A New Approach for Determining Quiet Area Accessibility in England

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Abstract

The introduction of the European Environmental Noise Directive (END) in 2002 has made available a wealth of noise exposure statistics and maps for EU urban agglomerations to acousticians and the general public. It has also introduced a mandate for the identification and protection of so-called "Quiet Areas" in cities.

The recognition of the importance of Quiet Areas as an enhancement to the urban environment leads to the question of how much of the urban population of a given agglomeration, with a particular environmental noise environment, can benefit from access to them. In particular, do the most vulnerable people from a social point of view have the same level of access to quiet open spaces as the most advantaged social groups?

This paper presents a methodology that allows the identification of Quiet Areas and the determination of their accessibility, which in conjunction with social vulnerability statistics allows the identification of problem areas in English urban environments. A case study for the city of Southampton that uses publicly available noise maps, social data and open source software tools is shown.

Introduction

The introduction of Directive 2002/49/EC (European Commission, 2002) in the European Union, also known as the Environmental Noise Directive (END), placed environmental noise in the spotlight and introduced the concept of Quiet Areas and the requirement for their preservation in the United Kingdom.

Although there exists a consensus that access to Quiet Areas and their preservation is beneficial for the population the awareness of this fact is low. A number of campaigns are being put forward to address this lack of awareness in England by different organisations such as Environmental Protection UK, the Noise Abatement Society and the Campaign to Protect Rural England.

Noise pollution is not as identifiable by the general public as other types of pollution (i.e. air, water pollution). Besides, the large amount of noise metrics and terminology (i.e. decibels, A-weighting, L_{eq}, L_{90}, L_{den}, etc.) and different noise legislation (local, regional, national and international) imposes planners, politicians and voters a layer of complexity towards understanding environmental noise issues. Thus, there is an incentive to present public noise data in a non-technical way.

Following this reasoning we propose to let the general public assist acousticians in the determination of quiet spaces by using collaborative online technology.

Tranquillity and Quiet Areas in England

Most people agree that there is certain environmental quality associated to places with feelings of calmness, but an exact definition of this quality does not exist. In current acoustic research the terms ‘tranquil space’ and ‘quiet area’ are often used interchangeably. Although attempts at defining formally ‘quiet space’ have been made (Grimwood 2009) the subject is still under debate, it varies from country to country and even may be different between urban and rural areas.

Mapping Tranquillity

First efforts on mapping tranquillity in England started early 90’s, for instance the work from Rendel (1996) for the Department of Transport. The focus then was the protection of the countryside, and was not suitable for urban areas. The general approach was a quantitative characterisation of disruptive visual and noise elements. The definition of “Tranquil Area” was based on objective terms, such as the distance to sources of visual or acoustic disruption.

In England, this was taken to be as follows:

- 4 km from the largest power stations.
- 3 km from the most highly trafficked roads.
- 2 km from most other motorways and major trunk roads.
- 1 km from medium disturbance roads, i.e. roads which are difficult to cross in peak hours (taken to be roughly equivalent to greater than 10,000 vehicles per day) and some main line railways.
- Beyond military and civil airfield/airport noise footprints as defined by published noise data and beyond very extensive opencast mining.

The development of computer-based Geographical Information Systems (GIS) allows a reasonably easy determination of tranquil spaces using the set of rules mentioned above.

However other studies argued that tranquillity should not defined in strictly objective terms, and that is dependent on factors such as cultural values on descriptions (Habron, 1996), (Macnaghten and Urry, 2000).

Online technology facilitates subjective studies greatly. For example, Carver et al. (2002) set an online website to survey public perceptions of wilderness in Britain. Here, GIS were used to present information on British wilderness areas and solicit public opinion as to which factors are perceived to be important wilderness quality indicators. Consensus maps were compiled from a composite of individual responses and the results compared to Britain's network of protected areas.

Asuejo *et al.* (2009) discuss the strength of web-based noise surveys against traditional methods but note that there is an implicit bias, which leaves certain social groups (those with less access to the Internet) underrepresented.

Mapping Noise in Urban Environments

The protection of existing Quiet Areas urban spaces has become an additional environmental issue that European local authorities and national governments need to deal with, particularly after the introduction of the Environmental Noise Directive (END).

It must be noted that the END is ambiguous regarding the definition of Quiet Area, and it is left for the European Union member states to come up with their particular interpretation of this term.

In England a noise mapping exercise for 23 urban agglomerations was completed in 2007.The national body designated to coordinate this effort was the Department for Environment, Food and Rural Affairs (DEFRA), which acts as the Competent Authority regarding the application of Directive 2002/49/EC in England (Grimwood 2009).

