

Comparison of noise indicators in an urban context

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TOWARDS A QUIETER FUTURE

45th International Congress and Exposition on Noise Control Engineering INTER-NOISE 2016 Hamburg, Germany, August 21-24, 2016





Introduction Physical characterization Perceptive evaluation Noise mitigation Discussion

Urbanization accentuates sound exposure issues



Need indicators to describe sound environments and evaluate noise mitigation strategies



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Introduction Physical characterization Perceptive evaluation Noise mitigation Discussion

Urbanization accentuates sound exposure issues Drivers Zones highly industrialized, Dense road traffic network... Pressure **Actions** Road traffic emissions. Industrial emissions... Enforced legislation against noisy vehicles or noisy industries, State Damaged sound environment Noise mapping, Noise barriers, protection of Exposure workers, Indoor exposure at work, at home... Prevention, education... Outdoor exposure during commuting... Socio-economic context: place Context : Effects of residence, lifestyle... Sleep disturbance, Cultural context: Health effects. susceptibility to noise... Hearing impairments... Sensitive populations: children... IRSTV / FR CNRS 2488 Institut de Pacharche en Sciences et Techniques de la Vile CeLvA

Physical characterization

Perceptive evaluation

Noise mitigation

Discussion

Introduction

Specificity of the noise pollution: High spatiotemporal variations Complexity of human hearing **Rich spectral content** Wide variety of sources

Comparison of indicators within END 2002/49/CE Long term effects L_{den}

New paradigms of urban sound environment analyses

new noise sources modelling approaches perceptual effects sounds categorization holistic evaluations interest towards sound events characterization possibility to underline noise levels variations mobile measurements



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Introduction

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Comparison of indicators based on three criteria: •

> Ability to describe and categorize physically urban sound environments

- Indicators should capture physical urban sound characteristics ٠
- Indicators should discriminate two different sound ٠ environments







Physical characterization Perceptive evaluation

Noise mitigation

Discussion

Introduction

• Comparison of indicators based on three criteria:

Ability to describe and categorize physically urban sound environments

Relevance of indicators to describe the perceptive appreciations of urban sound environments

- Indicators should correlate with perceptive attributes
- Indicators should correlate with the presence of sources of interest





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Physical characterization Perceptive evaluation

Noise mitigation

Discussion

Introduction

- Comparison of indicators based on three criteria:
 - Ability to describe and categorize physically urban sound environments
 - Relevance of indicators to describe the perceptive appreciations of urban sound environments
 - 3 Ability of indicators to be estimated through classical or more advanced traffic noise estimation models
 - Indicators should be possible to estimate
 - Indicators should be sensitive to mitigation strategies





a parte...

 Ability of indicators to be estimated through classical or more advanced traffic noise estimation models Introduction

Physical characterization

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Discussion



flow dynamics on urban soundscape, Applied Acoustics, 2005, 66, 175-194

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• Comparison of indicators based on three criteria:



Ability to describe and categorize physically urban sound environments



Relevance of indicators to describe the perceptive appreciations of urban sound environments

 Ability of indicators to be estimated through classical or more advanced traffic noise estimation models

 Today: Scan of some indicators following these three criteria







Classical energetic indicators

Energetic ind. Percentile ind. Variations ind. Spectrum ind. Emergences ind.

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		Physical descriptive power	Perceptive descriptive power
Leq ^(a) Highly impacted by noise peaks [4] ^(b) Hides the sound levels dynamics [7] ^(c) Same L _{eq} value whatever the sound variation are [15]		 Highly impacted by noise peaks [4] Hides the sound levels dynamics [7] Same L_{eq} value whatever the sound variation are [15] 	©Correlated to long term health effects [3]
Ene Indi	LAeq	Or A-weigthing often criticized for underestimating low frequencies at sound levels encountered in cities	Oracle A-weighting does not fulfil perceptive requirements [23]



Classical energetic indicators

Energetic ind.IntroductionPercentile ind.Physical characterizationVariations ind.Perceptive evaluationSpectrum ind.Noise mitigationEmergences ind.Discussion

