

Mitigation options for loud vehicle noise

LENS Sound of Silence Workshop

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Overview



1. Introduction
2. Causes and Examples
3. Observations
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5. Noise cameras
6. Conclusions and outlook

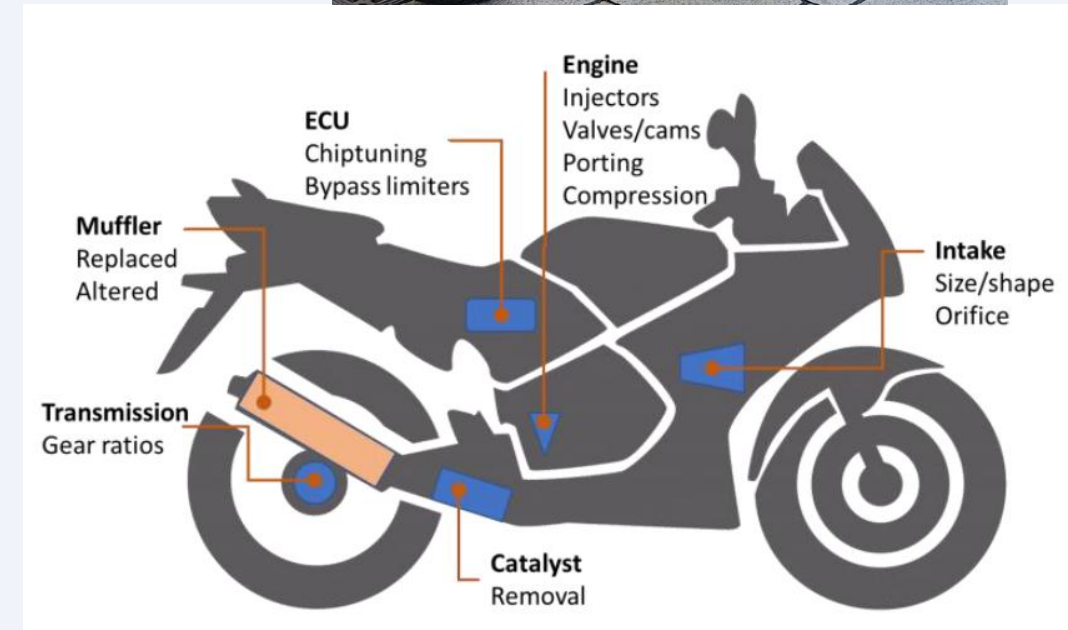
Introduction

- Loud vehicles lead to many complaints and significant impact on residents along affected routes both in urban and rural areas
- Local communities and associations protesting and petitioning
- The high noise levels have minor effect on long term Lden average exposure levels
- Mitigation options = Technical and policy solutions sought
- Monitoring of loud vehicles in four NL cities (G4)
- EU project LENS on mitigation of L-vehicle noise and emissions
- Study on feasibility of noise cameras

