Master Thesis Topic

Optimizing the Siting of Urban Air Mobility Systems in Multimodal Transportation Networks: Integration with Demand-Responsive Transit Services

Background

Urban Air Mobility (UAM) is a novel concept that aims to minimize travel time and environmental impact while traveling to and from significant locations in and around metropolitan areas. The "AMI AirShuttle" project is being conducted by the Chair of Transportation Systems Engineering (TSE) and its partners to investigate and assess the essential requirements and solutions for integrating electric vertical take-off and landing aircraft (eVTOL) into the infrastructure of commercial airports, with a specific focus on Munich Airport.

Problem statement

The successful integration of Urban Air Mobility (UAM) heavily relies on the careful selection of UAM station locations. Given the high cost of constructing UAM infrastructure, including UAM stations, it is unlikely to have many stations on a limited budget. Therefore, an optimal siting strategy is crucial to efficiently serve UAM requests with a relatively small number of stations (Raoul et al., 2021). Existing UAM studies suggest using car, Public Transportation (PuT), bicycle, or walking as the access and egress modes for UAM trips. However, since not everyone owns a car, and the other proposed modes of transportation may have poor accessibility, Demand-Responsive Transit (DRT) services could complement current UAM systems by improving service accessibility.

Methodology

This master's thesis requires the application of innovative methodologies, with a specific focus on developing a new Mobility as a Service (MaaS) framework. The framework will consist of the following components:

- Transportation simulation: To model multimodal MaaS services, existing MATSim extensions such as UAM and DRT extensions can be utilized.
- Advanced optimization algorithms: The objective function of the optimization model will consider the travel times of UAM passengers and the travel distances of UAM access and egress legs, subject to constraints such as UAM station cost, land use limitations, etc.

Expected results

The expected outcomes of this master's thesis are to utilize existing MATSim extensions (which may require code improvements) to optimize UAM station locations and develop a multimodal transportation system that integrates DRT and UAM services. The student will create a MaaS framework that offers a seamless UAM travel chain, while considering factors such as infrastructure, operating costs, and other constraints.

Key skills

1. Fluency in English and in German.
2. Able to work independently for 6 months.
3. Completion of the course "Optimization for Transportation Systems" or an equivalent course.
4. Previous experience with Java and **MATSim**.

Relevant work

Lu, C., Maciejewski, M., Wu, H. and Nagel, K., Demand-Responsive Transport for Students in Rural Areas: A Case Study in Vulkaneifel, Germany.

Rothfeld, R. L., Balac, M., Ploetner, K. O., & Antoniou, C. (2018). Agent-based Simulation of Urban Air Mobility. 2018 Modeling and Simulation Technologies Conference, 1–10.

For additional information regarding the “AMI-AirShuttle” research project, please visit the following link: https://www.mos.ed.tum.de/en/vvs/research/projects/ami-airshuttle/

Starting date

As soon as possible

How to apply:

If you are interested, please email your **resume** and **start date** to Hao Wu (wu.hao@tum.de) or Qinglong Lu (qinglong.lu@tum.de).