Issue 1 - February 2011

CityHush

CityHush – Accoustically Green Road Vehicles and City Areas

Editorial

Reducing noise in cities: The CityHush project is working on it!

The European-funded CityHush project starts from a vision: the quiet city! Implementing quiet zones with the help of quiet electric (or hybrid) vehicles resulting in noise levels 10-15 dB(A) lower than before, quiet tyres and road surfaces, as well as design solutions for buildings and noise barriers to mitigate low-frequency noise are the project's key instruments to achieve that.

Reducing noise in cities with 15 dB(A) – this is the aim of CityHush. Read in this newsletter how the project wants to achieve that!

Road traffic noise is the major noise problem in European cities. Changing to electric vehicles can bring about a significant noise reduction. In order to make the possible benefits tangible as early as possible – with only a small share of the vehicle fleet being electric in the beginning – CityHush is proposing quiet zones, so called Q-Zones. In Q-Zones only electric vehicles will be allowed, defined via a certain maximum noise level. Compared to the situation before, noise levels are expected to be reduced by about 15 dB(A). This concept will be supported by innovative designs for low-noise tyres and road surfaces. To further improve the situation at hot spots, CityHush suggests innovative noise barriers to absorb or mitigate the propagation of low-frequency noise.

This newsletter will inform you bi-annually about CityHush achievements and upcoming events. We already now want to raise your awareness for the CityHush seminar and training sessions that will be organised in autumn this year.

Go to **www.cityhush.eu** and register to our mailing list to ensure you are kept informed!

For now, we wish you a pleasant read with this first issue of the CityHush newsletter!

Urban planning & noise rating systems

Q-zones for noise reduction in urban areas

Quiet zones, or Q-zones, can be applied to establish or preserve quiet areas in urban environments. Noisy vehicles will not be allowed to enter a Q-zone. The idea is to make use of new vehicle technology, such as electric or hybrid power trains, which emit about 10 dB less drive-line noise. Utilising this potential requires that the share of such low-noise vehicles is very high, which can only be obtained by incentives or regulations keeping most other vehicles out of the Q-zone.

CityHush will implement Q-zones in five European cities – Bratislava (Slovakia), Bristol (UK), Essen (Germany), Gothenburg (Sweden) and Stockholm (Sweden) – through modelling, using input from traffic and noise mapping models available for the different cities. The test sites are located in

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SEVENTH FRAMEWORK PROGRAMME

central parts, where it may be impossible to reduce vehicle flows on major streets close to the intended Q-zone. In such cases, additional tools such as barriers or buildings and/or sound absorbing house facades will be used to achieve the desired effects.

The test site in Gothenburg includes the park "Trädgårdsföreningen" and the surrounding area. This area contains mixed work place and dwelling buildings, and a park. There is a major road along the right side of the park, requiring further measures to be implemented in addition to the effects of constraining the street flows to low-noise vehicles on the other side of the canal. Current noise levels are about 60 dBA in the central parts of the park and 67 dBA closer to the major road, so there is an urgent need for noise reduction in the area. Both traffic flow simulations and noise map calculations are in progress.

Park benefits

- promotion of on-site activities e.g. music, theatre, recreational activities etc.;
- increased usage and types of usage of the park;
- higher levels of relaxation/enjoyment for visitors;
- potential for additional funding revenues (park maintenance and improvement).

Health

- improved air quality within the park due to likely decrease in traffic flow around the park and its immediate environs;
- reduced stress levels, better well-being.