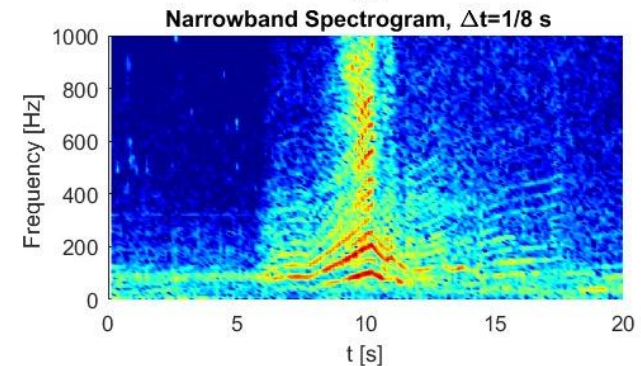
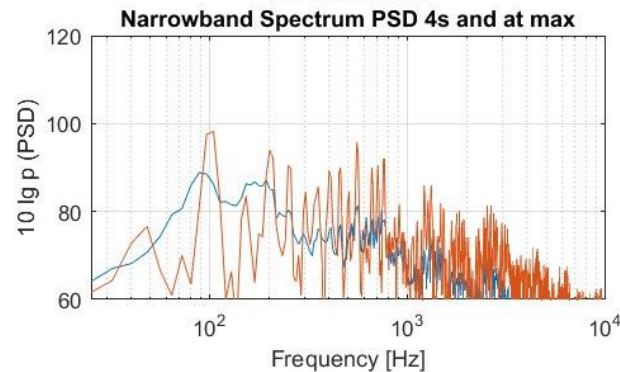
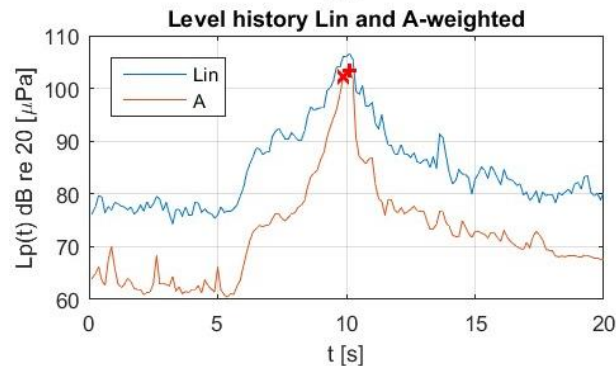
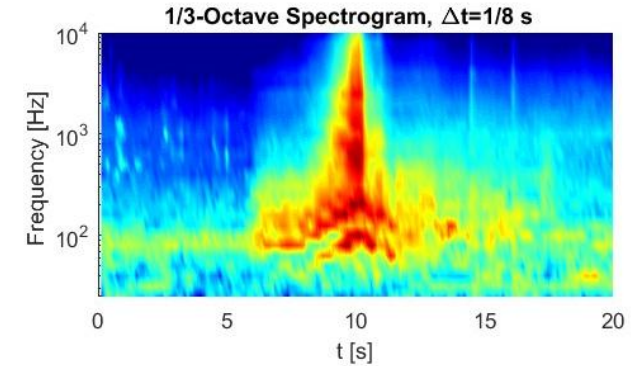
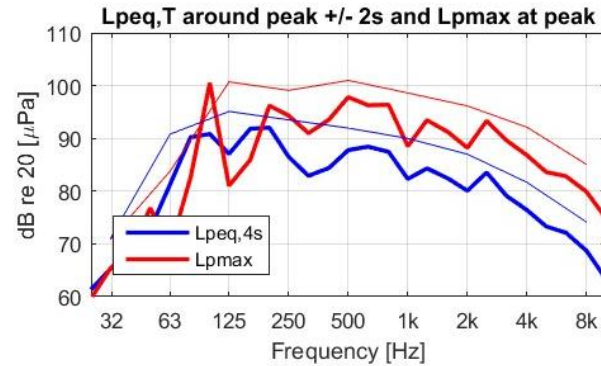
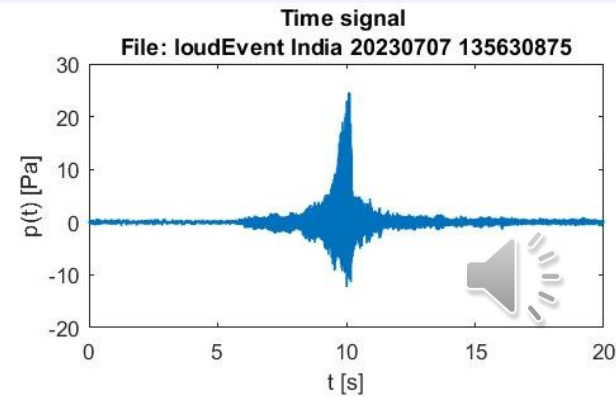


Causes of increased noise impact

- More vehicles on the road
- Higher building density and noise sensitivity
- Low enforcement of vehicle noise
- Vehicle power has increased
- Driving behaviour = acceleration, speed
- Vehicle modifications such as:
 - exhaust variations
 - tuning methods, products and services to increase power and noise are widespread
- New vehicles are not necessarily quieter than previous models in practice



Sound features – Fast accelerating motorcycle 104 dB(A)



Sound characteristics

LpAmax=104 dBA Lpmax=107dB tamax10=0.875s
Llin-LA= 3dB(max) Llin-LA= 5dB(eq) dLpAmaxeq= 9dB
SELA(4s)=101dBA LpAeq4s= 95dBA maxpeakprom= 26
Prom20= 33dB Prom4s= 16dB Max risetime= 26dB/s
Peak freqs @ 50 100 200 500 1250 2500
Levels at peak freqs= 77 101 96 98 93 93
Strongest freq peak @100Hz dLpmaxLMH= -6 -2 -9 dB
Sound indicator= engine bangs
Sound label= rpmshortacc