It should be noted that the main purpose of this noise mapping exercise was to identify the noisiest spots so that adequate mitigation procedures may be put in place, rather than the identification of Quiet Areas.

After the first round of noise mapping English data was made available through a web page (Department for Environment, Food and Rural Affairs, 2011). Noise contours from roads, rail and industry within agglomerations can be viewed interactively via a postcode-based search function and are expressed in dB(A) L_{den} or L_{night}. Noise contours from airports can also be viewed interactively. The website has a glossary of technical terms and a description of the relevant noise legislation.

Collaborative Online Mapping

Following an approach similar to Carver *et al.*, the authors are in the process of developing a web-based system that presents urban noise information in a non-technical way and solicits information regarding the location of Quiet Areas without explicitly defining what those are.

The objective is to attract users with the incentive of clear noise information relevant to their neighbourhood and entice them to locate urban spaces that they believe are sufficiently tranquil or quiet.

In this page, the user can type in a post-code and then receives noise map information presented on a 5-point relative scale (low noise to high noise) that makes no use of decibels or acoustic metrics such as L_{den}. The information is complemented with the distance to the nearest park recognised as a Quiet Area following an objective definition such as, for example, an area less than 45 dB(A) L_{den} of a particular minimum extension. Then the user is offered the possibility to spatially locate in the interactive map places that he or she believes are ‘quiet’ and ‘tranquil’.

OpenStreetMap

The tool chosen to present noise information interactively is OpenStreetMap (openstreetmap.org, 2010a), which is an openly-licensed repository of map data collected via copyright-free sources such as GPS surveys, public domain data and out-of-copyright maps.

In this study OpenStreetMap (see figure 1) is used in multiple ways. Aside from informing the public on the relative noisiness on their neighbourhood by means of a simple postcode search, it can locate the nearest Quiet Area using the recommended definition in England (less than 45 dB(A) yearly L_{den}) when used in conjunction with DEFRA’s noise map database. It also establishes a mechanism to help the public identify urban spaces deemed as “quiet areas” from a totally subjective point of view.

The geographical coordinates defining the bounds of all quiet spaces in the Southampton area was extracted using the Osmosis tool (openstreetmap.org, 2010b) and a MySQL (Oracle Corporation, 2010) database populated with the data.

OpenStreetMap uses tags to label map features; the criteria for selection of a feature as a quiet space were the presence of the key/value pairs "leisure=park" or "leisure=common".

Routing to the nearest quiet space is performed using OpenStreetMap data (openstreetmap.org, 2010a) combined with the Routino routing software (Bishop, 2010).

Routino uses a binary format for OpenStreetMap data optimised for routing (Bishop, 2010b). An extract of OpenStreetMap data containing all road and footpath data in the Southampton area was made using the Osmosis tool (openstreetmap.org, 2010b) and converted to the Routino format using a custom tool within the Routino suite. The algorithm (Bishop, 2010) involves searching for the shortest path between the node nearest the starting point and the node nearest the ending point. In common with other path-finding algorithms such as A* (Hart et al, 1968) the search is optimised by assessing intermediate nodes according to likelihood of being on the shortest path by combining the distance from the origin and the estimated distance to the destination. A further optimisation is performed by discarding non-"interesting" nodes (those which do not lie on junctions) from the search, as they will not influence the choice of shortest path.

Southampton Noise Statistics

Southampton is the largest city in the county of Hampshire on the south coast of England. It lies at the northernmost point of Southampton Water at the confluence of the River Test and River Itchen, which divides the city into an eastern and a western half, with the River Hamble joining to the south of the urban area.

Southampton has a large extension and number of parks as compared to other cities in Southern England. The largest is the 133 hectares Common, located relatively close to the city centre and designated a Site of Special Scientific Interest.

To determine the average ‘noisiness’ at postcode level noise data was sourced from the DEFRA noise model (figure 2). A resulting GIS file took the form of semi-contiguous regions of modelled noise data extrapolated into a 100x100m grid. An average for each 100x100m square was calculated from the initial noise data. This data is then used to calculate a mean noise level per postcode (figure 3).