CityHush aims at evaluating the noise gains of embedding a park in a Q-zone. The maximum expected noise in an embedded park will be determined by evaluating existing noise levels and analysing modified traffic data and the impact on the noise levels. Six test sites have been identified across Europe, both noisy and quiet ones. Based on data input from the municipalities involved, the project will analyse the effects of implementing various transport strategies on noise levels (e.g. using the noise rating system developed within the

Gothenburg test site: park "Trädgårdsföreningen"

photo: Jens Persson

Parks embedded in Q-zones

A special focus within CityHush is on parks embedded within a Q-zone, i.e. parks centrally located within a Q-zone where the aim is to achieve a 10-20 dB noise reduction. This should lead to a park environment with a greatly reduced noise level, a better acoustic environment, additional health benefits and a more useable and relaxing recreational space. Benefits can be summarised as follows:

Noise

- reduced noise impact to visitors of the park;
- better noise environment for residential properties around the park;
- better ambient noise levels.

About CityHush

The CityHush project will support city administrations with the development and implementation of noise action plans according to the directive EC 2002/49. Noise action plans made with existing technology suffer from major shortcomings: there is a poor correlation between hot spots and annoyance and complaints, most measures lead to increased emissions, and only indoor noise comfort is addressed.

In order to reduce noise in city environments, CityHush develops suitable problem identification and evaluation tools and designs noise reduction solutions for hot spots that show a high correlation with annoyance and complaints. The innovative solutions and tools under development are listed below.

Urban planning & noise score rating systems

- Q-zones;
- parks embedded in Q-Zones;
- improved indoor noise score rating models integrating low-frequency noise and the occurrence of high noise single events;
- noise score rating models for the outdoors.

Vehicles, tyres & road surfaces

- objective and psychoacoustic evaluation tool for low noise low emission vehicles;
- mathematical synthesis tool for noise from low noise low emission vehicles;
- general performance noise specifications for low noise low emission vehicles;
- novel concepts for low noise roads based upon dense elastic road surfaces;
- novel concepts for low noise roads based upon grinding of asphalt top layers;
- novel concepts for tyres for low noise vehicles, including heavy vehicles;
- criteria for use of low noise motorcycles;
- active and passive noise attenuation measures within the tyre hood.

Building design & noise barriers

- solutions for high low-frequency absorption at facades of buildings;
- solutions for high low-frequency isolation in the propagation path.

The CityHush project is co-funded by the European Commission under the 7th Framework Programme for RTD.
Duration: January 2010 - December 2012
Budget: appr. 5 m€
13 partners in 7 countries
www.cityhush.eu

