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Työn nimi / Arbetets titel – Title		
Assessing and minimizing dynamic exposure to traffic noise with routing analysis and Web GIS		
Oppiaine /Läroämne – Subject		
Geoinformatics		
Työn laji/Arbetets art – Level	Aika/Datum – Month and year	Sivumäärä/ Sidoantal – Number of pages
Master's thesis	April 2020	

Tiivistelmä/Referat – Abstract

It is likely that journey-time exposure to pollutants may compromise the positive health effects of active transport modes (e.g. walking and cycling). One of the pollutants caused by vehicular traffic is traffic noise, which is likely to cause various negative health effects such as increased stress levels and blood pressure. In prior studies, individuals' exposure to community noise has usually been assessed only with respect to home location, as required by national and international policies. However, these static exposure assessments most likely ignore a substantial share of individuals' total daily noise exposure that occurs while they are on the move.

In this study, I developed a multifunctional routing application for 1) finding shortest paths, 2) assessing dynamic exposure to noise on the paths and 3) finding less noisy (i.e. quieter) paths for walking. The application uses street network data extracted from OpenStreetMap and modelled traffic noise data of typical daytime traffic noise levels. The underlying least cost path (LCP) analysis employs a custom-designed environmental impedance function for noise. I defined a set of indexes for quantifying and comparing dynamic (i.e. journey-time) exposure to high levels of noise.

I applied the developed routing application in a case study of pedestrians' dynamic exposure to noise on commuting related walks in Helsinki. The walks were projected by carrying out an extensive public transport itinerary planning on census based commuting flow data. Statistical analysis was carried out to explore the average dynamic noise exposures at both municipality and neighborhood level. Also, achievable reductions in exposure to traffic noise by taking quieter paths were assessed with statistical means by a subset of 12180 commuting related walks (OD pairs).

The results show significant spatial variation in average dynamic noise exposure between neighborhoods but also significant achievable reductions in noise exposure by quieter paths; depending on the situation, quieter paths provide 12–57 % mean reduction in exposure to noise levels higher than 65 dB and 1.6–9.6 dB mean reduction in mean dB (compared to the shortest paths).

I published the quiet path routing application as a web-based quiet path routing API (application programming interface) and developed an accompanying quiet path route planner as a mobile-friendly interactive web map application. The online quiet path route planner demonstrates the applicability of the quiet path routing method in real-life situations and can thus help pedestrians to choose quieter paths. Since the quiet path routing API is open, anyone can query short and quieter paths equipped with attributes on journey-time exposure to noise.

The results suggest that at least the following factors affect the achievable reduction in noise exposure on quiet paths: 1) exposure to noise on the shortest path, 2) length of the shortest path and 3) additional length of the quiet path. It is likely that the presence of alternative (quieter) paths limit the accuracy of indirect dynamic noise exposure assessments to some extent. Hence, the results of the case study may not provide especially reliable results on the true variation in opportunities for walking in quiet. When developing exposure-based routing further, attempts should be made to enable simultaneously assessing and optimizing multiple environmental exposures in order to optimize overall healthier paths.

Avainsanat – Nyckelord – Keywords

Dynamic exposure, traffic noise, environmental impedance, least-cost path analysis, Web GIS, Helsinki

Säilytyspaikka – Förvaringställe – Where deposited

Muita tietoja – Övriga uppgifter – Additional information