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Urban Sound Planning

– A presentation for UNECE/WP29/GRB*, February 2016

*Working Party on Noise (GRB), subsidiary body of UNECE World Forum for Harmonization of Vehicle Regulations (WP.29)

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- What is Urban Sound Planning?
- What do we do at Applied Acoustics, Chalmers?
  - Outdoor sound propagation & urban sound planning
  - Auralisation of road traffic, including listening tests
  - Road/tyre noise & rolling resistance
  - ...

Urban Sound Planning

Planning of the acoustic qualities in an urban environment

A careful study of the sound environment can:

- Prevent negative effects on health and wellbeing
- Make it appropriate to the uses and functions of the place and enhance its perception and experience

The planning has to be holistic and long-term, needing:

- A masterplan for a city defining qualities to be maintained or achieved
- Involvement in the general planning process from the very beginning

Does not exist today!

Today:

- We talk noise issues not acoustic qualities
- We solve problems in a very limited location
- We solve them often in a short time perspective (solution now)
- We come in late in the planning process
- Mainly an issue of costs

SONORUS project: Urban Sound Planning

- Training network for young researchers
- Sweden, United Kingdom, Belgium, Italy, Switzerland, Germany
- Test sites: Rome, Antwerp, Brighton, Göteborg

14 young researchers - ITN financed by the EC 3.7 mil €

Why urban sound planning?

Example Berlin:

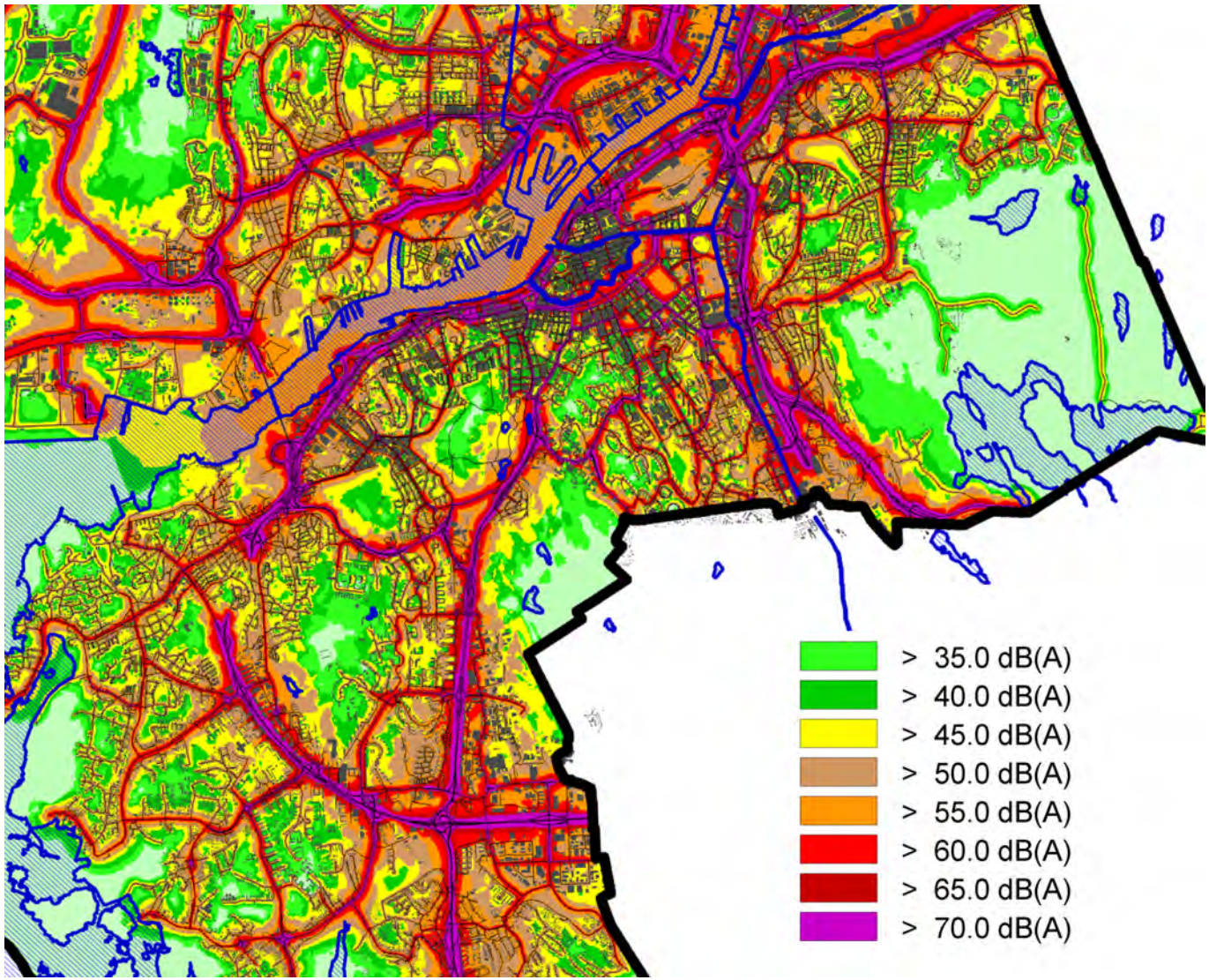
245000 persons live where L_{DEN} >65 dB
27% of the major roads are taken up in the noise action plan.
Expected population growth until 2030 +7%