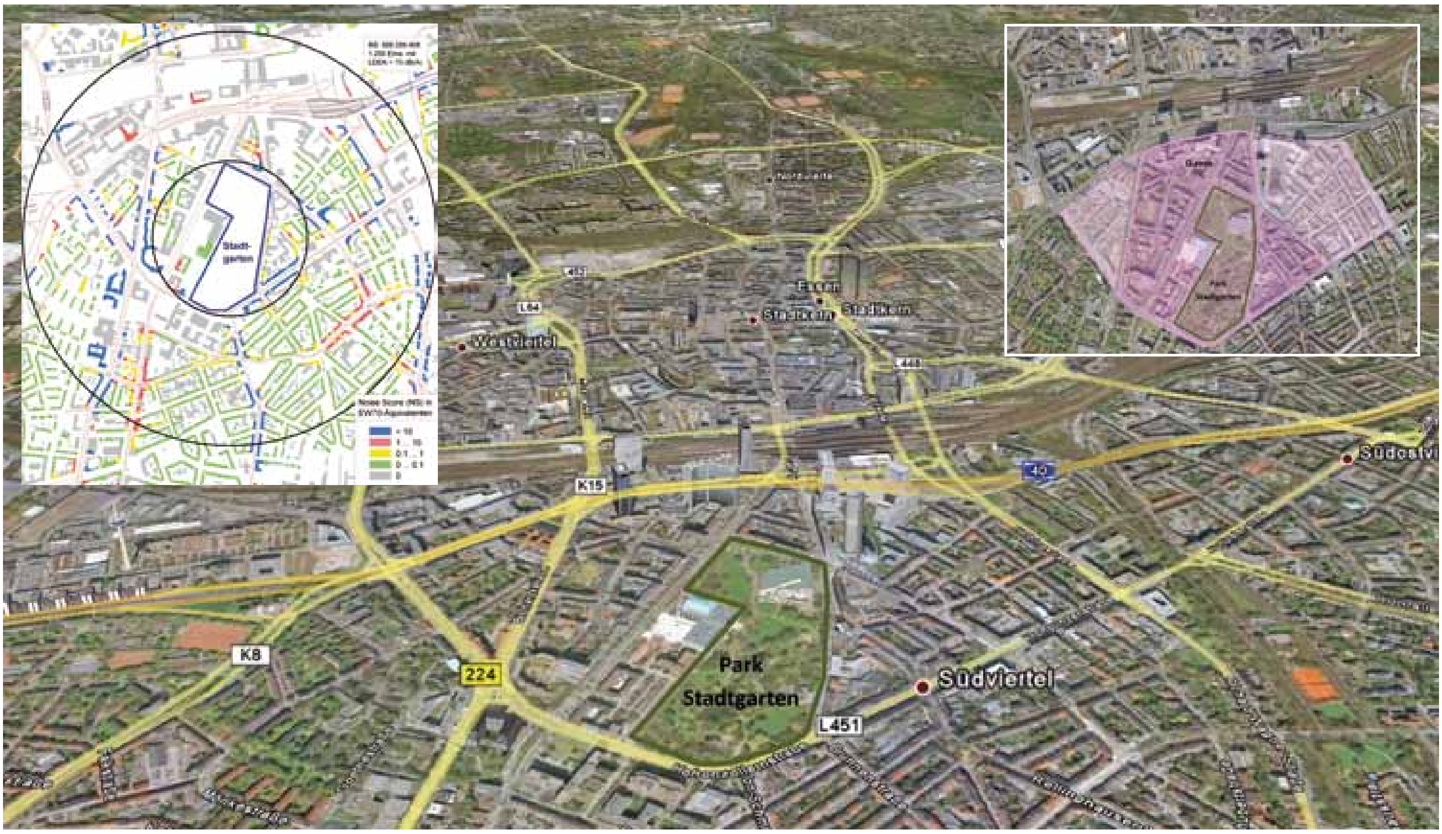
project; see further on in this newsletter). Project outputs include:

- calculated examples of embedded parks, establishing the maximum potential noise gains attainable by the creation of a Q-zone;
- identification of boundary conditions, specifying the parameters that will define an embedded park;
- combining the functionality and usage levels of an embedded park with work being carried out to establish a noise rating system, and testing the derived system on real-life examples.

Noise rating model for the outdoor environment

The current identification of hot spots in noise maps is based on facade levels and does not include possible beneficial effects of a nearby quiet outdoor environment. To enable an evaluation of noise in the outdoor environment as perceived by residents and visitors of parks, a tentative noise rating model is being developed. So far, most information on the impact of noise in outdoor areas pertains to specific situations, such as aircraft overflights in wilderness areas, which cannot be applied directly to the impact of predominantly road traffic related noise in the urban outdoor environment.

Still, annoyance due to outdoor noise seems to be influenced by the equivalent noise level during the day, the percentage of time a certain noise source may be heard, and source characteristics such as peak levels and low-frequency noise components. To predict the overall annoyance response, the rating mode combines such indicators for outdoor noise with information about the function of the area and the number of people making use of the area.



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In the next stage of the project, the model will be further tested by investigating the effect of noise in the outdoor urban environment on subjects residing and walking in a realistic situation. On the basis of these results, the noise rating model will be evaluated and improved.

Vehicles, tyres & road surfaces

Measuring noise sources

As part of CityHush, a measurement system is being developed, allowing for the detection, separation and quantification of the various noise sources contributing to the overall noise of road traffic. Traffic consists of many single vehicles and each vehicle contains a number of noise sources, such as tyre/road interaction, engine, etc.

