Discussion

Summary of the BIG THREE findings (1, 2, 3), i.e. the higher-level idea

In this paper, we developed a modeling approach that applies two walkability indices, the Local Significance (LS) and the Detour Index (DI).

We demonstrated the application of both indices in a test case, the Lene Voigt Park in Leipzig.

Furthermore, we compared the two indices on a European scale and, in a final step, implemented them in different cases to demonstrate possible uses of LS and DI for city planners.

We managed to create a workflow for modeling the walkable environment using the Detour Index (DI) and the Local Significance Index (LS).

Furthermore, we found a way for an intuitive visualization of the two indices that might help future city planners and decision makers.

The workflow is applicable, and – with limitations – comparable on a European scale.

We could show the effect of changing parameters in

**Applying indices**

In his paper, Wolff mapped the LS with colored straight lines that directly connect residential areas with the respective UGS (Wolff 2021).

His representation of the index enables an overview of potential overcrowding in individual UGS and the direction from which people flow into the green spaces.

By plotting the LS in a cumulative way on individual street segments, we enable an even more targeted representation of the flows.

Researchers and city planners can utilize our results to distinguish potential overcrowding effects that might limit accessibility of a specific UGS at individual street segments or green space entry points.

Local Significance (LS) maps are intuitive

Detour Index (DI) is harder to interpret but can also yield inference

* Both indices work (with limitations) also in areas with sub-optimal OSM data coverage
* LS: values might be lower than “in reality” due to incomplete residential building coverage
  + LS does not account for further obstacles people have to overcome on their ways to the nearest UGS like traffic lights, large streets.
* DI: should be accurate for all buildings that are digitized in OSM
  + One of the largest limitations of the DI is that the DI values do not account for further obstacles people have to overcome on their ways to the nearest UGS.
  + For example, there can occur high DI values in close proximity to UGS, even though the residents have to cross larger streets or pass traffic lights on their trajectory to the UGS.
  + Low DI values also occur in close proximity to the LVP as an artifact of small network and Euclidean distances.
  + In these cases, a minor difference can lead to a low DI value even though the overall traveling distance to the next green space entry in relatively small (DISCUSSION?).
  + Both indices only account for the fasted route from A to B given the underlying network.
  + People might choose their trajectories towards UGS based on different factors than pure distance, though.

**Comparing indices**

Wolff und Haase D. 2019, Kabisch (Europa), Poelman paper -> Karten anschauen und mit meinen vergleichen

Cortinovis, C., Haase, D. Geneletti, D. 2022. Higher immigration and lower land-take rates are driving a new densification wave in European cities. Nature Sustainability. In press.

Xu, Chao; Haase, Dagmar; Su, Meirong; Wang, Yutao; Pauleit, Stephan. 2020. Assessment of landscape changes under different urban dynamics based on a multiple-scenario modeling approach. Environment and Planning B: Urban Analytics and City Science.

Xu Chao, Dagmar Haase, Didit Pribadi, Stephan Pauleit 2018. Spatial variation of green space equity and its relation with urban dynamics: A case study in the region of Munich. Ecological Indicators 93, 1-12.

Yet, there are countries with large city samples and a high percentage of population reaching green spaces in 500 meters network distance, like Germany (126 cities, 73%) or Poland (68 cities, 69%)

→ Das bestätigt bisherige studien (kannste in den disc auch nochmal erwähnen).

we can for example observe relatively high average LS values at the green space entries in mid- to southwestern Germany.

OSM coverage:

* Mostly central European cities (Poland, Czech Republic, Austria, Northern Italy, Switzerland, France, Netherlands)
* Approach not really suited for a European comparison
* Due to incomplete digitization of buildings in OSM
* UA polygons covered by at least one OSM polygon is only a proxy for the „real“ coverage. No real inference about the nature / quality of the OSM data.

**Implementing indices**

(Es Hilft:

1. Bedarfe abzuchecken,
2. Verschiedene Planungen zusammenzudenken -> Straßen + Grünflächen
3. Auswirkungen von Veränderung hinsichtl. Bebauter und Grün/blauer Infrastruktur abzuleiten (green / blue infrastructure, built-up + demand)

In general, we can say that an increase of the DI value of a building is a desirable effect because the residents have a more efficient – or more direct – way to UGS.

As a result, people might be incentivized to visit UGS more often and reap the positive effects of physical exercise and being in the nature (Quelle).

In contrast, a decrease of the LS value of a street segment can usually be deemed positive.

If no larger changes in the built-up structure have be made, a decreasing LS means less people traveling through the same network, resulting in less crowded streets.

Alternative 1: Unlimited access

LS:

- Removing the entry barriers might have ambiguous effects:

- On the one hand, the streets around the UGS might become less crowded, which is desirable for city planners, as it might alleviate the effects of overcrowding.

- On the other hand, a UGS with less barriers might be more attractive, and thus, pulling more people from the surrounding residential areas, resulting in more traffic in the remaining network.

DI:

- In the first alternative, the DI shows how hard it can be to interpret.

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Alternative 2: Densification

LS:

- Reacts strongly on changes of UGS

- highlighting importance of the UGS that were changed into residential buildings

- DI:

Alternative 3: Population increase

Alternative 4: Ensemble model

Conclusion:

Both indices are only as good as the data that they are built on. Errors in the UA or OSM data sets might propagate from data preparation to index building and multiply on the way.

To really model the walkability of a city, we need to take the environment into account:

A more convenient walking experience on one street might cause people to change their trajectories and even take detours on their way towards UGS.

At the same time, a less pleasant walk may cause the opposite behavior (Quelle).

Furthermore, certain features that are not reflected in our network can turn out to be barriers for the accessibility of UGS, like large streets that have to be crossed.

Even though most of the data that is required to account for these features might be hard to get and to harmonize, an implementation can be easily realized by re-running our program, once the data is present.

Another point that the two indices are not sensitive for, is the fact that many residents have access to more than one UGS. Thus, building a new block of residential housing might not be as grave in a neighborhood with a plethora of alternative UGS. If the only park around is sealed and even more people are invited to live in the area, it can be a disadvantageous decision.

→ change index calculation process to account for this in future work.

Make results accessible and available (e.g. on a website) for urban planners so they will actually use them.

For each of the findings:

How does this map/relate to previous findings?

Compare to e.g.

How does this add to previous findings?

Comparability / applicability with public data

Challenges

Implications

notes: