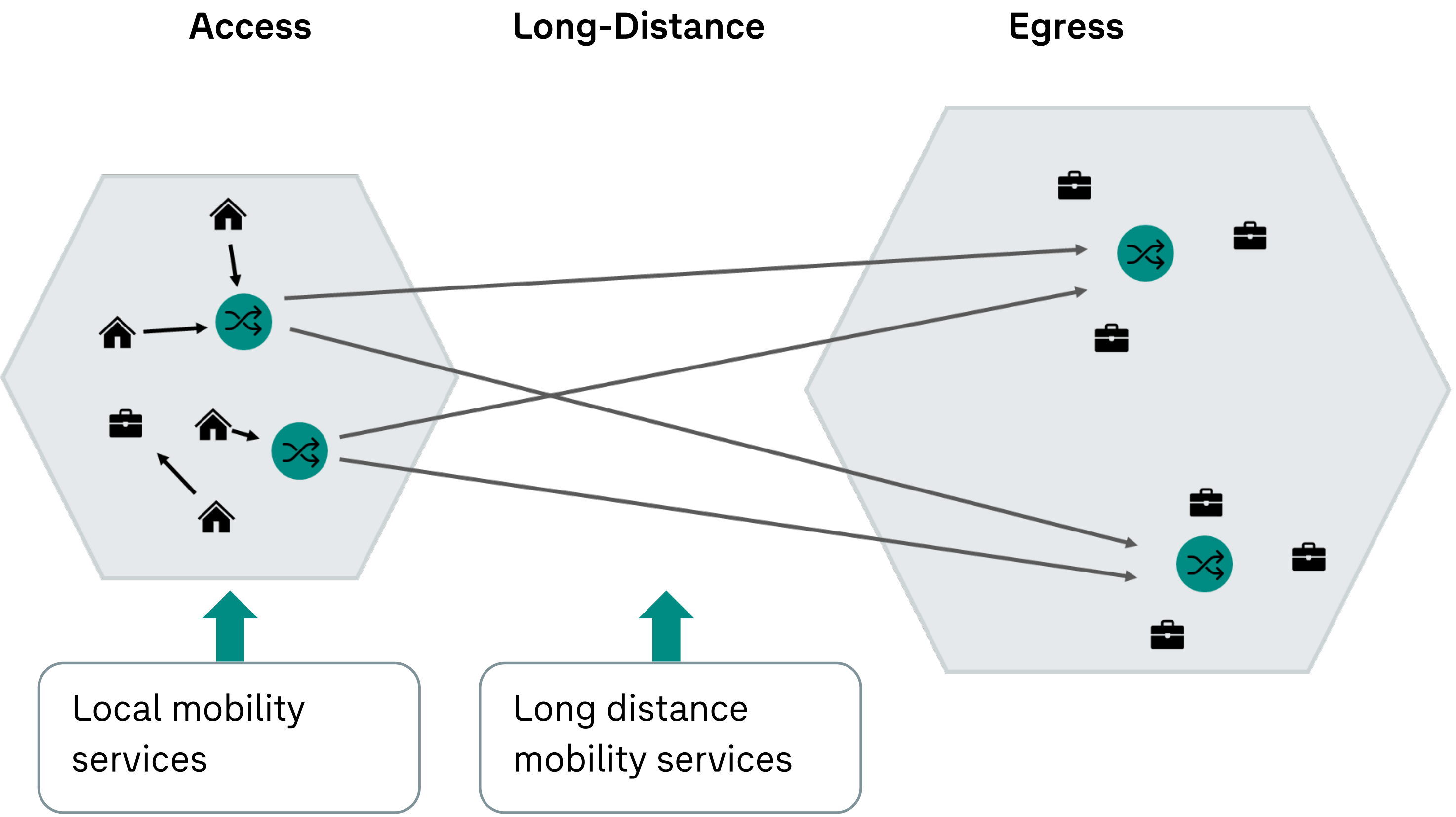
Long Distance Commuter Mobility Service

Scenario
- Population
- Network
- Transit schedule
- Policy measures

Mobility modes

Boundaries and Objectives

Mobility Simulation + Optimizer



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Methodology

Contribution

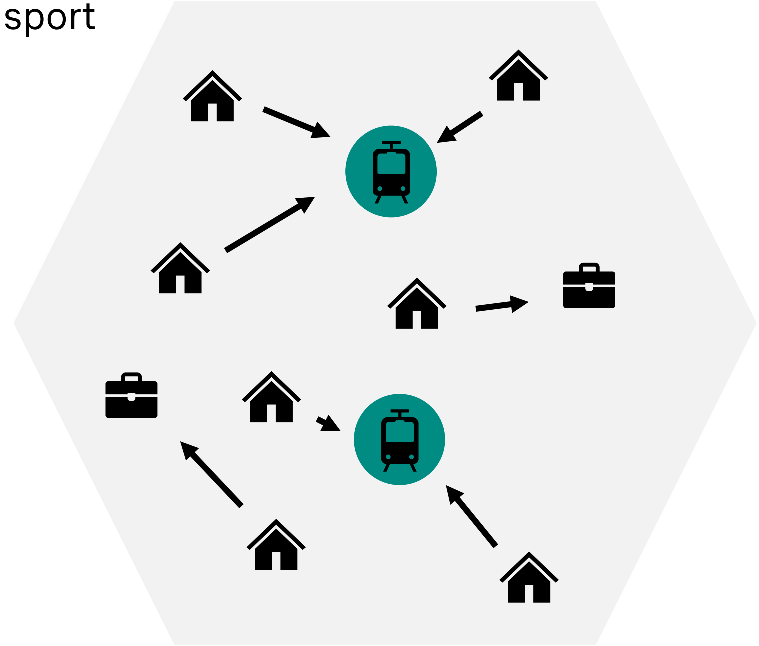
Enable or disable (predefined) modes in the target region

Usage of Local Modes:

- direct trips
- access / egress within the service area

Long Distance Mode:

- Public transport



Mobility Service Choice Set

	Trial 1	Trial 2	● ● ●
Ridepooling	✓	✓	
Ridehailing	✓	✓	
Sharing services			
Bike	✓	✗	
Car	✗	✗	

Intermodal Transport

Contribution

Optimization

Intermodal Trips

Importance
- Large search spaces

Problems
- Long exploration phase
- Restricted changes possible once the controller is running

Approach
- Terminate the simulation when equilibrium is reached, use this as a starting point for the next simulation

Importance
- Enables more efficient transportation
- Essential for rural public transport
- Individual trip planning enabled by agent-based simulation approach

Problems
- Private vehicle (chain-based modes) can not be used for intermodal transport
- No specific intermodal scoring function

Approach
- Allow chain-based modes everywhere
- Check for vehicle availability during replanning
- Filter feasible trips
- Weight scoring constants based on trip distance share

