Seminar in the winter term 2020/2021

Urban data analytics

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Kick-off-meeting:
11.11.2020, 2pm-4pm, room 017, Hertzstr. 16, Geb. 06.33, Westhochschule

Final-meeting with presentations:
18.2.2021, 1pm-5pm, room 017, Hertzstr. 16, Geb. 06.33, Westhochschule

Submission deadline for the seminar theses:
01.03.2021 (12am) (digital and print)

Content of the seminar:
The seminar deals with topics related to the analysis of urban areas and structures. The topics are worked on individually with the possibility to receive feedback during the working process by the supervisors Zoe Mayer, Mihir Rambhia and Dr. Rebekka Volk.

The topics are designed as literature research, method comparison and data analysis projects. The goal of each project is to summarize and clearly present current approaches as well as research trends for the analysis of urban structures. The preparation of the seminar thesis serves as preparation for the bachelor / master thesis. Furthermore, the whole seminar will be conducted in English both in the seminar sessions and the seminar work and presentations.
Topics:

1. Analysing the thermal quality of buildings on district-scale
2. Using drone-based data to analyse urban structures
3. Analysing stakeholders for the energy improvement of a city district
4. Impact analysis of urban green on water stress in Karlsruhe
5. Analysis of the green space access in Karlsruhe
6. Analysis of assessment methodologies to quantify the benefits of urban green

**Topic 1: Analyses of the thermal quality of buildings on district-scale**
(main supervisor: Zoe Mayer)

The analysis of the thermal quality of a building stock on city-district-scale is important for developing district planning strategies. In Germany, for example, these analyzes are necessary for the development and effective implementation of energy improvement district concepts (German: ‘energetisches Quartierskonzept’) including their expected GHG saving potential and cost. Instruments to analyze the thermal quality that are currently used are surveys for building owners and tenants, energy consumption data from infrastructure operators or the classification of buildings with representative building typologies. Main open questions are:

- How is it possible to get a structured overview of the thermal quality of buildings in a district?
- Which approaches exist, which approaches might be used in the future?
- What are the relevance, strength and weaknesses of those approaches?

**Topic 2: Thermal (UAV) image analysis of urban structures**
(main supervisor: Zoe Mayer)

Drones/UAV (unmanned aerial vehicles) are increasingly used in the analysis of landscapes and buildings. In the future, drone data could also be used more frequently in cities. Equipped with thermal cameras, drones can take automated pictures with a high quality over a big area. Like this, it is for example possible to check the thermal quality of infrastructures (e.g. district heating networks) and buildings from the air and in an automated way. Main open questions are:

- In which fields of city districts analysis of drone-based images are used and can be used in the future?
- Which methods exist to process the image material obtained from drones?
- What algorithms and programs for the automated image processing of aerial thermal images exist?
- What are their strengths and weaknesses?
Topic 3: Stakeholder analysis for the energy improvement of a city district  
(main supervisor: Zoe Mayer)

City districts have a large number of stakeholders. Building owners, tenants, employees and other users of a district play an important role for the strategic development of an urban area. When changing district structures, their acceptance and active cooperation are necessary. To develop and implement policy concepts for a city district that rely on the participation of stakeholders, a good socioeconomic analysis of the affected groups is necessary. Energy improvement district concepts (German: ‘energetische Quartierskonzepte’) intend to improve the energy-related quality of a city district. These concepts require a high level of stakeholder participation in order to develop measures that are tailored to the needs and possibilities (capital investment) of the stakeholders. Stakeholders also need to be informed about potential benefits and need to be motivated to implement measures of the concepts such as the energy retrofit of their own buildings.

Main open questions are:
- What should an analysis of stakeholders look like as a good basis to develop an effective energy improvement concept for a district?
- Which aspects should an analysis take into account?
- Which approaches are currently used and which other approaches might be used in the future?
- What are their strengths and weaknesses?

Topic 4: Impact analysis of urban green on water stress in Karlsruhe  
(main supervisor: Mihir Rambhia)

To make cities more livable and sustainable, there is a strong focus on ‘greening the cities’. However, this development introduces an uneasy tension between more green spaces and the increased use of scarce water resources to maintain this greenness, particularly in dry regions. At the same time, the high retention capacity of vegetation makes it important for mitigating floods and managing storm water runoff. This raises a question of water footprint of urban green areas.

The present topic requires the use of open-datasets and satellite imagery to analyse the net impact of urban green on water stress of the city based on an existing dataset of urban green space. The aim of the study includes:
- Study the parameters determining water consumption of the urban green.
- Estimate the total annual water consumption of the urban green in Karlsruhe.
- Use the open datasets to determine the water quantity indicators for the city.
- Analyse the change in water-stress over last two decades and identify the co-relation.

Reference:
- Aqueduct global water dataset
- Literature: Study 1, Study 2
Topic 5: Analysis of the green space access in Karlsruhe
(main supervisor: Mihir Rambhia)

Studies have shown that parks and urban green spaces deliver health and wellbeing benefits. Green space exposure may also prevent or mitigate stress, anxiety, and depression in both children and adults, especially in urban environments where green space offers respite and opportunity for interactions among neighbours in ways that promote social cohesion and collective efficacy. However, there is some evidence of inequities to accessing green space, particularly in low-resource communities. The SDG indicator 11.7.1 discusses the average share of the built-up area of cities that is open space for public use for all, disaggregated by age group, sex and persons with disabilities. This topic aims to assess the access of green space in Karlsruhe city based on an existing dataset of urban green space. The methodology is based on the WHO/EURO indicator which recommends an access to green space of at least 0.5 ha to all the city inhabitants. The aim of the study includes:
- Study the parameters/indicators determining ‘quality’ of urban green.
- Categorize the urban green spaces of Karlsruhe according to different quality.
- Use the open-datasets to map the urban population characteristics.
- Analyse the access to green space and identify the socio-economic patterns.

Reference:
- Open dataset Karlsruhe
- Guidelines
- Literature: Study 1 Study 2 Study 3 Study 4

Topic 6: Analysis of assessment methodologies to quantify the benefits of urban green
(main supervisor: Mihir Rambhia)

The presence of green spaces in cities of any type and to any extent offers numerous benefits for the city and its citizens. Green space interventions have been used to improve environmental conditions, protect and improve biodiversity, promote outdoor activities and active lifestyles, increase social interaction and exchange, and provide healthy urban conditions for good physical and mental well-being. This topic is a systematic literature review of the studies analysing the benefits of urban green. The study should aim to answer following research questions:
- What are the social, economic, and environmental benefits of urban green?
- Which are the available methodologies to quantify these benefits?
- Compare different methodologies and present their strength and weaknesses.

Reference:
- Literature: Study 1 Study 2 Study 3