		Physical descriptive power	Perceptive descriptive power	Noise mitigation
tic Dr S	Lea	 Highly impacted by noise peaks [4] Hides the sound levels dynamics [7] Same I walke whatever the sound 	©Correlated to long term health effects [3]	Estimated with Static modelling
rge cato		variation are [15]		
Ene Indi	LAeq	A-weigthing often criticized for underestimating low frequencies at sound levels encountered in cities	A-weigthing does not fulfil perceptive requirements [23]	Estimated with Static modelling



Is a real L_{Aeq} estimated by static models?



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• L_{10}, L_{50}, L_{90} Describe the dynamic range of sound levels $\int_{0}^{49} \int_{0}^{49} \int_{$

But :

- on homogeneous periods
- one only point of the distribution

Percentile indicators

- fail to characterize the rhythm of sound variations



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5	Discussion

Percentile indicators

		Physical descriptive power		
	L ₉₀	L ₉₀ © Describes background noise [50]		
_ ~		😑 Low range of variation in urban context		
tatistica	L ₅₀ , L _{50,A}	Good for environments [15]	discriminating	sound
~ .I	L ₁₀	🗇 Describes high n	oise levels [50]	



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0	Discussion

Percentile indicators

		Physical descriptive power	Perceptive descriptive power
	L90	© Describes background noise [50]	😑 Does not emerge from studies
<u> </u>		😑 Low range of variation in urban context	
tatistica Idicator	L ₅₀ , L _{50,A}	Good for discriminating sound environments [15]	Very good correlation with perceived sound intensity and sound pleasantness; outperforms L _{Aeq} [24]
li s il	L ₁₀	Describes high noise levels [50]	Outperforms L _{Aeq} [25]



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Percentile indicators

		Physical descriptive power	Perceptive descriptive power	Noise mitigation
L ₉₀ © Describes background noise [50]		© Describes background noise [50]	😑 Does not emerge from studies	😑 Estimated with
	2	😑 Low range of variation in urban context		Dynamic modelling
lica	L ₅₀ ,	© Good for discriminating sound	© Very good correlation with perceived	😑 Estimated with
list	L _{50,A}	environments [15]	sound intensity and sound pleasantness;	Dynamic modelling
tat			outperforms LAeg [24]	
∝ .=	L ₁₀	© Describes high noise levels [50]	© Outperforms LAeg [25]	😑 Estimated with
				Dynamic modelling



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		Physical descriptive power
DLS	L ₁₀ - L _{90,} L ₅ -L ₉₅	© Describes the amplitude of noise variation (Boulevard vs irregular traffic street)
iations indicate	$\sigma_{LAeq,ls}$	 Describes the width of the sound levels distribution Good for discriminating sound environments [15] Assumes a normal distribution of L_{Aeq,1s} values
oise vai	$\delta_{LAeq,1s}$	Discrimination of traffic situation based on 1-s dynamics [51], although its discriminative power is not proved
Z	Slope of 1s- fft	Discrimination of road traffic situations [11]





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		Physical descriptive power
	L ₁₀ -	I Describes the amplitude of noise variation
	L90,	(Boulevard vs irregular traffic street)
ors	L5-L95	
dicate	$\sigma_{LAeq,1s}$	© Describes the width of the sound levels distribution
ine		🕲 Good for discriminating sound
ns		environments [15]
tio		⊖ Assumes a normal distribution of L _{Aeq,1s}
ria		values
val	$\delta_{LAeq,1s}$	Discrimination of traffic situation based
se		on 1-s dynamics [51], although its
oi		discriminative power is not proved
z	Slope	Discrimination of road traffic situations
	of 1s-	[11]
	fft	

Slope of 1s-fft



De Coensel, B. Botteldoren, D., De Muer, T. 1/f noise in rural and urban soundscape, Acta Acustica united with Acustica, vol. 89 (2003) 287 - 295, 2003,