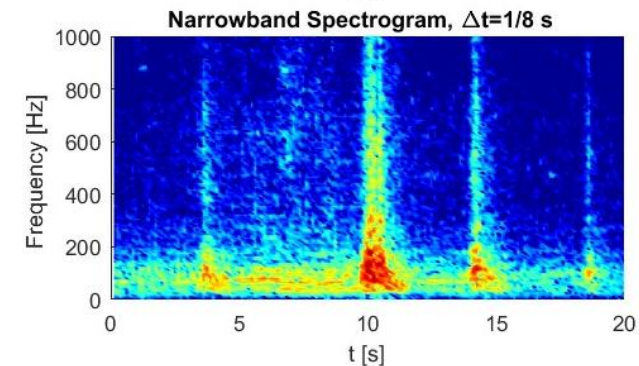
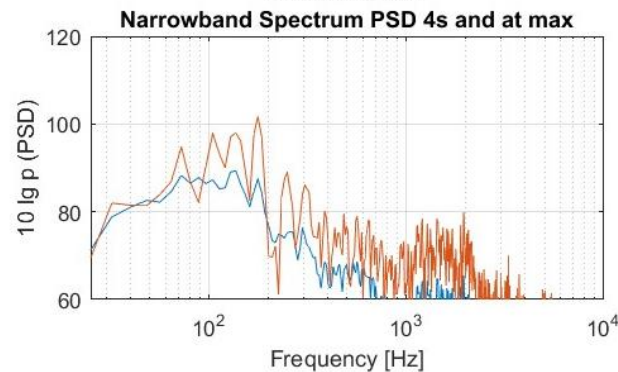
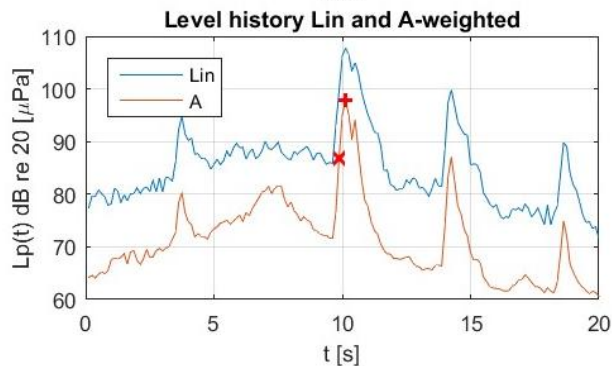
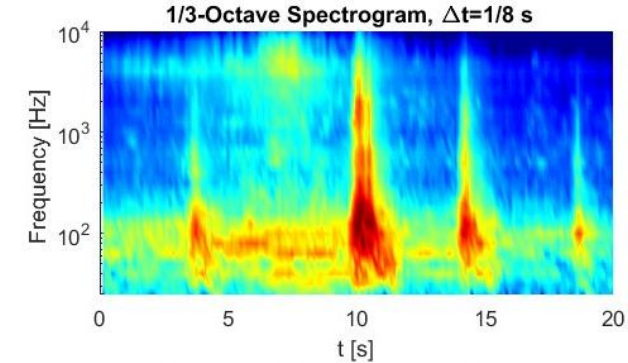
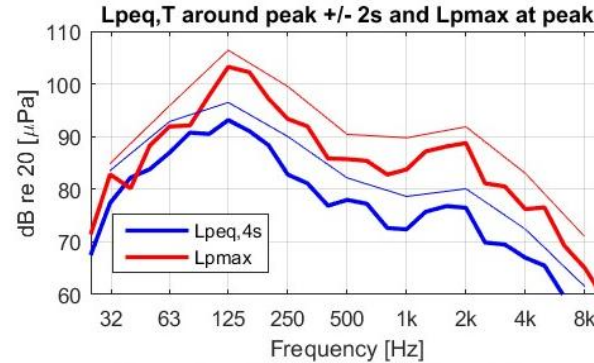
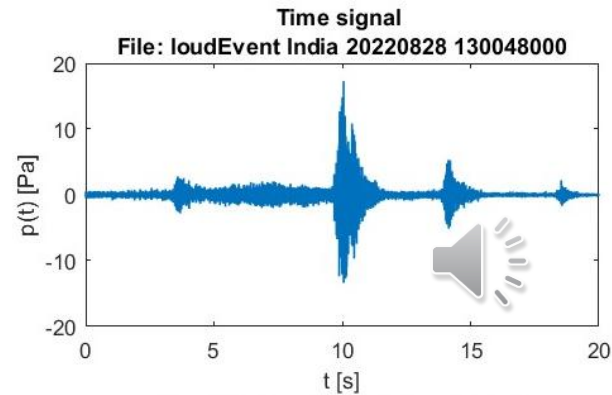
Vehicle data

2023-07-07 15:56:30.875 locAS Dir:South
Motorcycle
BMW R 45
Petrol 473cc 2 cyl 205 kg 26 kW 2 wheels
63 km/h First reg. 21/04/1979

PB level: dBA ST level: 92dBA
Event#1543(match#2516) Reg#79032



Sound features – Revving motorcycle 98 dB(A)



Sound characteristics

LpAmax= 98 dBA Lpmax=108dB tamax10=0.75s
Llin-LA= 10dB(max) Llin-LA= 12dB(eq) dLpAmaxeq= 10dB
SELA(4s)= 94dBA LpAeq4s= 87dBA maxpeakprom= 32
Prom20= 26dB Prom4s= 17dB Max risetime= 82dB/s
Peak freqs @125 2000
Levels at peak freqs=103 89
Strongest freq peak @125Hz dLpmaxLMH= -1 -7 -15 dB
Sound indicator= engineL
Sound label= rpmburst

