A Sensivity Analysis for the Selection of Business Critical Geodata in Swiss Outdoor Advertisement

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1. Introduction

At the beginning of a project often the question is asked, "How accurate must spatial data be and what geodata are needed?" The spontaneous response is usually, "As precise as possible and as much data as available." However, large quantities of precise geodata are expensive and the advantage of increased precision is not always clear. Therefore, it is expedient to compare the trade-off between different levels of geodata. Such a comparison causes additional implementation costs and is often regionally limited as test data are available only for a small portion of the application area. However, it provides a feeling for the sensitivity of an application with respect to different levels of geodata and usually allows for the estimation of effects on global scale. In this paper we present a case study to support a business critical decision of Swiss Poster Research Plus (SPR+) about the sufficient level of street network geodata in Swiss outdoor advertising.

The Swiss outdoor advertisement branch belongs to the pioneer companies that rely on GPS-technology for the performance evaluation of poster sites (Pasquier et al. 2008). One important data set in the modelling process thereby is the street network. It is used to verify GPS-data and to limit the visibility area of poster sites. Currently, SPR+ uses Vector25 geodata of Swisstopo, however considers a change to Navteq due to stability reasons over the next five years. Although both data sources contain street networks of similar quality, only Vector25 provides an entire building layer. The building layer plays a major role during the determination of visibility areas, because buildings block the view to poster sites from nearby streets. A combination of Navteq street network and Vector25 building layer is not possible due to geographic displacements (see Figure 1). Therefore the central questions are a) under which conditions and b) with which consequences may the topological richer Vector25 geodata be exchanged with Navteq data.

Burrough et al. (1996) already recognize the impact of data quality on the modeling process and propose the use of error propagation tools to estimate which combination of model and data achieves a certain level of quality. Agumya and Hunter (1999) follow a risk-based approach to assess the fitness for use of spatial data. Our paper presents a sensitivity analysis to estimate the effect of different data quality on the model used for performance measurement in outdoor advertising. Before we explain the layout of our case study, we will describe the construction and influence of poster visibility areas.

Figure 1. Vector25 buildings in combination with Vector25 streets (left) and Vector25 buildings in combination with Navteq vectors (right)

2. Visibility Areas of Poster Sites

A simple way to understand the construction of visibility areas and their impact on performance measurement is to think about your daily way to work and the posters you pass. Some posters are large and can be seen from far away, some posters are small and you can recognize their content only from nearby. Therefore, the visibility area of each poster is unique and depends on the poster's size and location. The visibility areas must be considered during performance evaluation, because the proximity between a GPS-track and a poster location does not imply that the poster has been visible for the passer-by.

SPR+ creates visibility areas, i.e. the geometric areas from which the panels can theoretically be viewed, using the panel's coordinates (x, y) and azimuth. As the roads in Switzerland are very narrow, a viewing distance of usually 40 meters is assumed and a maximum opening angle of 150°. Currently the visibility areas are intersected with a building layer. Thus, all parts of a street from which the sight of the panel is blocked, are removed. Figure 2 shows an example of visibility areas.

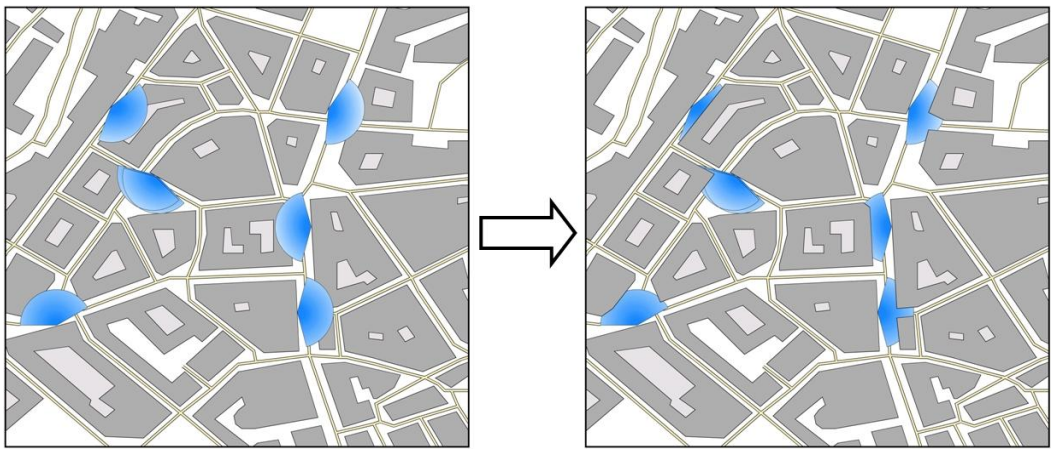

Figure 2. Visibility area of poster sites before (left) and after (right) intersection with buildings

3. Sensitivity Analysis for Geodata Selection

The basic unit for performance evaluation of a poster panel forms the so-called *opportunity of contact (ooc)*. An ooc occurs when a person passes the visibility area of a panel with a passage angle below or equal to 110°. The passage angle is hereby the

angle between the movement direction of the passer-by and the orientation of the poster. This restriction prevents the counting of passages when persons cross the visibility area with their back to the panel. We distinguish between a frontal poster contact <45° (a), a parallel poster contact: 45°-110° (b) and no poster contact >110° (c) (see Figure 3).