Problems cannot be solved in a short time perspective but need long term planning

Example Gothenburg

- Population growth 0.5-1 % per year
- Extreme shortage of housing
- Ongoing process of urban densification
- Making use of “empty” spaces


Tram and road traffic
Oscarsleden
Tunnel opening
Stena Danmarksterminal
Rosenlundsverken


> 35.0 dB(A)
> 40.0 dB(A)
> 45.0 dB(A)
> 50.0 dB(A)
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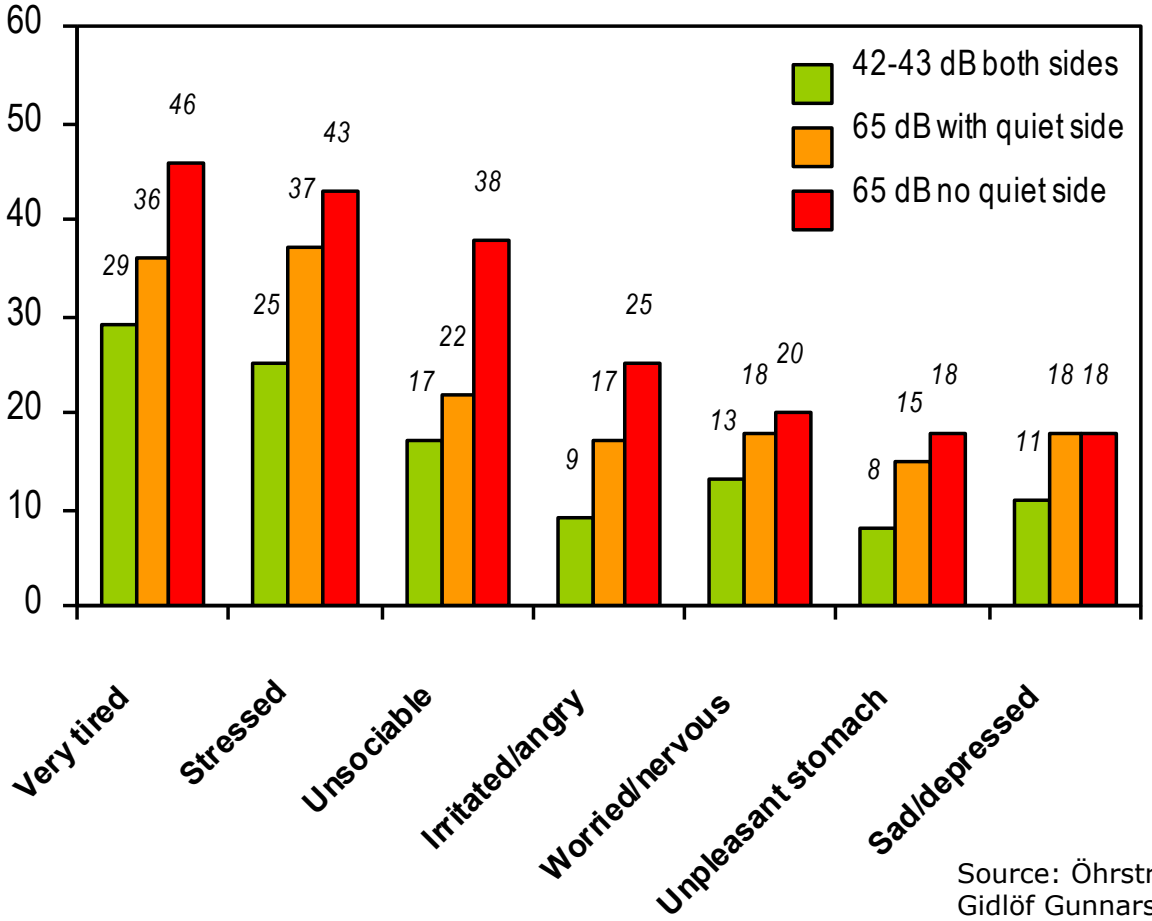
> 65.0 dB(A)
> 70.0 dB(A)