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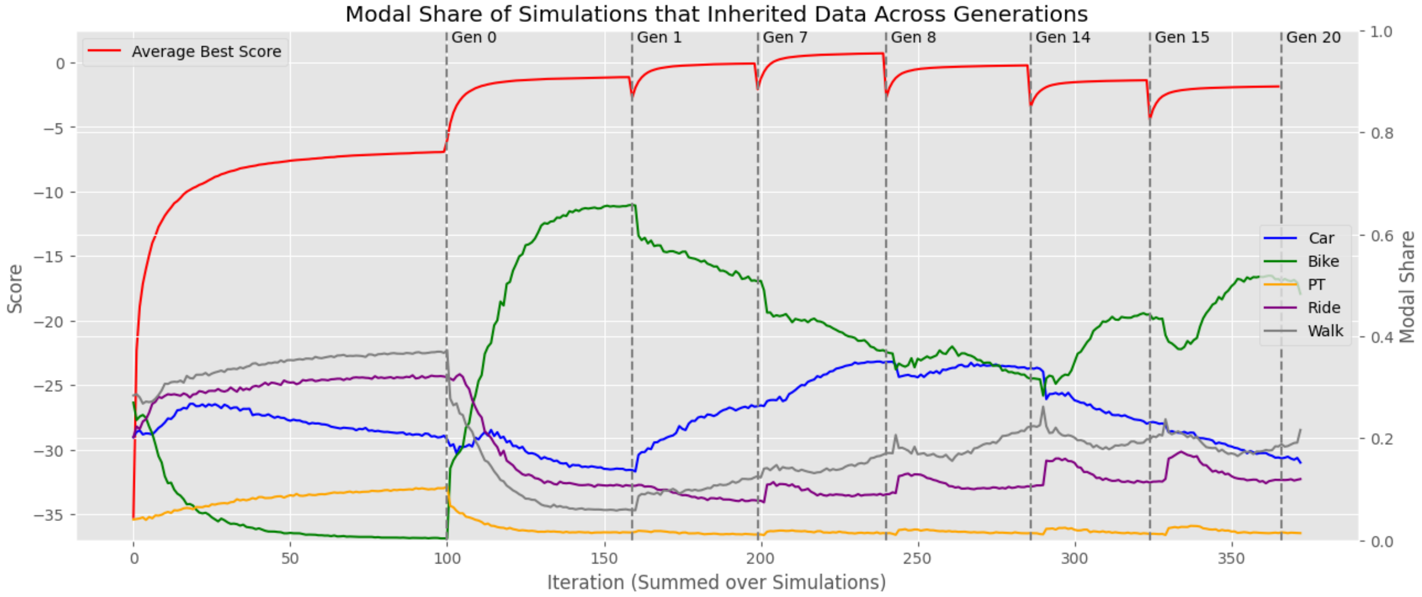
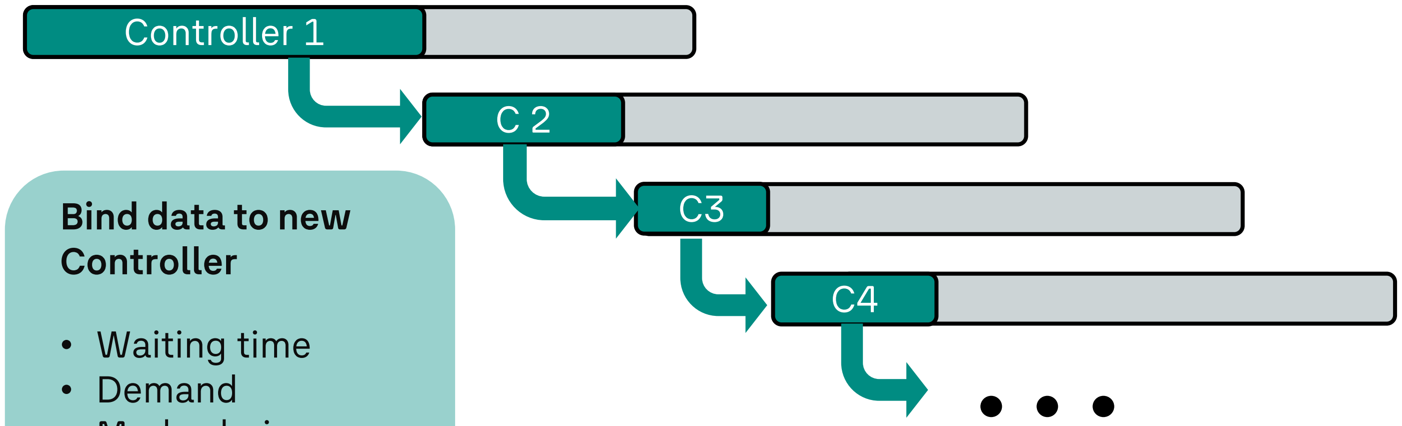
Optimization

Methodology





Bind data to new Controller

- Waiting time
- Demand
- Mode choice
- Travel time

1. **Equilibrium Recognition**:
   - Utilize best score derivative to identify equilibrium
   - Alternatively, prune non-promising trials
   - Shutdown controller
2. **Parameter Adjustment**:
   - Generate next parameter set
3. **Simulation Database**:
   - Find the previous simulation that has the closest parameters
4. **Simulation Execution**:
   - (Re-)start the simulation using data from previous simulations