The system should be capable to distinguish and track a single vehicle using optical information by means of calibrated video cameras. The position of the dominant noise sources is determined using the microphone array technology. The combination of optical and acoustical information allows for the identification of the noise sources with each passing vehicle.

The spatial resolution of a microphone array strongly depends on the array size. To resolve the complex traffic noise, a modular system consisting of square grids (1.5m x 1.5m) has already been developed. The grids can be combined arbitrarily to build e.g. an array of 6m x 3m with up to 192 microphones and 3 video cameras to cover the entire street.

The algorithms for vehicle detection, classification and tracking are under development. Further work is planned to optimise the methods for the separation of incoherent sources to increase the resolution of the acoustic source map. At the end, the system will be tested and validated with measurements of real vehicle pass-by and complex traffic scenarios.

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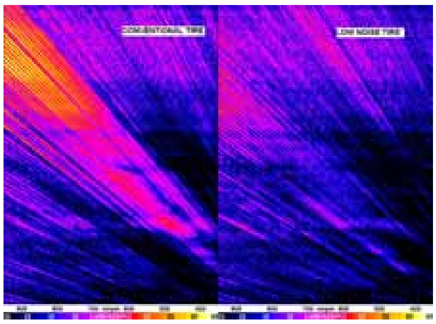
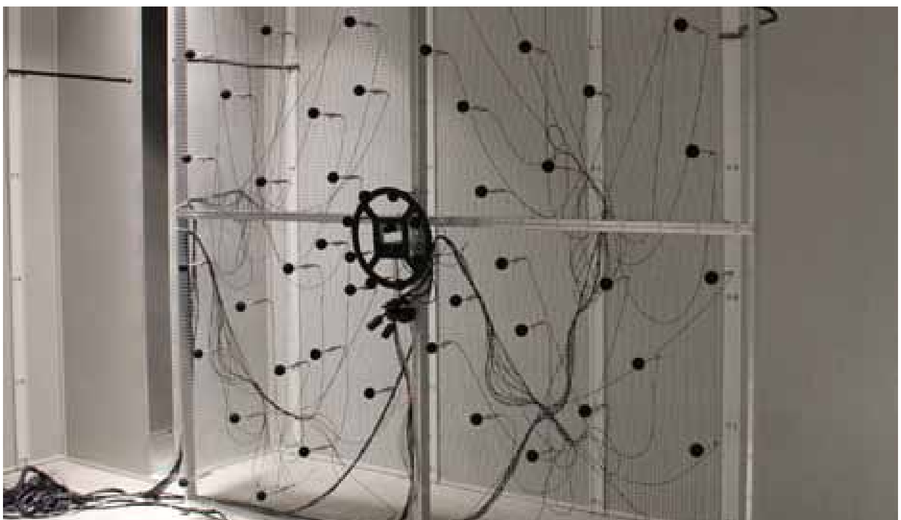
Low-noise tyres for electric vehicles

One of the components of traffic noise is generated by the interaction between motor vehicle tyres and the road surface. The amplitude and frequency content of this noise is a function of many parameters, including the road surface texture, tyre dimensions, tyre materials, and construction and the tread pattern design.