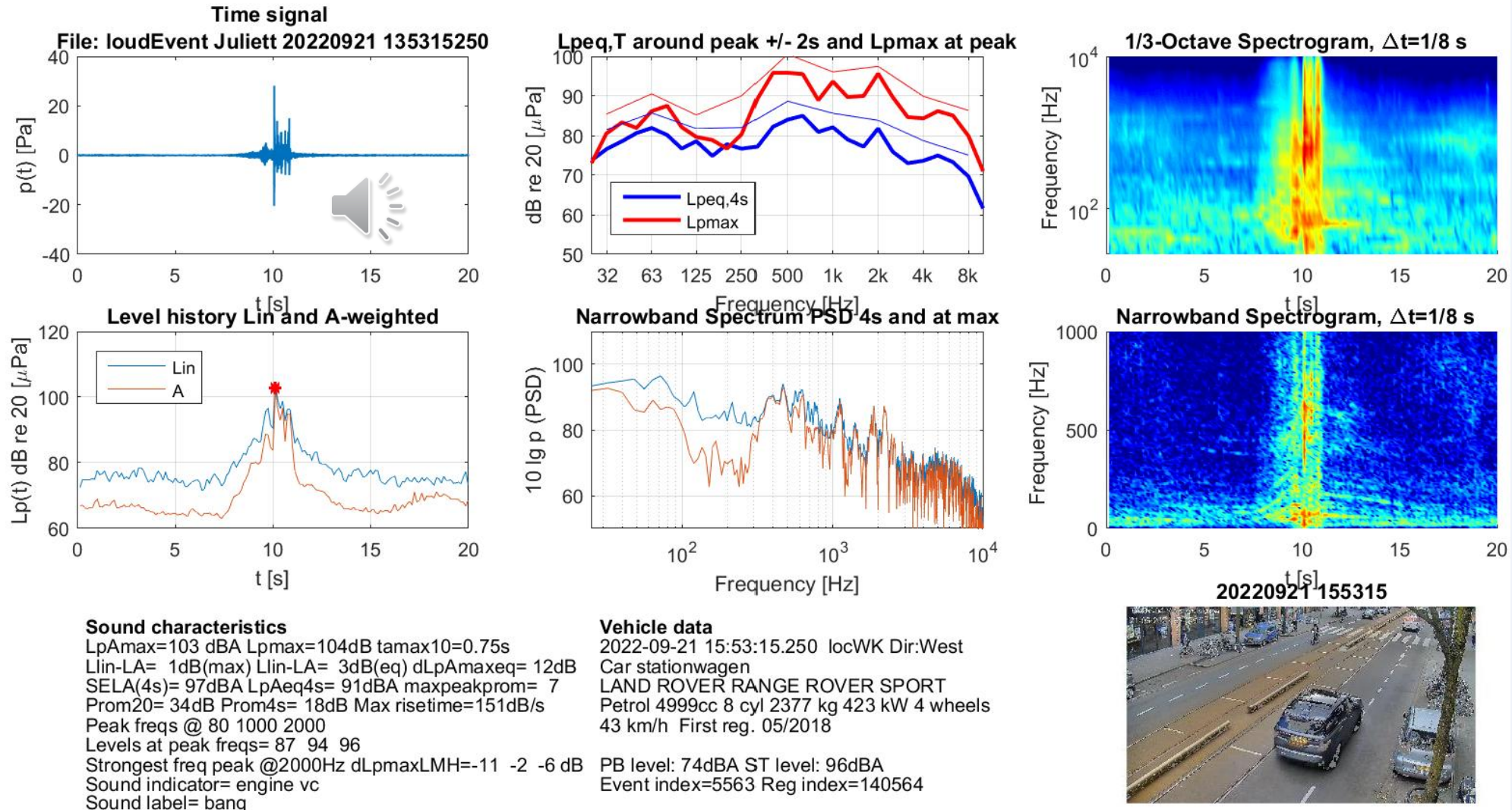
Vehicle data

2022-08-28 15:00:48.000 locWW Dir:West
Motorcycle
HARLEY DAVIDSON CVO ULTRA LIMITED
Petrol 1923cc 2 cyl 428 kg 78 kW 2 wheels
30 km/h First reg. 09/2021

PB level: 76dBA ST level: 92dBA
Event#325(mid#866) Reg#17161



Sound features – Car with backfire noise 103 dB(A)



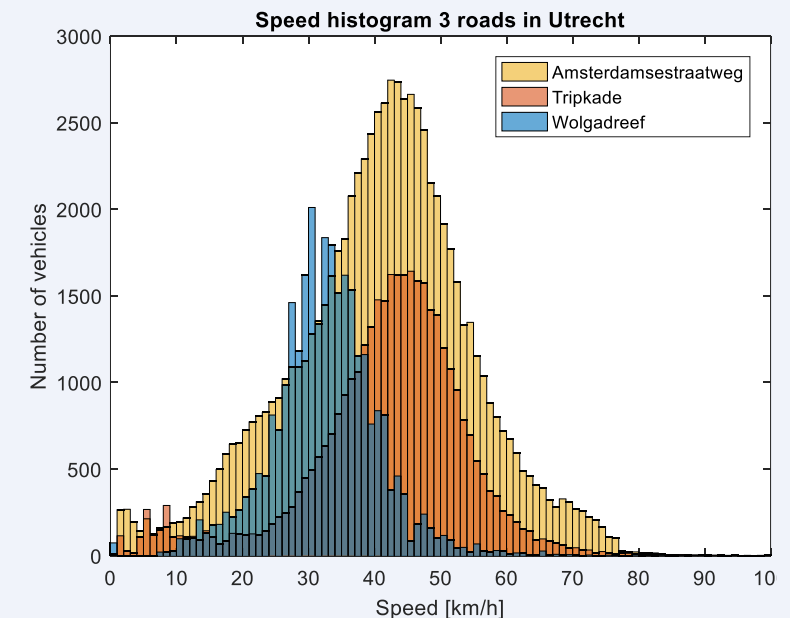
Observations in cities

- Many speeding vehicles
- High noise levels also at low speeds
- Motorcycles are loudest
- Show behaviour (backfire etc.)
- Fast noisy acceleration
- Particular brands are frequent
- Luxury sports cars but also smaller tampered vehicles
- Routes to recreational destinations (beaches, entertainment etc.),
Café streets
Long straight city roads, loud acceleration after crossings
- Some locations many loud quads (rental?)
- Canyon streets and high rise flats –reflections
- The busier the road and more complex the situation,
the harder it is to correctly identify vehicles