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Intermodal Transport

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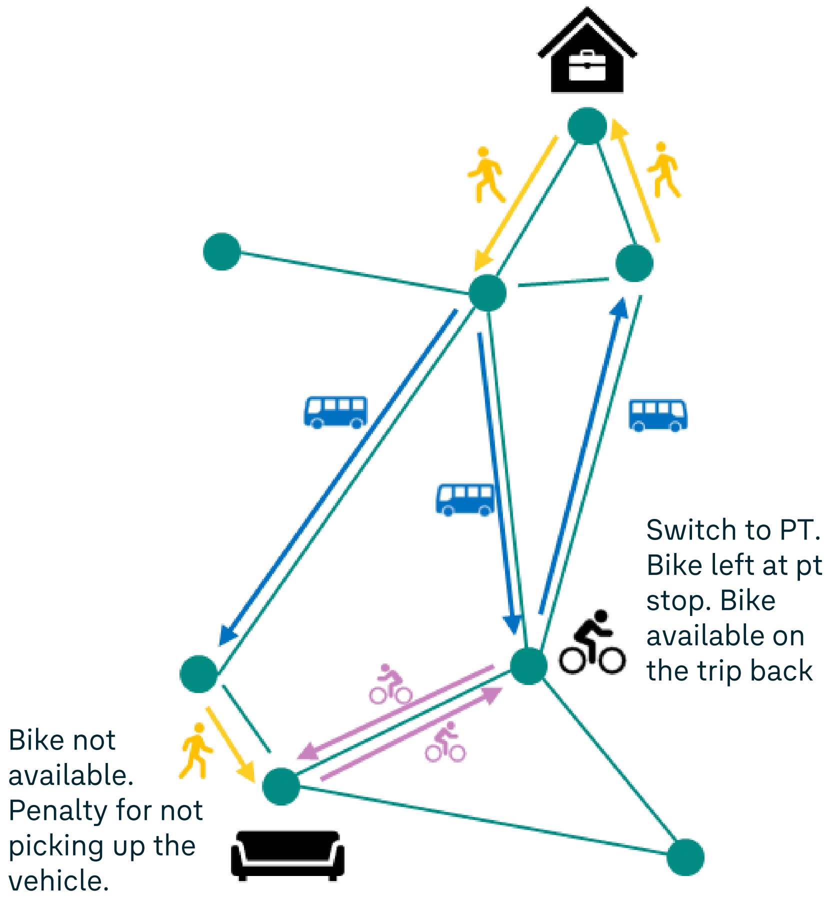
Intermodal Transport