Make use of the quiet side



Source: Öhrström, E., Skånberg, Svensson, H., and Gidlöf Gunnarsson, A. (2006). Effects of road traffic noise and the benefit of access to quietness. J Sound Vib. Vol 295, pp. 40-59.

Characteristics of the quiet side

- Sound fields in an urban environment and especially at the “quiet” side are rather diffuse
- Directivity of the sources are not important, but sound power
- Levels are determined by a wide area of roads
- To reduce levels on the quiet side we need to reduce source power, secure shielding and introduce absorption

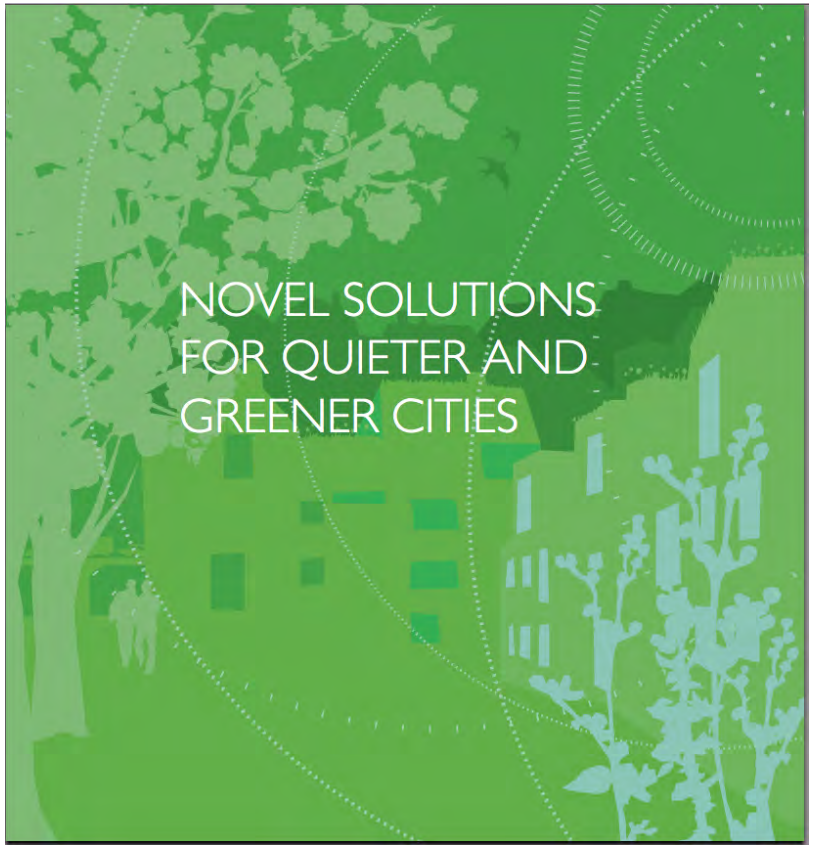
Reduction during propagation: HOSANNA project