Mitigation options

- Measures matrix developed in 2020 (TNO report for Dutch Ministry)
- General and location-specific measures, such as:
 - Speed limit down to 30 km/h where possible
 - Warning sign for drivers, static or electronic
 - Access restrictions for vehicle types or individual
 - More, improved or automatic enforcement (e.g. noise camera)
 - Targeted enforcement based on hot spots and times
 - Attended enforcement based on Regulation RVV Article 57, audible indications of too loud vehicles:
 - heard from afar
 - exhaust pops and bangs
 - unnecessary and loud engine revving
 - unnecessary and loud acceleration
 - speeding
 - visible modifications such as missing dB killer, small exhaust etc.



Feasibility of noise cameras in the Netherlands

- TNO Study for NL cities and Ministry, 2024
- Review of required functionality and requirements
- Consultation of suppliers, authorities and others
- Review of available systems and pilot tests
- Legal: some obstacles to overcome before using for automatic fining
- Recommendations: prepare legal basis and gain experience with pilot projects; Organise as for speed cameras



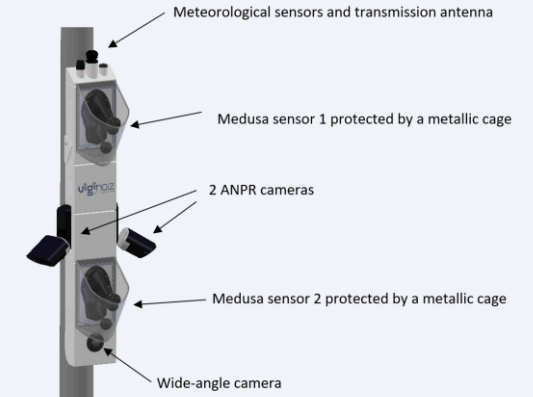
Warning systems, Munisense (NL)



dbFlash (FR)



Sorama (NL)



Hydra/Bruitparif (FR)



SoundVue (UK)

Conclusions and outlook

- Loud vehicle monitoring in 4 cities provided insight into causes and potential mitigation measures
- Loudest vehicles are motorcycles, quads and three-wheelers, cars and mopeds
- Key causes are driving behaviour and vehicle modifications
- A number of mitigation options are possible including roads, vehicles, drivers and enforcement
- LENS:
 - - Main driving conditions for loud vehicles identified, some easy to detect
 - - Insight into vehicle modifications, detection methods for tampering, mitigation solutions and impact analysis
- Feasibility of noise cameras in NL:
Possible, but legislation changes, certification, pilot projects and process integration required