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Very precise picture of sound variations But : dedicated to sound environments with cadenced rhythm



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		Physical descriptive power	Perceptive descriptive power
DLS	L ₁₀ - L _{90,} L ₅ -L ₉₅	 Describes the amplitude of noise variation (Boulevard vs irregular traffic street) 	No consensus concerning the perceptive effects ([24],[34],[28])
iations indicate	$\sigma_{LAeq,ls}$	 Describes the width of the sound levels distribution Good for discriminating sound environments [15] Assumes a normal distribution of L_{Aeq,1s} values 	No consensus concerning the perceptive effects
$\begin{array}{c c} \overline{b} \\ \overline{b} \\ \overline{b} \\ \overline{c} \\ $		Discrimination of traffic situation based on 1-s dynamics [51], although its discriminative power is not proved	⁽²⁾ Difficult to handle and relate with effects
Z Slope Image: Slope of 1s- [11] Sound quality of Slope of		 In musical context acknowledged as a sound quality descriptor Further studies required to demonstrate link to sound quality 	



IntroductionEnergetic ind.Percentile ind.Variations ind.Spectrum ind.Emergences ind.Discussion

		Physical descriptive power	Perceptive descriptive power	Noise mitigation
	L ₁₀ - L ₉₀	© Describes the amplitude of noise variation (Boulevard vs irregular traffic street)	• No consensus concerning the perceptive effects ([24],[34],[28])	Estimated with Dynamic modelling
OLS	L ₅ -L ₉₅	(,		-,
iations indicat	σ _{LAeq,ls}	 Describes the width of the sound levels distribution Good for discriminating sound environments [15] Assumes a normal distribution of L_{Aeq,1s} values 	No consensus concerning the perceptive effects	Estimated with Dynamic modelling
oise vai	$\delta_{LAeq,1s}$	Discrimination of traffic situation based on 1-s dynamics [51], although its discriminative power is not proved	[©] Difficult to handle and relate with effects	
Z Slope © Discrimination of roa		© Discrimination of road traffic situations	In musical context acknowledged as a	-
	of 1s-	[11]	sound quality descriptor	
	fft		S Further studies required to demonstrate link to sound quality	



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		Physical descriptive power	Perceptive descriptive power	Noise mitigation
	L ₁₀ -	Describes the amplitude of noise variation	No consensus concerning the	😑 Estimated with
ors	L _{90,} L ₅ -L ₉₅	(Boulevard vs irregular traffic street)	perceptive effects ([24],[34],[28])	Dynamic modelling
iations indicat	σ _{LAeq,ls}	 Describes the width of the sound levels distribution Good for discriminating sound environments [15] Assumes a normal distribution of L_{Aeq,1s} values 	No consensus concerning the perceptive effects	Estimated with Dynamic modelling
oise val	$\delta_{LAeq,1s}$	Discrimination of traffic situation based on 1-s dynamics [51], although its discriminative power is not proved	^(a) Difficult to handle and relate with effects	Estimated with Dynamic modelling
Z	Slope	Oiscrimination of road traffic situations	© In musical context acknowledged as a	😑 Estimated with
	of 1s-	[11]	sound quality descriptor	Dynamic modelling
	fft		😣 Further studies required to	
			demonstrate link to sound quality	



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		Physical descriptive power	Perceptive descriptive power	Noise mitigation
	L ₁₀ -	Describes the amplitude of noise variation	No consensus concerning the	😑 Estimated with
×2	L _{90,}	(Boulevard vs irregular traffic street)	perceptive effects ([24],[34],[28])	Dynamic modelling
to	L5-L95	Describes the width of the sound levels	No consensus concerning the	Estimated with
lica	ULAeq,1s	distribution	perceptive effects	Dynamic modelling
ind		Good for discriminating sound	Por of a contract	
us		environments [15]		
tio		\bigcirc Assumes a normal distribution of $L_{Aeq,1s}$		
ria		values		
Va	$\delta_{LAeq,1s}$	i Discrimination of traffic situation based	O Difficult to handle and relate with	Estimated with
on 1-s dynamics [51], although its effect		on 1-s dynamics [51], although its	effects	Dynamic modelling
20	~	discriminative power is not proved		
	Slope	Discrimination of road traffic situations	In musical context acknowledged as a	Estimated with
	of 1s-	[11]	sound quality descriptor	Dynamic modelling
	fft		😕 Further studies required to	
			demonstrate link to sound quality	
	DANP	© Discrimination of road traffic situations	😣 Further studies required to	😑 Estimated with
			demonstrate link to sound quality	Dynamic modelling