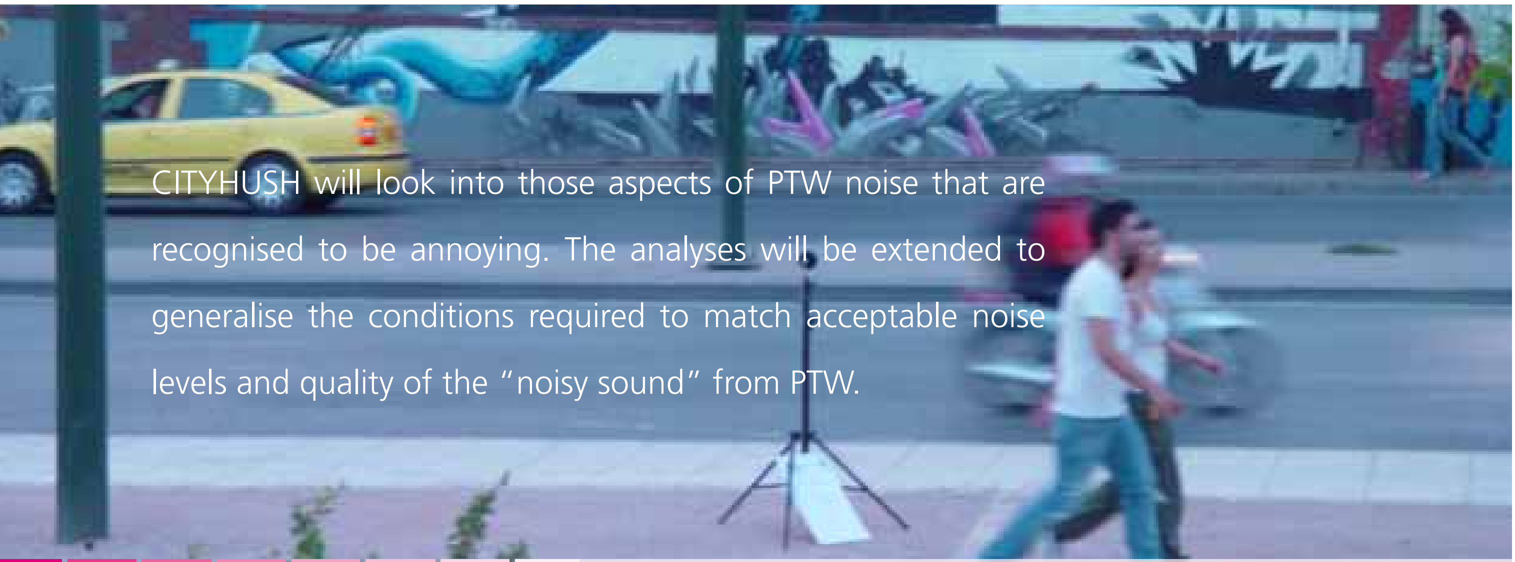
Tyre/road noise generation contributes to the interior vehicle noise as well as to the exterior noise. At low acoustic frequencies (below 500 Hz), the transmission of forces from the tyre/road contact zone to the vehicle body is related to the interior vehicle noise, especially on rough road surfaces. At high frequencies, the noise originating from the vibration of the tyre surface also contributes to the noise perceived in the environment, which becomes most intense in the frequency range around 1000 Hz.

In CityHush, engineers of the Goodyear Innovation Center Luxemburg are developing a prototype tyre specifically aiming to fulfil the distinctive requirements of future electric vehicles. The reason is that at higher speeds (above 50 km/h) electric cars are just as noisy as usual cars due to the fact that the overall noise is dominated by tyre/road noise. The design of the concept tyre will be uniquely suited to complement the performance requirements of electric vehicles. Electric engines often provide a relatively high torque, even at very low speeds, which increases the acceleration performance of an electric vehicle in comparison to a vehicle with a similar internal combustion engine. This required the development of a modified tread design in combination with a new tread compound to ensure reduced noise generation, excellent grip on wet roads and low rolling resistance.





Experimental setup of a 3m x 3m array grid with 56 microphones and integrated video cameras.



Annoyance of Powered Two-Wheelers

In southern Europe, the noise coming from powered two-wheelers (PTW) is significant in cities. It is common knowledge that PTW are a major cause of concern when it comes to road traffic noise. However, very little was studied in the past on the effect that PTW have on people in general and pedestrians in particular. Assessments show that PTW represent 20% of the vehicles running in the city centre of Athens, and that, concerning noise, a car pass by and a PTW pass by have comparable though not identical effects in terms of Leq (equivalent continuous sound level). A questionnaire was presented to around 200 people walking on the street and in parks in central Athens, while simultaneously recording the traffic noise at the locations where people were interviewed.