Acknowledgements

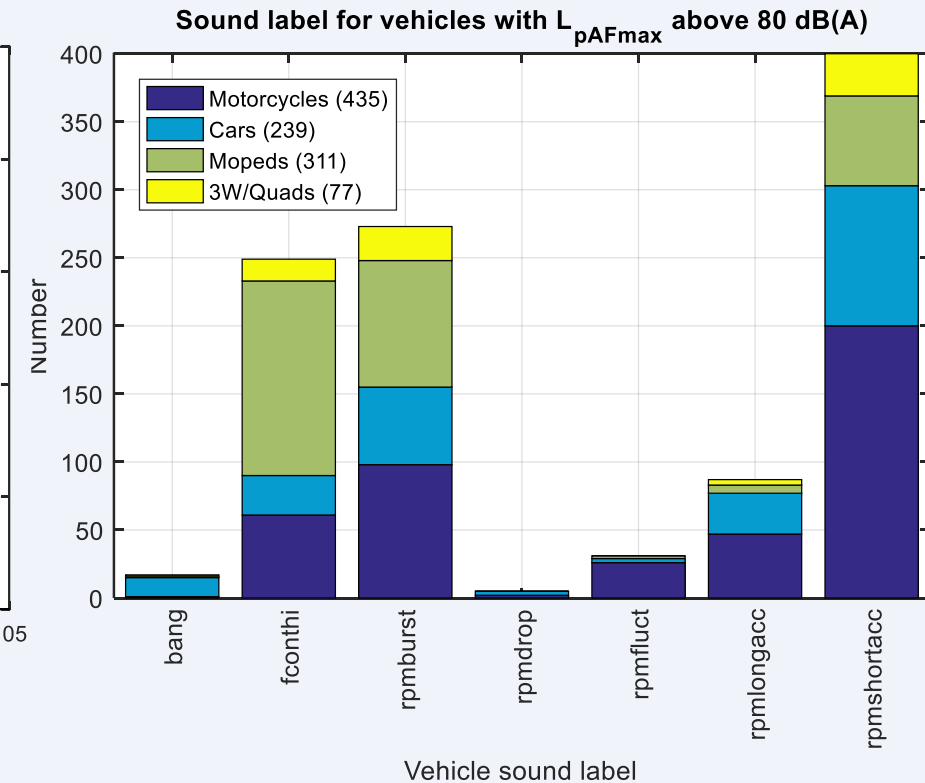
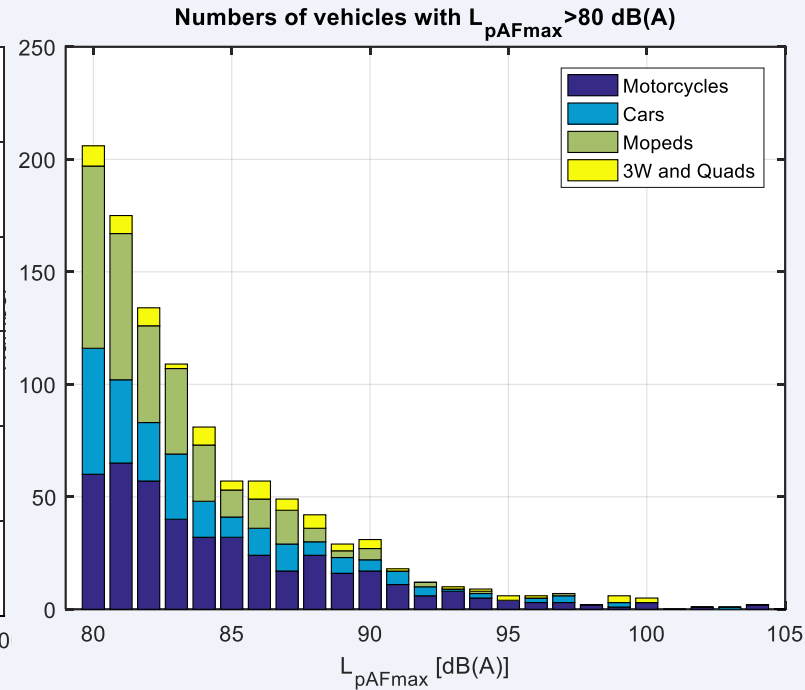
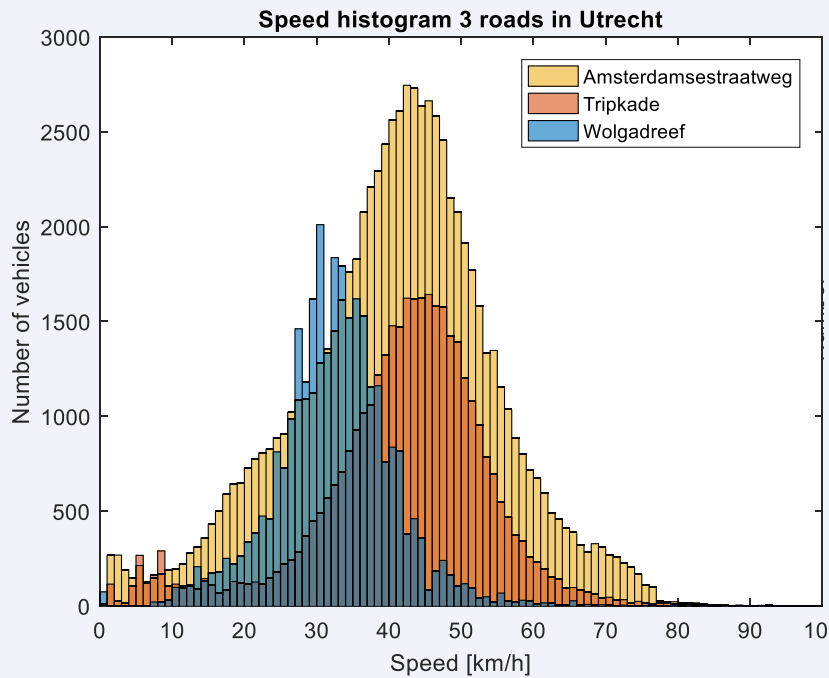
- With thanks to:
 - G4 cities (Amsterdam, Rotterdam, The Hague, Utrecht)
 - EU LENS project
 - NL Ministry of Infrastructure and Water Management
-
- **Thank you for your attention!**



