Master's Thesis Proposal

Using semantic 3D City Models for modelling Air Spaces in the context of Urban Air Mobility (UAM)

3D city model including 3D air spaces representing potential drone flight zones and drone model in Gazebo

With steadily growing numbers of people living in urban areas, transportation and mobility is a major challenge of cities in the future. In this context, new concepts such as Urban Air Mobility (UAM) (e.g., transportation drones or flight-taxis) have recently gained in relevance. While there are developments for creating safe and efficient air mobility concepts, there are currently no standardized methods for modelling and representing 3D air spaces for UAM applications.

The international OGC standard CityGML is commonly used for modelling semantic 3D city models and provides concepts for representing transportation infrastructure as well as 3D (air) spaces. However, these concepts are fairly new and thus have not yet been implemented in the context of Urban Air Mobility.

In a conceptual part of this thesis, a data model for representing 3D air spaces needs to be developed by using existing concepts of CityGML and potentially extending the standard with missing ideas. For this, relevant standards such as the Aeronautical Information Exchange Model (AIXM), related work and requirements of Urban Air Mobility (UAM) applications (such as eVTOL taxis) need to be examined and discussed. Several concepts of restructuring the airspace to host new air vehicles have been proposed in the academic and industry literature (Bauranov and Rakas, 2021). These concepts shall be investigated and used as a reference when developing a model for a study area (Munich).

In the practical part of the thesis, methods for generating 3D air spaces such as flight (or no-flight) zones from existing data (e.g., 2D flight-zone maps and digital 3D city models) need to be developed. This may include volumetric representations of flight corridors as well as linear representations of actual drone flight paths. The software **Gazebo** (https://gazebosim.org/home) together with **ArduPilot** (https://ardupilot.org/) and **ROS** (https://www.ros.org/) can be used to establish a SITL and simulate drone flights. It should be tested how information from 3D city models could be integrated and used within these simulation environments. Then, based on these simulations, approximate values of air traffic parameters (e.g., safety gaps between UAM vehicles, maximal density of an air corridor) useful for UAM microsimulations shall be determined and potentially linked with the original 3D city model.

Experience with the Linux operating system and basic programming skills are beneficial.

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