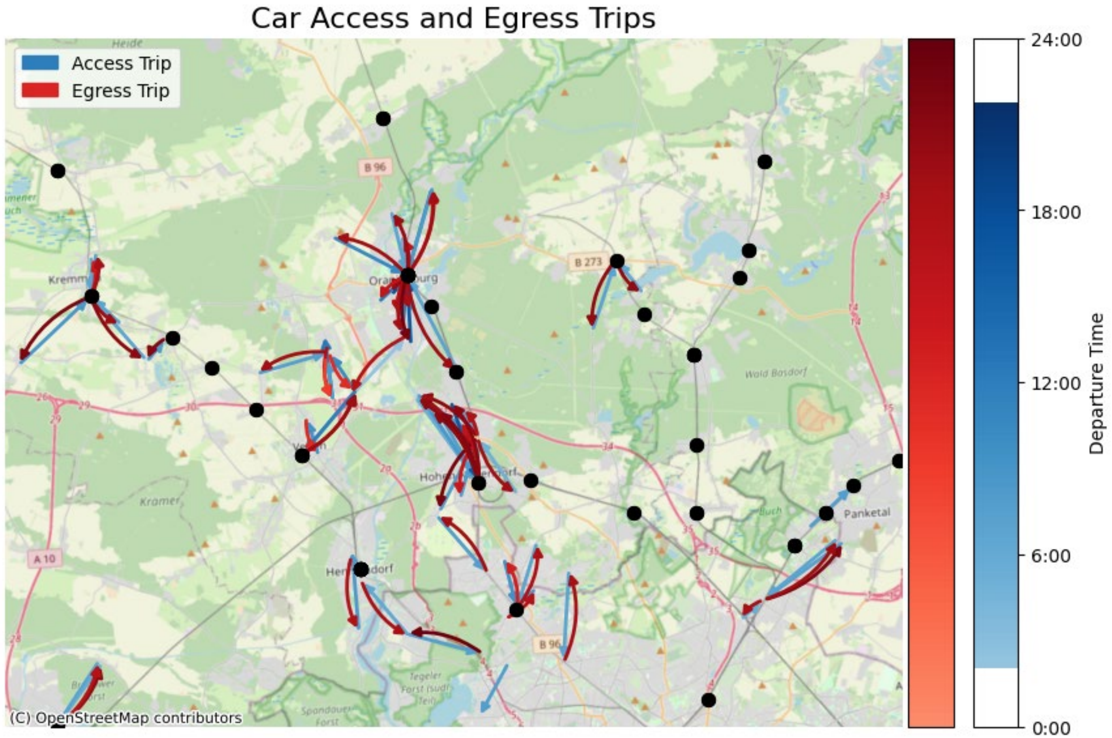
Methodology

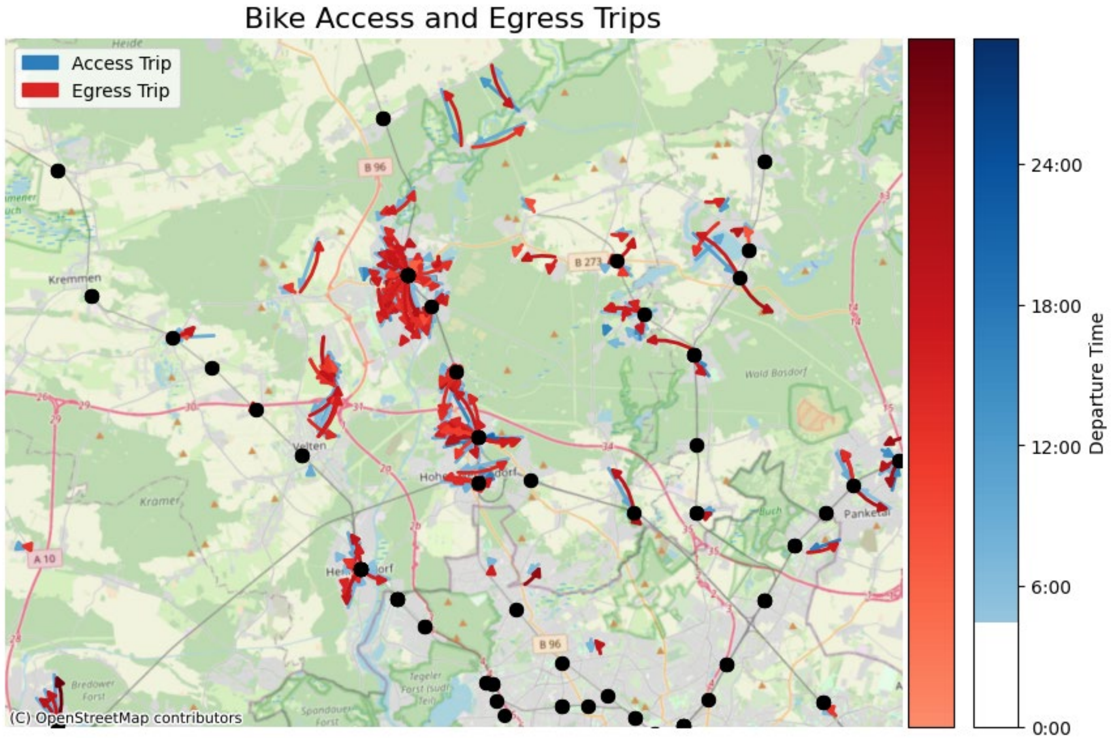


1. **Label Transit Stops**:
   - Identify and label stops for Park & Ride and Bike & Ride.
2. **Intermodal Public Transport Routing**:
   - Enable access and egress with all modes.
3. **Tracking Vehicle Availability**:
   - Monitor vehicle position according to the agents' plan.
   - Ensure vehicles are available within a predefined radius.
   - Check vehicle availability during mobility simulation.
4. **Filter Access and Egress**:
   - Select feasible trips for accessing and departing public transit.
5. **Scoring**:
   - Penalize agents when vehicles are left behind.
6. **Optimize Routing Times**:
   - Use caching techniques to speed up PT routing.