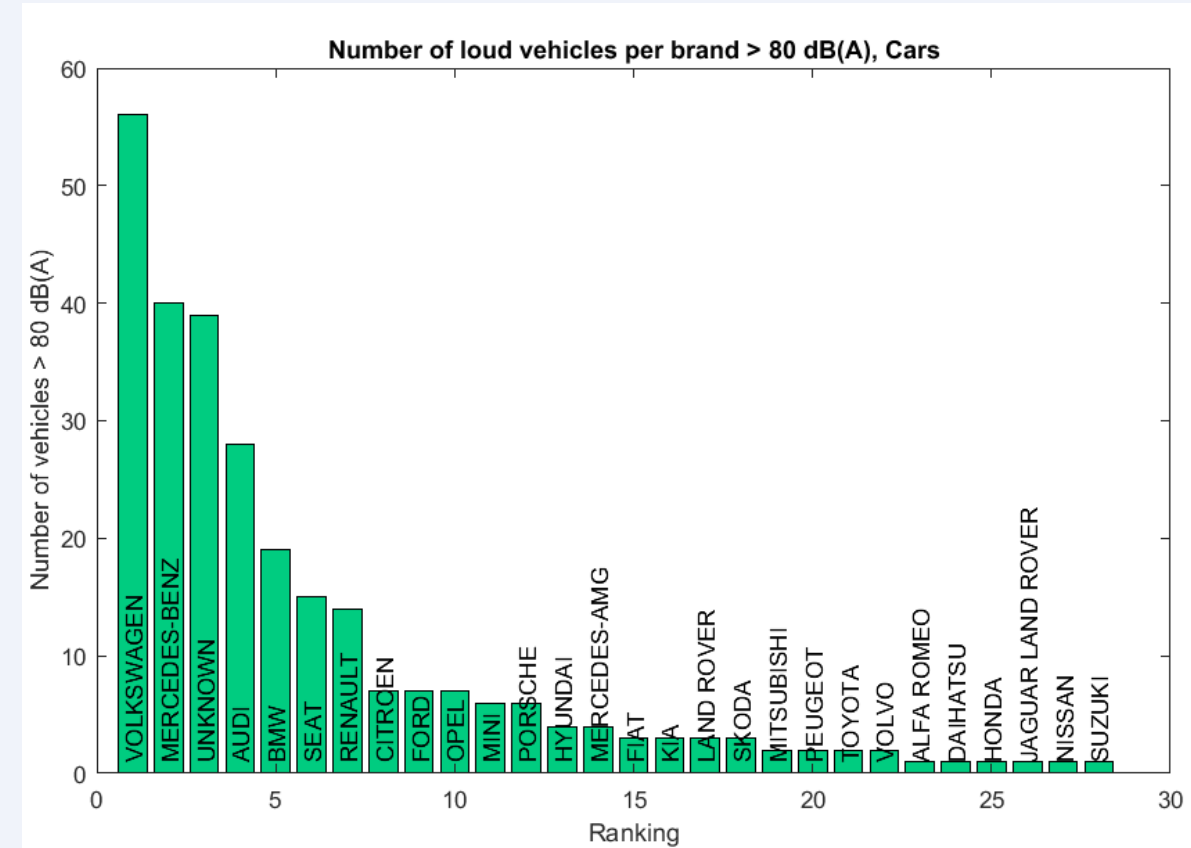
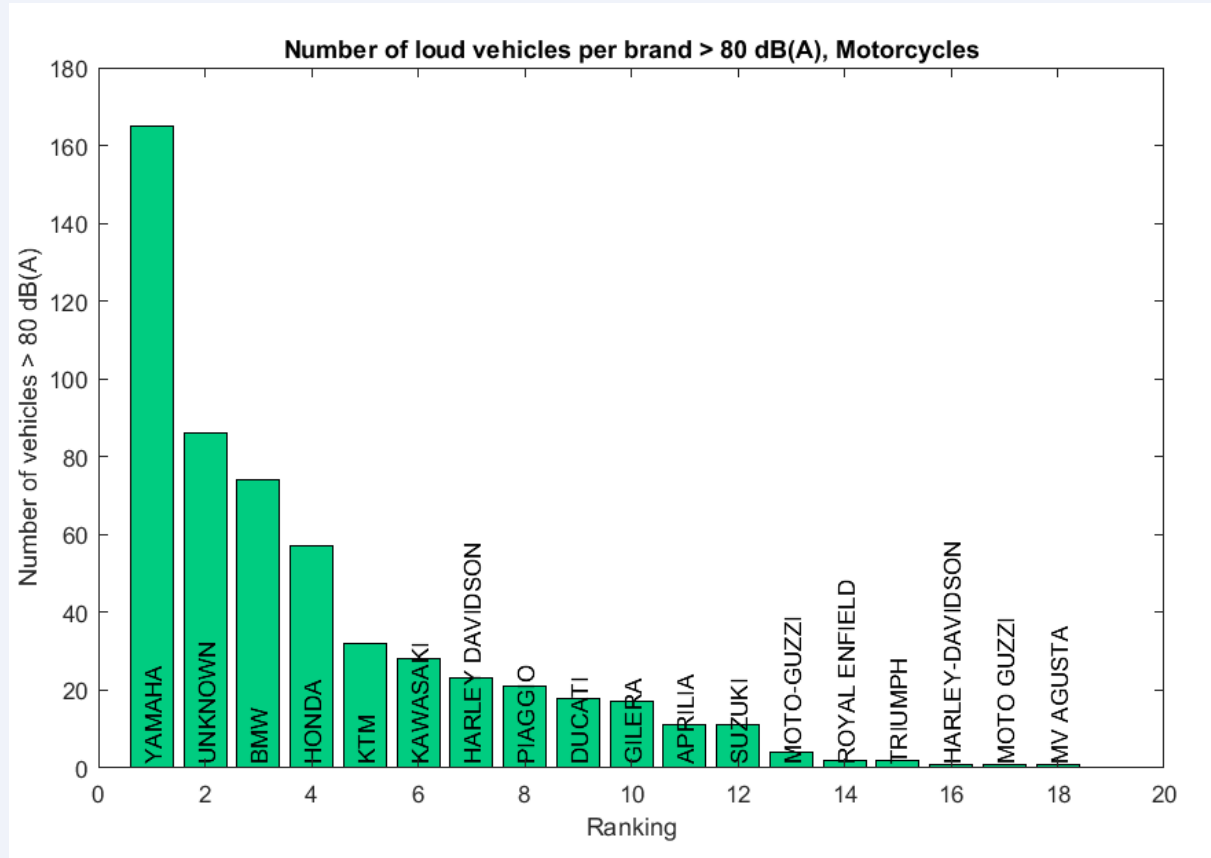