- **Ho**listic and **S**ustainable **A**batement of **N**oise by optimized combinations of **N**atural and **A**rtificial means

The main idea of the project is to optimize the use of green areas, green surfaces and other natural elements in combination with artificial elements in urban and rural environments for reducing the noise impact of road and rail traffic.

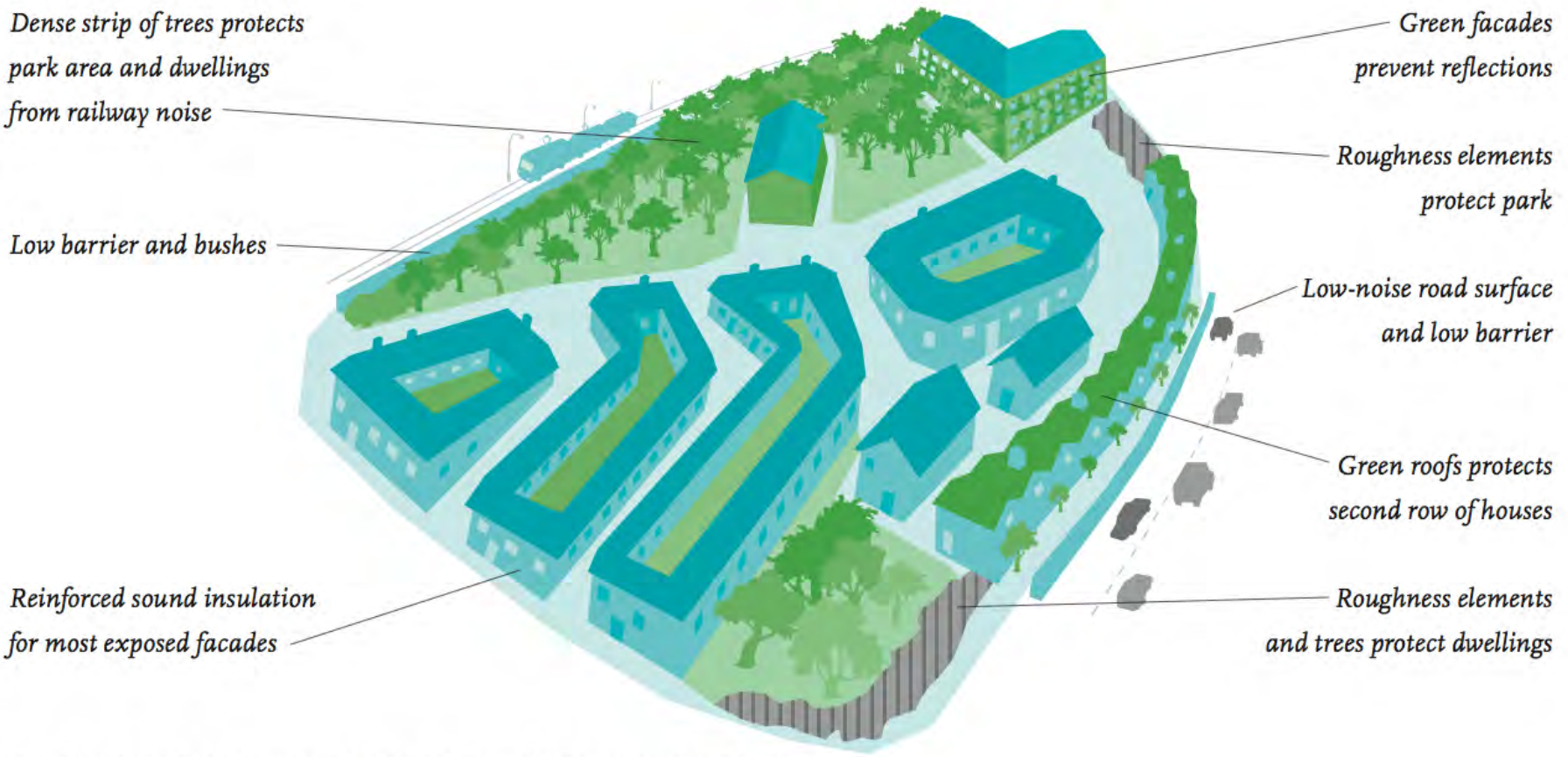
HOSANNA – Workpackages

1. Management
2. **Innovative barriers** exploiting natural materials
3. **Trees**, shrubs and bushes