Intermodal Transport

Results





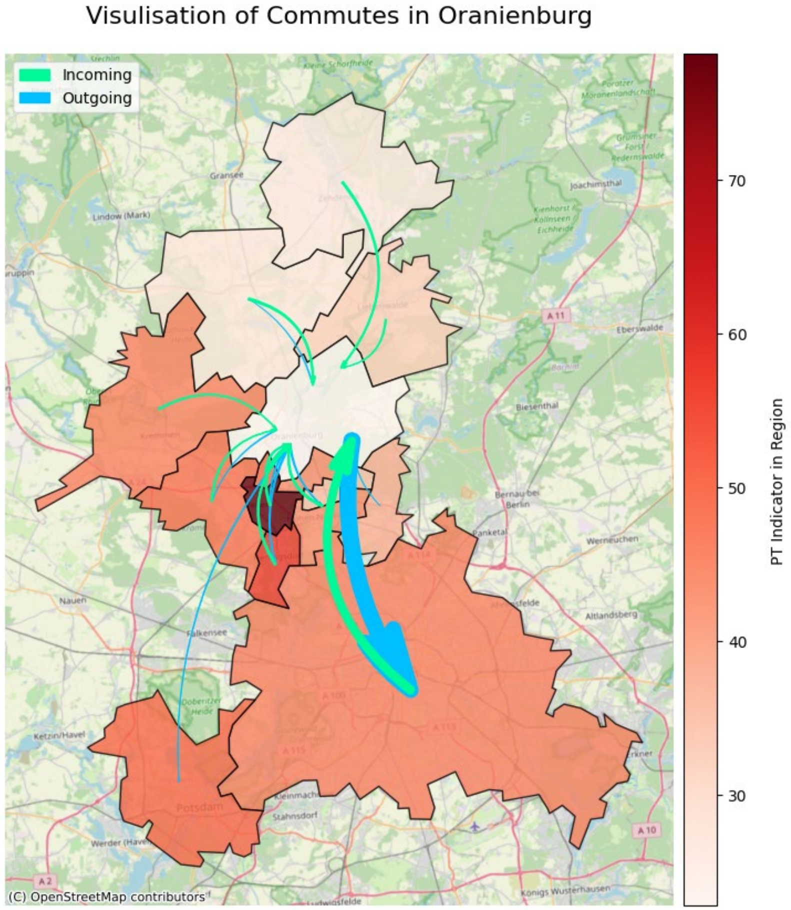
Vectors of access (blue) and egress (red) trips.
Public transport stations (black markers) within the Open Berlin Scenario (focus on Commuters from and to Oranienburg). Darker color represents trips that depart later in the day. Car trips on the left, bike trips on the right.

Key takeaways:

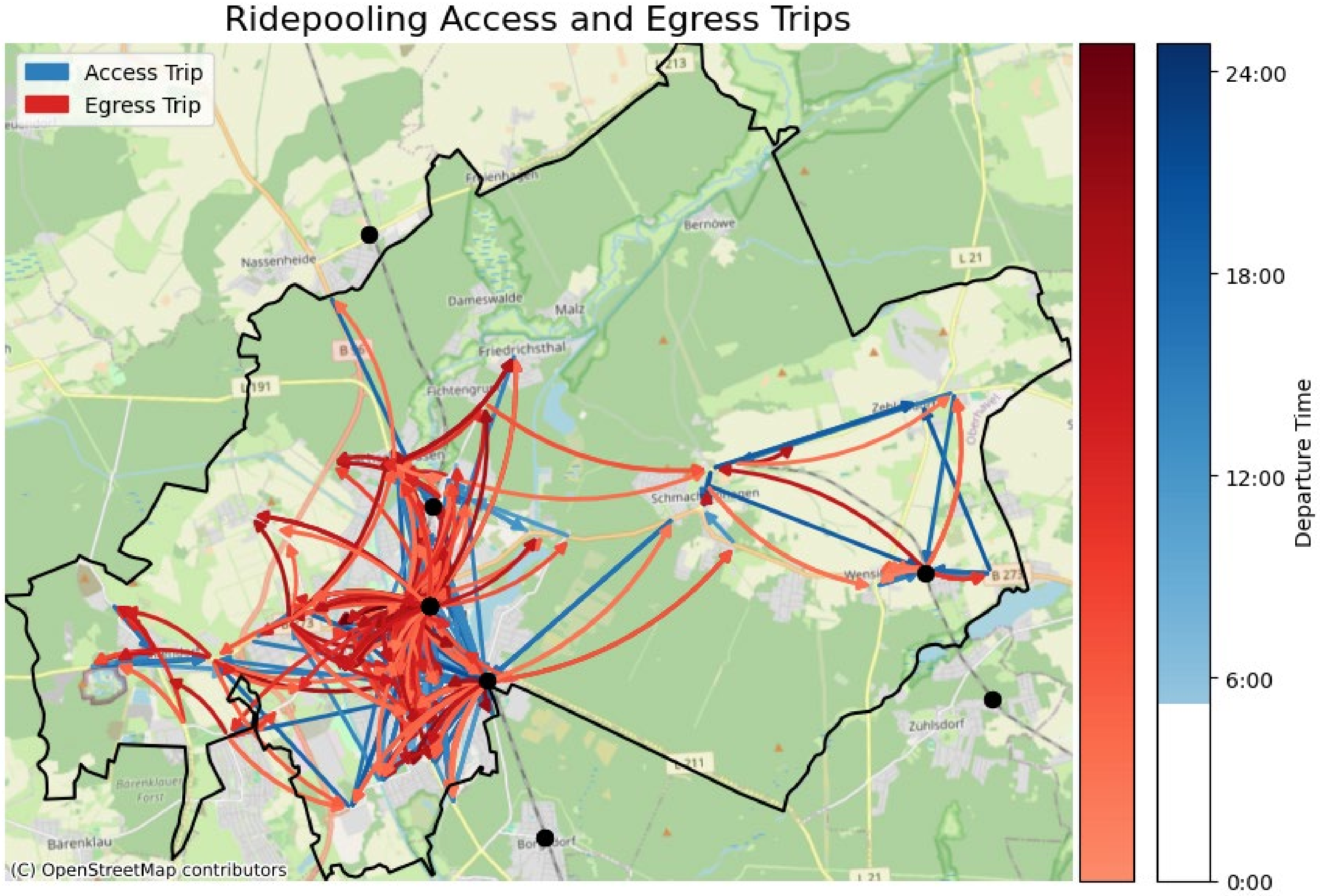
- Car is used for longer trips than the bike. Bike is used by more agents.
- Access trips have a corresponding egress trip. Egress always happens later in the day.
- Few agents have unfeasible trips in their memory. Those trips should be filtered before innovation fadeout.