Backup slides

Speeds, numbers of loud vehicles, vehicle sound labels Utrecht



Ranking of makes, motorcycles and cars, Utrecht



Ranking

Causes of high noise levels

- Driving behaviour, vehicle modifications or both
- Driving behaviour: engine revving, fast acceleration, late gear change, speeding, backfire
- Some new vehicles intrinsically loud 'sports mode' etc.
- Vehicle modifications: tuning, boosting (turbo, supercharger etc.)
- Partly detectable from sound



Components	Modification	Effect on noise	Effect on power
Electronic control unit (ECU)	Reprogramming or replacing		
	Boost power	Increase at higher torque or rpm	Increase
	Modify injection, timing or quantity	Increase and/or backfire in the exhaust	Increase
	Electronic derestriction	Increase at high rpm	
Mechanical derestriction	Derestriction set	Increase at high rpm	Increase
Air intake + and silencer	Widening, replacement or removal	Increase	Increase
Catalyst	Removal	Increase	Increase
Exhaust	Removal	Increase	Increase
Exhaust	Replace by non-compliant exhaust	Increase	Possible Increase
Exhaust	Replace by compliant louder exhaust	Increase	
Exhaust	Drill holes	Increase	
Exhaust	Damage or remove internal parts	Increase	
Motor	Modify intake or exhaust ports	Increase	
	Change compression	Increase	
	Change stroke, bore or cylinder volume	Increase	
	Change injection system or camshaft	Increase	
Transmission	Transmission ratio change	Increase	

LENS: Vehicle modifications/ tampering

- Europe-wide survey on most common vehicle modifications and reasons

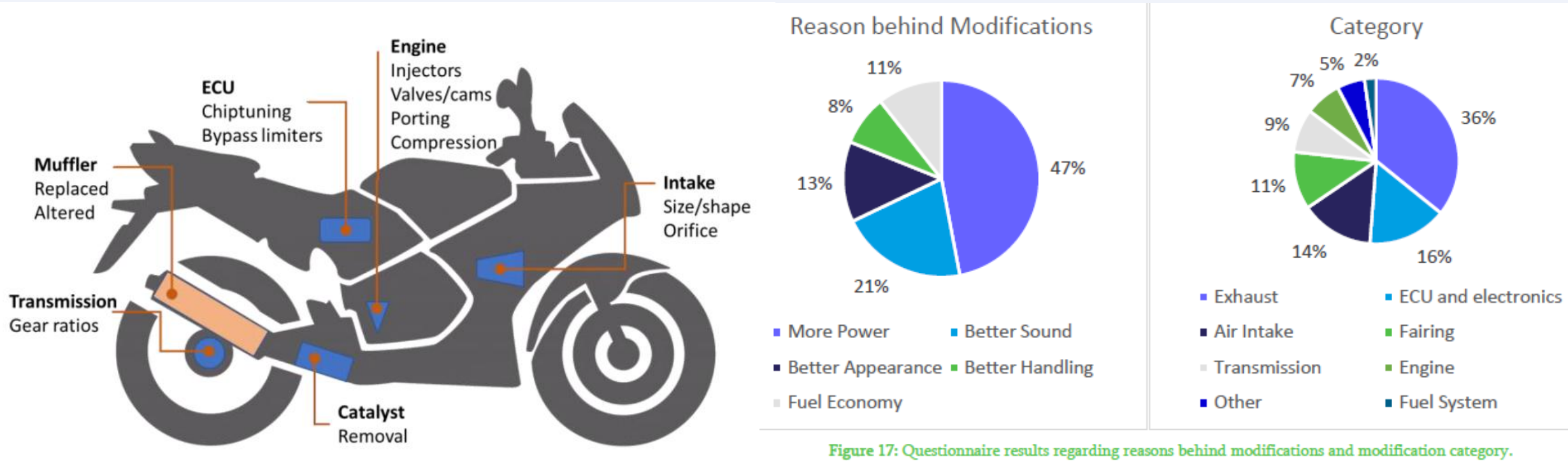


Figure 17: Questionnaire results regarding reasons behind modifications and modification category.

Source: LENS report D5.1, Emisia, TNO

Feasibility of noise cameras: Findings

- Systems are available, not yet certified, require pilot projects for evaluation
- Evaluations underway in several countries (FR,CH,UK,US,DE,BE at al)
- Analogy with speed cameras, also for enforcement process
- (semi) Mobile systems would be preferable
- 100% hit rate not probable, but allow rejection of false positives
Manual checks for penalties
- Technical challenges: complex situation with heavy traffic
- Legal:
Application for penalties is most demanding
Some changes required to legislation to incorporate noise cameras
Certification required, mainly for vehicle noise location
Data privacy is important but can be fulfilled
Threshold peak sound level is simplest criterium, depends on definition and road/traffic situation
Tampering detection partly possible for some types (backfire, loud exhaust),
but more complex to administer
- Benefits should be evident: reduced police effort and increased effectiveness