Figure 1 – A view of Southampton in OpenStreetMap

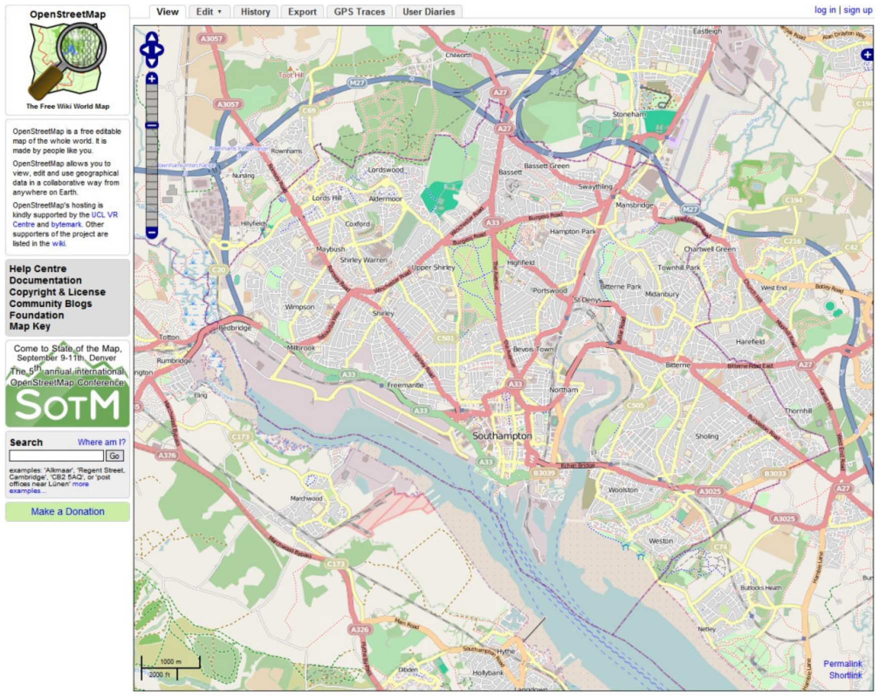
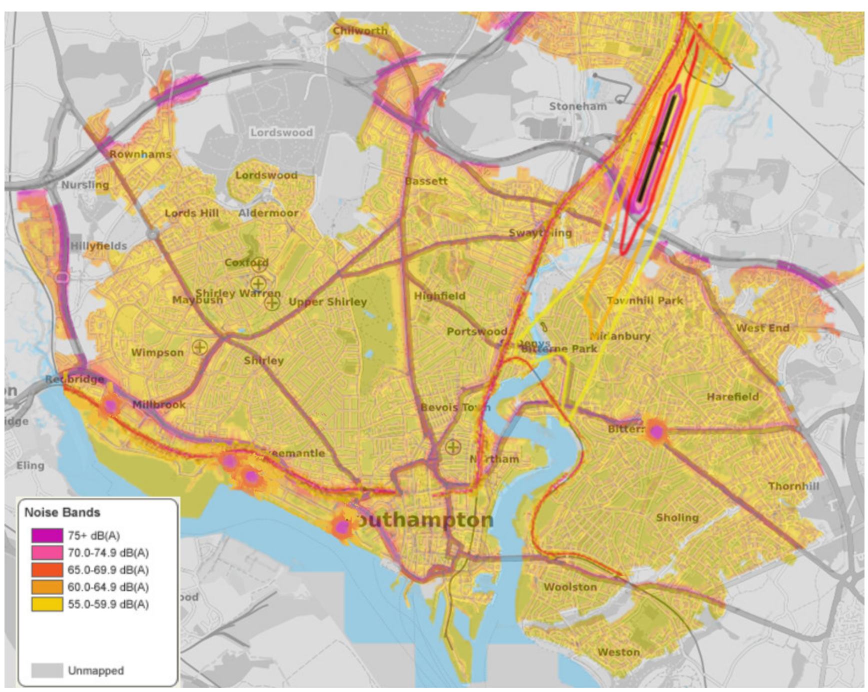


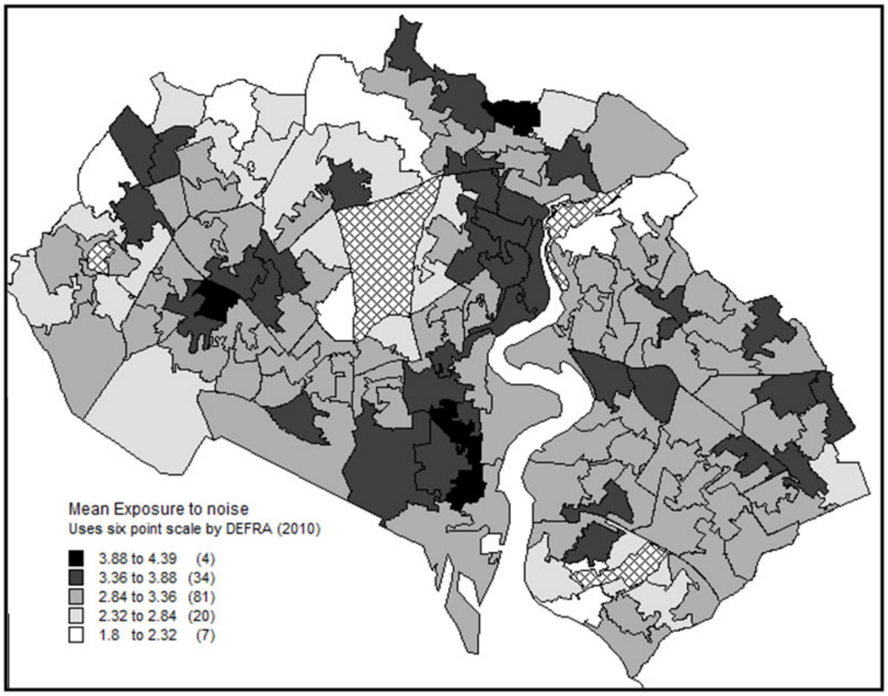
Figure Source: http://www.openstreetmap.org/. (Last accessed 2011)