Urban Mobility System Optimization

Scenario and Preliminary Results

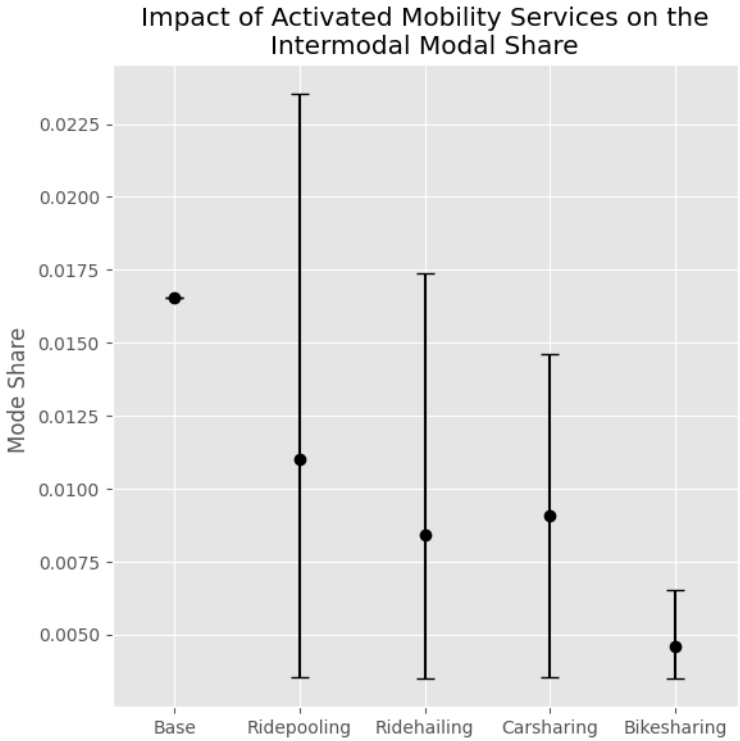


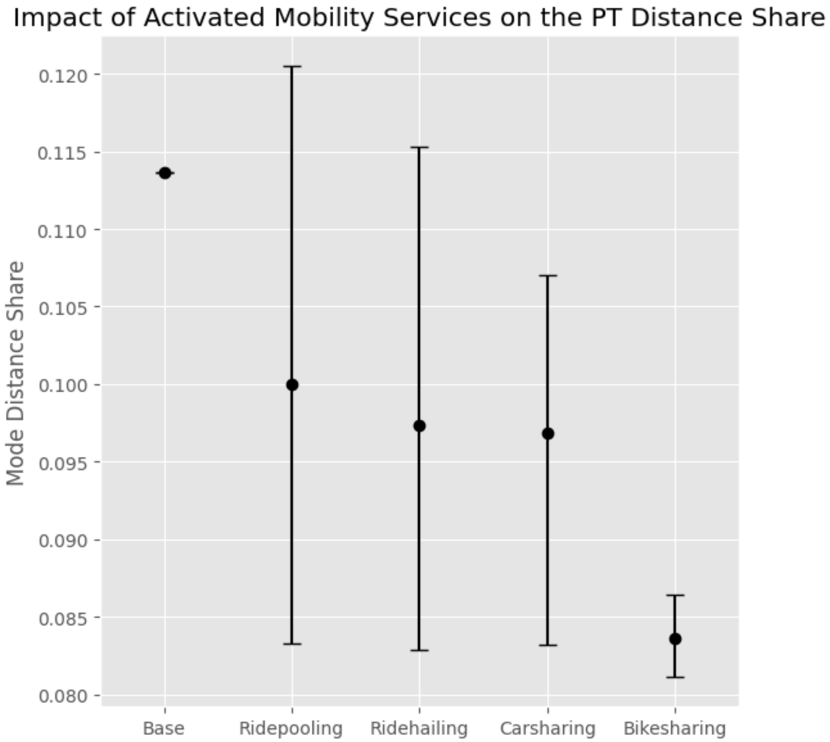
Commuting flows from and to Oranienburg (extracted from open Berlin scenario).
Bad PT in Oranienburg, good PT in commuter regions makes it a promising region for new mobility services.

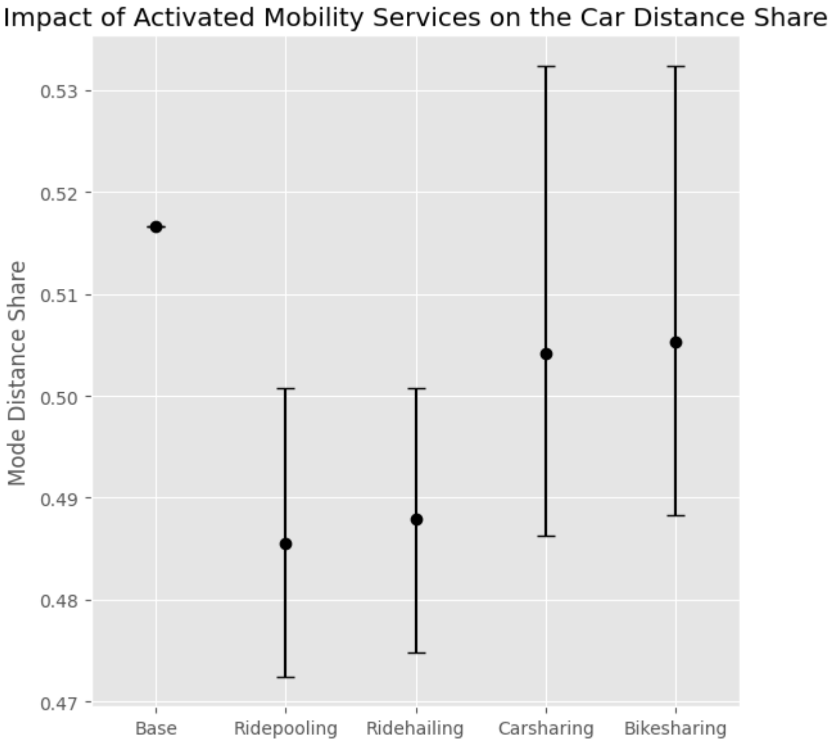


Vectors of ridepooling access and egress trips in the Oranienburg scenario.

Urban Mobility System Optimization
Preliminary Results







Average values of mode (intermodal) and distance (PT and car) shares for combinations where the modes are activated.
Error bars mark the min and max values that can be reached in different configurations with or without the other modes.

Key takeaways from Simulation results:

- Ridepooling has the chance the improve the mobility system in all target criteria. It is also used as an access and egress mode to the PT network. Ridehailing performs slightly worst, still with improvements over the base scenario
- Sharing services do not improve the objectives. Reasons need to be examined.

Summary

Optimization	Intermodal Mobility	Urban Mobility System Optimization

Enhancements
- Faster exploration of large search spaces
- “Limitless” optimization targets
- Reuse computation heavy initialization

Enhancements
- More realistic public transport and competition for new mobility modes
- More realistic intermodal scoring
- Base for more complex intermodal trips

Enhancements
- Tool to derive first design of mobility services and estimate impacts on different objectives
- Enables more detailed research (pricing, competition, cooperation, policy measures)

Next steps:

- Examination of simulation results
- Within Simulation dynamic fleet adaptations
- Inclusion of policy measures
- Inclusion of a long-distance Ridepooling service