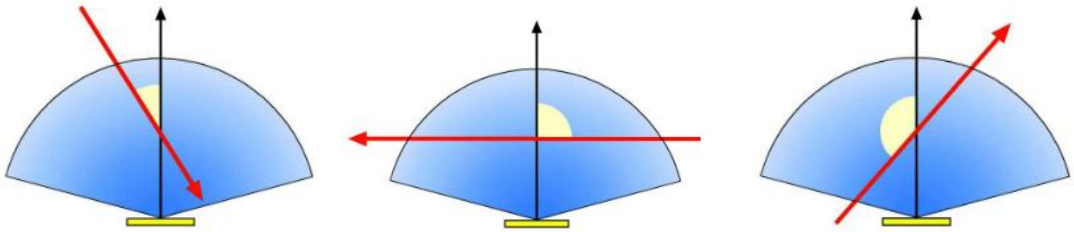

Figure 3. ooc for different passage angles (a-c)

In our sensitivity analysis we use the ooc in order to measure the effect of different geodata on poster performance. We calculate the ooc once with and once without intersection of the visibility areas with the building layer. In addition we vary the maximum viewing distance of the panels between 20, 40, 60, 80 and 100 meters. This variation is of interest because a possible future change in poster formats may influence the viewing distance.

The experiments calculate the ooc in St. Gallen, Basel and Bern based on 2'319, 3'090 and 911 poster sites in these regions, respectively. Table 1 shows the results as the number of contacts obtained without building layer indexed by the number of contacts obtained with building layer. I.e. a value of 100% means that both results are identical and a value above 100% means that the omission of the building layer leads to an increase in contacts. The higher the difference to 100%, the stronger is the influence of the building layer. All regions show only very small deviations until a distance of 60 meters. If we increase the distance further the difference increases, too. This can be explained by the fact that a large visibility area is more likely to cover streets from which the view to the poster location is blocked by buildings. However, the sensitivity analysis also shows that the effect of building-restricted visibility areas is negligible for panel viewing distances equal to or below 40 meters, which is the case for most panels in Switzerland. The variance of our values lies about 2% on average.

Table 1. Number of contacts with and without building layer

	100 meter	80 meter	60 meter	40 meter	20 meter
Basel	105,6%	103,6%	101,9%	100,7%	100,0%
StGallen	109,5%	105,9%	102,8%	100,9%	100,1%
Geneve	106,0%	103,8%	102,0%	100,6%	100,1%
Total	106,2%	104,0%	102,1%	100,7%	100,1%

Buildings are not equally spread over an area, but are predominately found in the city centre. In our second experiment we therefore analyse the ooc separately for inner-city panels and panels outside of the city. The results are depicted in Table 2. It shows that the effects in inner city regions are stronger than in suburbs. The result confirms our

preliminary considerations that due to denser development and consequently also a finer-meshed road network the importance of a building layer increases for within-city locations. However, the experiment shows also that for viewing distances equal to or below 40 meters the difference is again very small.

Table 2. Number of contacts with and without building layer separated for panels in inner cities and suburbs

	100 meter	80 meter	60 meter	40 meter	20 meter
Basel Inner City	106,5%	104,2%	102,4%	100,8%	100,1%
Basel Suburb	104,7%	103,0%	101,5%	100,5%	100,0%
StGallen Inner City	110,9%	107,1%	103,6%	101,3%	100,1%
StGallen Suburb	106,7%	103,7%	101,2%	100,3%	100,0%
Geneve Inner City	110,8%	107,2%	103,6%	100,9%	100,0%
Geneve Suburb	102,9%	101,6%	100,9%	100,4%	100,1%
Total Inner City	108,8%	105,7%	103,0%	100,9%	100,1%
Total Suburb	104,0%	102,4%	101,2%	100,5%	100,0%

4. Summary

In this paper we conduct a sensitivity analysis to estimate the effect of additional geodata on performance measurements in Swiss outdoor advertisement. Our analysis shows that for most of the Swiss poster locations it is not necessary to restrict visibility areas additionally by a building layer. However, without restriction, panels with viewing distances above 40 meters show increased opportunities of contact, especially in inner-city regions. In future research we will confirm our results further by statistical testing and a structural comparison of the building layer between other regions in Switzerland.

References

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