The features that could make traffic noise, including the noise of PTW, acceptable for pedestrians will be assessed on the basis of an analysis of several acoustical and traffic type parameters. A first look at the data shows that less than 30% of the respondents are annoyed with up to 60 dB Leq, while the percentage increases to 90% above 70 dB. Based on the questionnaire, which is aimed at assessing the effects of noise on annoyance, CITYHUSH will look into those aspects of PTW noise that are recognised to be annoying. The analyses will be extended to generalise the conditions required to match acceptable noise levels and quality of the "noisy sound" from PTW.

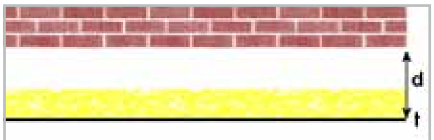


Figure X.1: Solid panel absorber

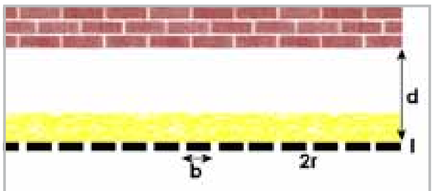


Figure X.2: Perforated panel absorber

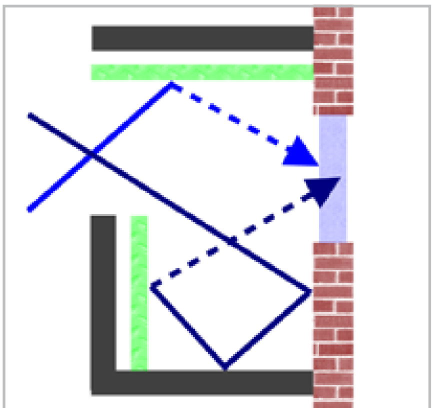


Figure X.3: Application of LFN absorbers

Building design & noise barriers

Low frequency absorption of facades

Trucks and buses are major contributors to traffic noise. At low speeds, the engine and exhaust typically produce low-frequency noise (LFN) with dominant frequencies between 31,5 Hz en 63 Hz.

Commonly used window types do not perform well when it comes to low-frequency sound insulation. Trucks and buses passing by at low speeds and at close proximity to building facades therefore generate noise inside the building with high low-frequency content.

In CityHush, two LFN absorbers for installation on the facade are being developed to reduce the LFN around the exposed windows, so that they will transmit less to the inside of the building: the solid panel absorber and the perforated panel absorber.

Both LFN absorbers are designed to have a resonance frequency that matches the frequencies of traffic noise. The resonance frequency of the solid panel absorber depends on the mass of the panel and on the depth of the cavity behind. For the perforated panel absorber, it is the combination of the perforations and the cavity behind that determines the resonance frequency. Both systems are known to be efficient absorbers for LFN.

An application of both LFN absorbers consists of placing them in front of balcony surfaces. See figure X.3: incident sound rays (blue lines) reflect on parts of the balcony before they reach the window. The sound rays are absorbed by the panel absorbers installed against the balcony surfaces facing the building facade (green lines). Thus the LFN from trucks and buses is prevented from entering the building through the windows. Theoretically, up to 90 % of the noise at the dominant frequencies of 31,5 Hz and 63 Hz that reaches the panels can be absorbed.

External Events

Date	Event	Place
21 - 24 March 2011	DAGA 2011	Düsseldorf, Germany
27 April 2011	International Noise Awareness Day / Der Tag gegen Lärm	Berlin, Germany
8 - 9 June 2011	3. Bayerische Immissionsschutztage	Augsburg, Germany
26 June - 1 July 2011	Forum Acusticum	Aalborg, Denmark
4 - 7 September 2011	Internoise 2011	Osaka, Japan

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