4. **Ground treatments**
5. **Greening buildings**
6. **Holistic acoustic design and perceptual evaluation** (including field studies)
7. **Comparative cost benefit analysis** (CBA)
8. **Dissemination** (brochure, handbook and workshops)



Information leaflet at www.greener-cities.eu

Combined measures



Combining solutions to protect the quiet sides of noise-exposed dwellings

Measures can be very cost efficient since they make use of multi-functionality

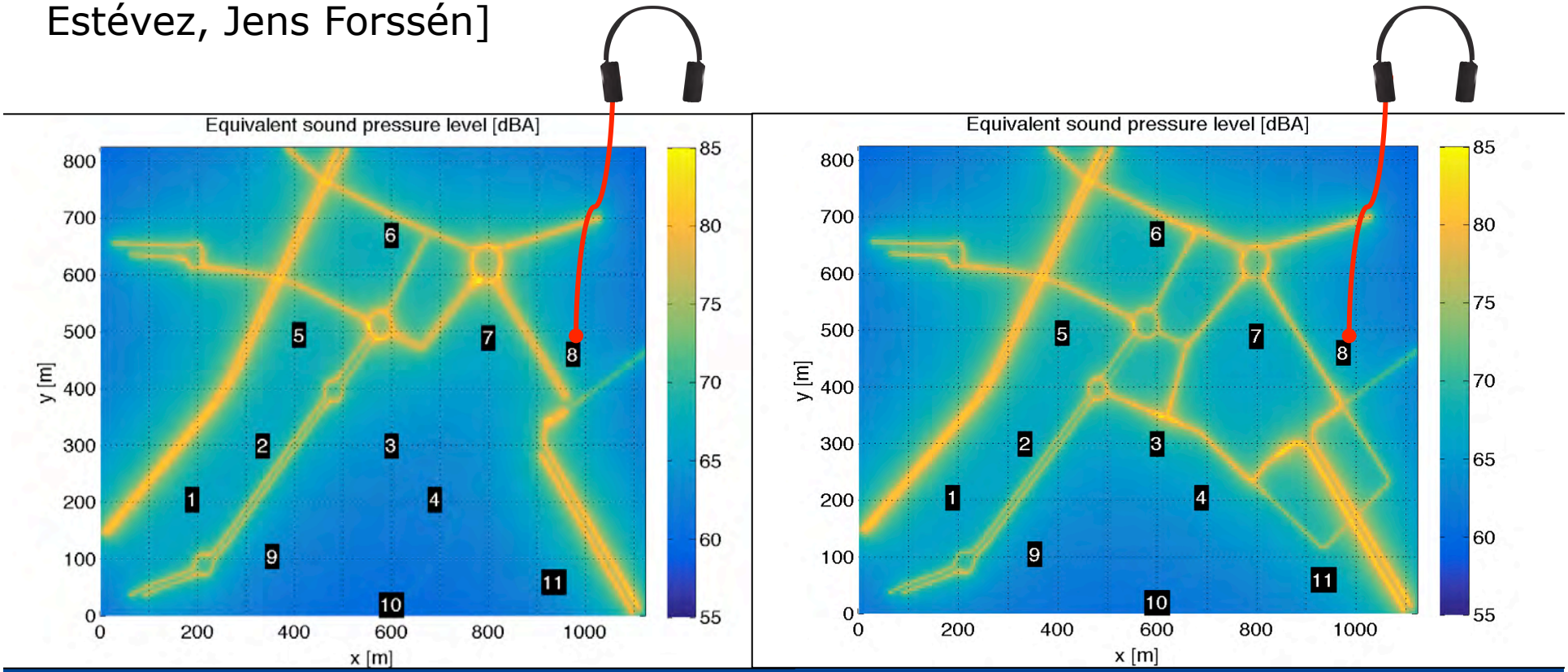
Important:

- Need to be planned carefully (beyond todays standard)
- Have to be included early in the planning process to be cost efficient
- Pro-active planning

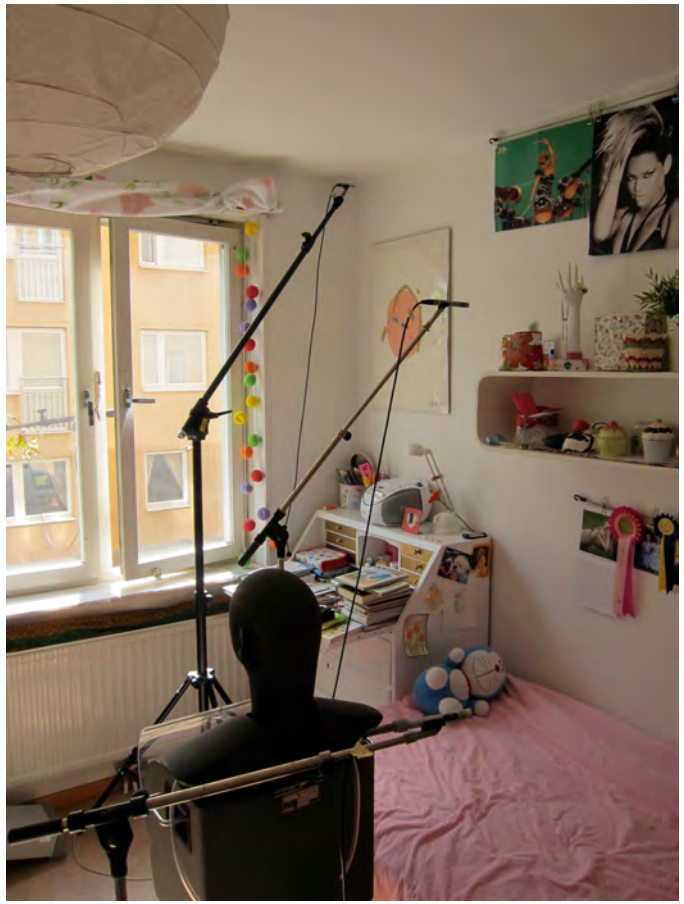
Other projects

Auralisation of road traffic scenarios – "interactive planning tool"

Use of traffic flow data as function of time, including acceleration, as input to auralisation [Georgios Zachos, Laura Estévez, Jens Forssén]

