Analysing the Potential of Network Kernel Density Estimation for the Study of Tourism based on Geosocial Media Data

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Today, social media is playing an important role in promoting tourist destinations, and its use has proven to be a successful strategy [1]. Even though social media is considered as a useful and reliable source of tourist information, the analysis of its big data is still underexplored in tourism destination management.

By using geotagged photos uploaded by tourists to the photo-sharing social media sites, e.g. Flickr, destination management organisations can easily predict tourist behaviour and patterns at a destination. Currently, a major challenge is how to track these behavioural patterns of tourists [2]. A possible method is Network Kernel Density Estimation (NKDE).

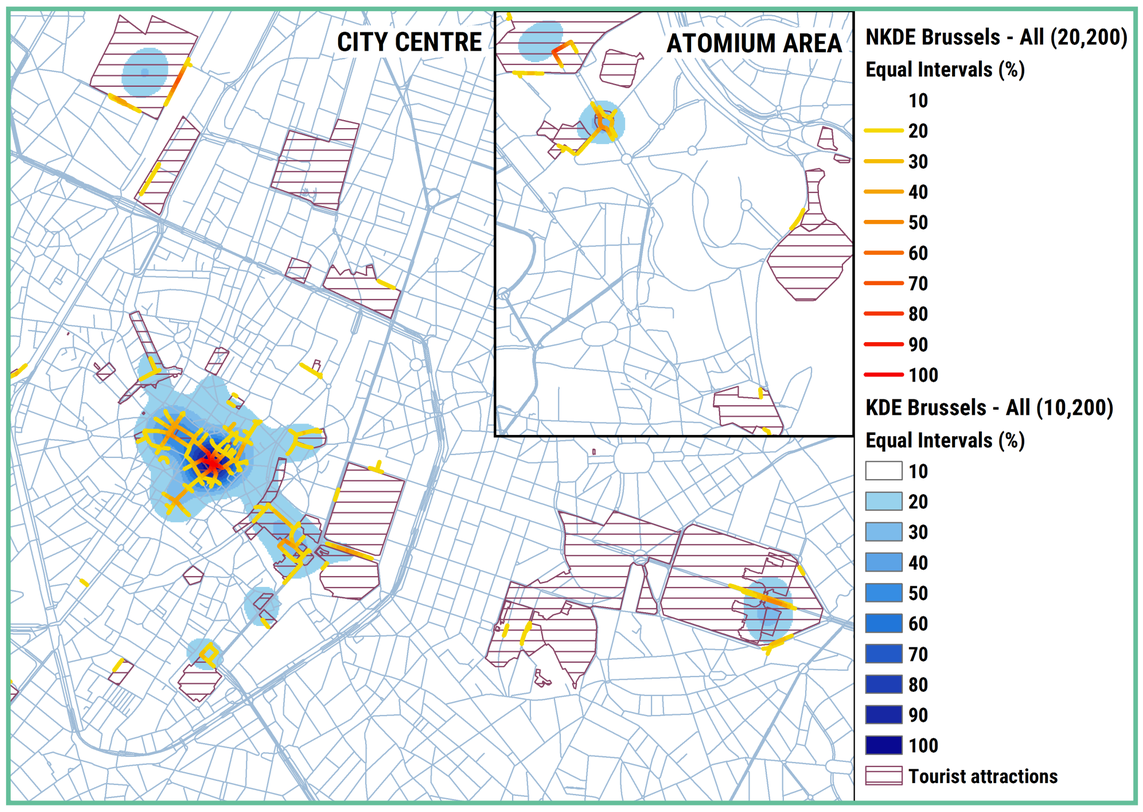
WHAT IS NKDE?

NKDE is focused on examining point pattern distributions on a network, without taking into consideration the usual hypotheses of homogeneity and isotropy of space. Many human-related point phenomena are distributed over a space which is mostly not homogenous, as their location in space also depends on a network. The main idea is to consider the kernel function as a density function based on network distances rather than Euclidean ones [3]. NKDE has been widely used to identify hotspots, especially in the field of road accident analyses [4] and to evaluate pedestrian mobility [5].

FOCUS OF THE STUDY

This study was focused on the possibility of using NKDE in the tourism industry, and its prospect of using it to identify the most popular tourist places in a city. As NKDE is a density analysis on a network, it was used to identify the most popular tourist street segments in a city. Besides defining street segments, Kernel Density Estimation (KDE) was used to determine tourist areas. To perform the analyses, Flickr dataset of pictures from Brussels-Capital Region (Belgium) was used.

The study was also trying to define the main differences in the results of both density analyses, advantages and disadvantages of both approaches for this type of analysis, and the possibility to integrate both KDE for areas of interest (AOI) and NKDE for street segments of interest (SSOI) and how would such integration look.



Map represents NKDE and KDE analysis results of all Flickr pictures. Layout is focused on the city centre of Brussels and the area around Atomium where is the highest concentration of tourist attractions

METHODOLOGY

To perform NKDE analysis, the SANET toolbox was installed in ArcGIS 10.2. SANET is a Plug-in programme developed in Japan that statistically analyzes spatial patterns of events that occur on or alongside networks. NKDE was applied on geolocated pictures represented as points distributed along the street network. KDE analysis was performed using Kernel Density Spatial Analyst Tool included in ArcGIS software.

Data was collected from Flickr's API. Dataset has 150,002 pictures from 12,261 users. Retrieved metadata of each uploaded picture contains photo owner, geolocation, description text and photo owner's country of origin. Besides recognizing AOIs and SSOIs of Brussels using all pictures, the study also focused on defining AOIs and SSOIs for visitors from different countries of origin. Out of the total number of users, only 9,987 had a country of origin, and only their pictures were included in the research (138,999). Countries (121) were classified into 12 groups according to the continents.

It was important to predefine areas of tourist attractions to easily establish which are of great interest for each group of countries of origin. In that way, it would be clear to define a specific tourist product for each group. Around 81 tourist attractions were included.

RESULTS

The final result of the research is 28 maps, 14 present combined results of NKDE and KDE analysis, and other 14 are suggested tourist maps of attractions per each group of countries of origin. Tourist maps were made from the final results of both density analyses.

CONCLUSION

NKDE provides more precise results than KDE, but its visualization is not clear enough to distinguish density intervals. Besides giving precise results in defining SSOIs, in some cases results can be incorrect, as NKDE cannot recognize the actual state of the street network in a city. In reality, street network include tunnels, motorways, etc. and NKDE can show SSOIs in these parts of the network. Therefore in results interpretation, a researcher needs to know the street network in reality in order to interpret results correctly. In conclusion, NKDE can be used in tourist management to identify touristic streets and can be used to improve and create tourist product in a city. With minor corrections in visualization technique, with more knowledge and understanding of this method and with more openness to innovations, tourism managers could find NKDE a very valuable asset in improving management in a tourist destination.

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