Figure 2 – Yearly L_{den} contours for Southampton



Data Source: DEFRA.

Figure 3 – Calculated Mean Noise Exposure at LSOA level (darkest areas are noisier, main parks also shown as patterned areas)



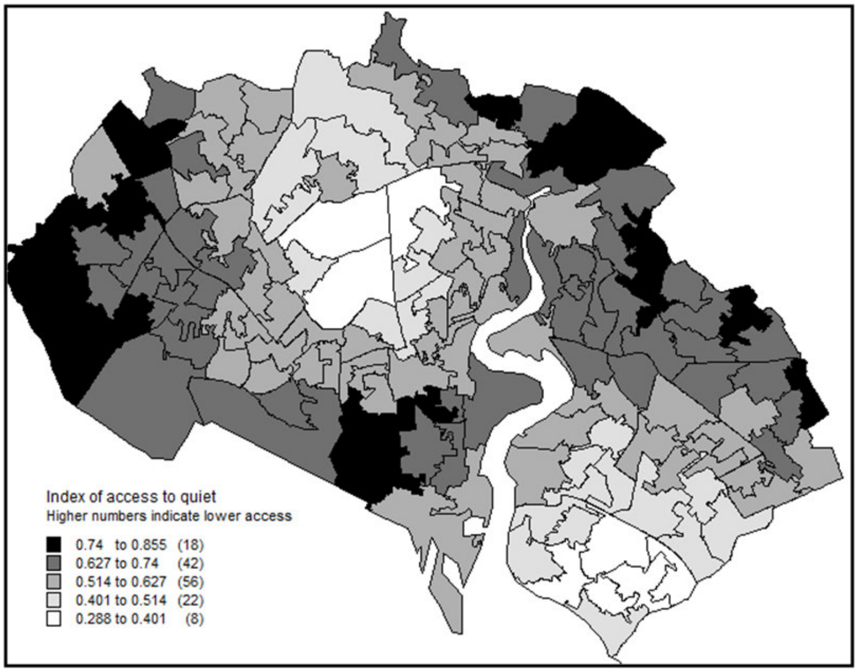
Quiet Area Accessibility

Battaner *et al.* (2010) have discussed a metric to determine Quiet Are accessibility. It takes into account both the mean noise exposure on a given location plus its shortest distance to the nearest, objectively defined, quiet area. This metric (figure 4) was then compared with existing social deprivation statistics and it was found that although the mean noise exposure does not correlate with the Multiple Deprivation Index in Southampton, Quiet Area Accessibility does (Battaner 2010). The accessibility metric in this study considered straight distances, "as the crow flies", which is only valid as a crude approximation. By using the routing options available in OpenStreetMap it is now possible to calculate the correct distance and validate the correlations with deprivation statistics.

The quiet area accessibility metric can be used in conjunction with house noise insulation statistics to define a tranquillity deprivation indicator. This indicator could be useful to urban planners to determine areas lacking a healthy acoustic environment which could benefit from the creation of nearby quiet open spaces.

It has been shown that the quiet area accessibility indicator has a significant correlation with house in poor condition indicator and the multiple deprivation index in Southampton (Battaner 2010).

Figure 4 – Calculated quiet area accessibility indicator at LSOA level



Conclusions

In this paper the use of an online cooperative mapping tool to assist in the identification of quiet areas and to calculate a quiet area accessibility metric has been presented. A Southampton Quiet Area website is under construction, which will present noise statistics and allow the creation of a database of quiet spaces as chosen by the public and the comparison to those based on objective definitions. Finally, the possibilities of using the quiet area accessibility metric in conjunction with social deprivation statistics has been shown.

Acknowledgments

The authors would like to thank DEFRA for providing the raw noise contours for this study.

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