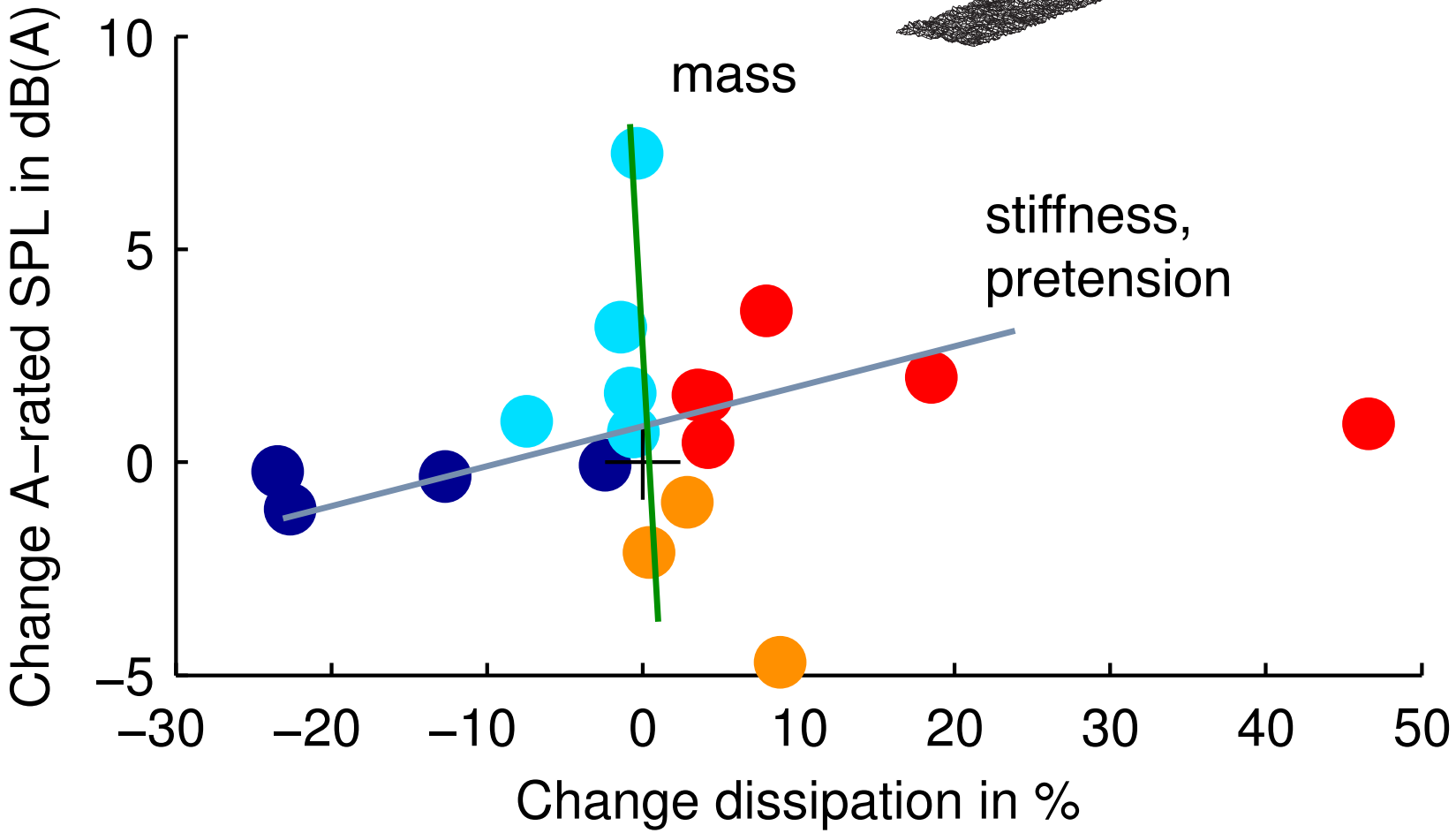


Auralisation of indoor sounds for passing heavy-duty vehicles [Patrik Höstmad, et al.]



Tyre/road modelling

Ex: Influence of tyre properties
on rolling resistance and rolling noise
[Carsten Hoever, Wolfgang Kropp]

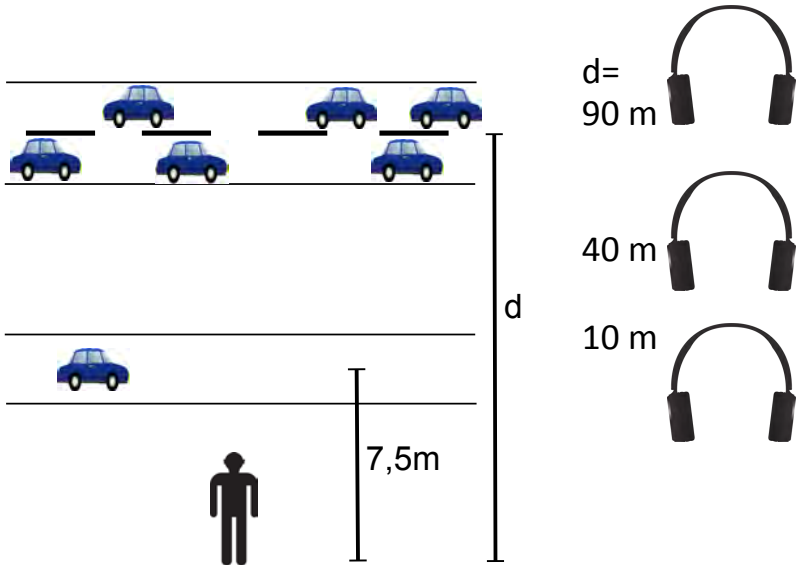


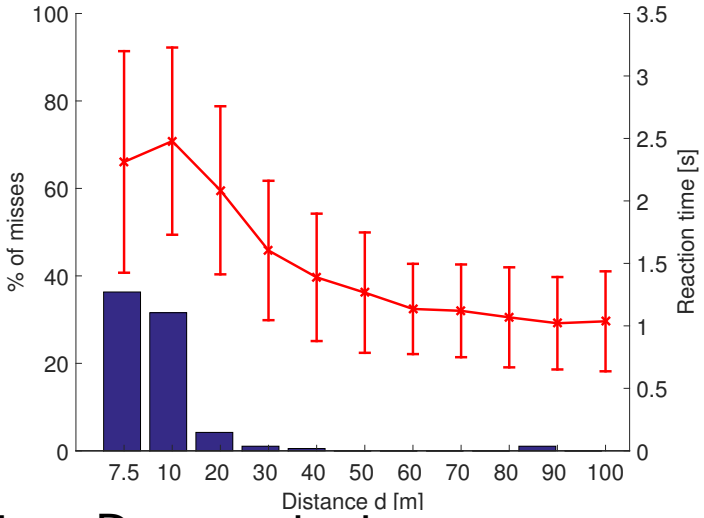
Psychometric function for car pass-by in background noise based on simulated data

[Alice Hoffmann, Wolfgang Kropp]

Use auralised car pass-by in listening tests:

- **Distance**
- Traffic amount/regularity
- Speed
- Same car-type or different (extra sound components)
- Only rolling noise vs. rolling noise and combustion engine





Auralisation based on SPERoN and Listen-Demonstrator:
http://publications.lib.chalmers.se/records/fulltext/227854/227854.pdf

So, what can help the planning?

- Source model and control:
  - Test method in terms of **sound power** (enables stronger link to noise mapping results, "dB per dB")
  - Test method for **various operational conditions** (-"-)
  - **Control on each source type**, with high precision (-"-)
  - ...demand on **separation of sources**, i.e. measuring tyres, vehicles and roads separately
  - **Spectrum** of sources' strengths (for estimation of abatement effects and indoor levels)
  - **Strong link between source models used in noise mapping and test methods with corresponding limits**
    - To date, CNOSSOS-EU source model describes an average of vehicle fleet, and models road surfaces as a correction term, e.g. making tyre labelling less relevant

- ... (contd.):
  - **Study total effect of combined measures** – to avoid sub-optimisation and unnecessary costs for all parties
  - **Responsibility by all involved parties**

- Further thoughts:
  - AVAS could be a parenthesis in evolution
  - Use of new/emerging technology to reduce noise at source, e.g. geo-fencing
  - Use of near-road propagation abatements, e.g. acoustically optimised ground and low barriers
    - All measures are needed
  - What can we do within GRB?

Conclusion

- To reduce negative impact of road traffic noise, all tools are needed: reduction at source, near-road propagation abatements, and urban planning
- Source modelling, and actual community noise, needs to be linked with test methods (source separation, sound power, spectrum, various driving conditions)
- We need control of road surfaces
- AVAS could be a temporary measure