Spectrum indicators

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		Physical descriptive power			
	SGC	Good for discriminating sound			
		environments based on their spectral content			
		[15].			
		8 Highly unstable.			
OLS	TFSD	😣 Never investigated			
cat	mean,4kH				
Ē	z				
m İ	TFSD	😣 Never investigated			
	mean,500				
E	Hz				
ect	L _f ,	Related to road traffic time of presence			
Sp	with <i>f</i>	(f=65 Hz,125 Hz) [34]			
	freque	Good for discriminating sound			
	ncy of	environments frequency content [13]			
	intere	😣 Spectrum described through a large			
	st	number of indicators			



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Spectrum indicators

		Physical descriptive power	Perceptive descriptive power	
	SGC	 Good for discriminating sound environments based on their spectral content [15]. Highly unstable. 	No consensus concerning the perceptive effects	
licators	TFSD mean,4kH z	8 Never investigated	 Related to perceived birds time of presence [34] Only appears in one paper 	
rum ind	TFSD mean,500 Hz	8 Never investigated	 Related to perceived voices time of presence [34] Only appears in one paper 	
L _f , ③ Related to road traffic time of presence with f (f=65 Hz,125 Hz) [34] freque ③ Good for discriminating sound ncy of environments frequency content [13] intere st number of indicators		 Related to road traffic time of presence (f=65 Hz,125 Hz) [34] Good for discriminating sound environments frequency content [13] Spectrum described through a large number of indicators 	© Low frequencies and tonal components increase annoyance [20,21]	



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Spectrum indicators

		Physical descriptive power	Perceptive descriptive power	Noise mitigation
	SGC	Good for discriminating sound	😑 No consensus concerning the	😑 Estimated with
		environments based on their spectral content	perceptive effects	Dynamic modelling
		[15].		
		😕 Highly unstable.		
0L2	TFSD	😣 Never investigated	Related to perceived birds time of	😣 No current model
at	mean,4kH		presence [34]	allows its estimation
indic	z		😣 Only appears in one paper	
	TFSD	😕 Never investigated	Related to perceived voices time of	😣 No current model
Ξ	mean,500		presence [34]	allows its estimation
2	Hz		😣 Only appears in one paper	
ect	L_f ,	Related to road traffic time of presence	😂 Low frequencies and tonal components	😑 Estimated with
Sp.	with <i>f</i>	(f=65 Hz,125 Hz) [34]	increase annoyance [20,21]	Dynamic modelling
	freque	😊 Good for discriminating sound		
	ncy of	environments frequency content [13]		
	intere	😣 Spectrum described through a large		
	st	number of indicators		

Sound recognition in urban environments should produce new indicators





Emergence indicators

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• Number of Noise Events (NNE) and Mask Index (MI) :

Threshold : fixed value (i.e.70), or adaptative (L_{Aeq+10}, L_{10+10}) Designed to measure either noisy or quiet periods



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Emergence indicators

Map of emergences :



Can A, Guillaume G, Gauvreau B. Noise indicators to diagnose urban sound environments at multiple spatial scales. Acta Acust unit Acust. 2015;101:964-74





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Physical descriptive power discriminating L_{1.A}, \odot Good for sound environments based on emergences [8] MILA50 \odot Good for discriminating sound environments based on emergences [8] +10**Emergences indicators** discriminating MI_{LLF5} \odot Good for sound environments based on emergences [8] 0+15 \mathbf{CF} Good for discriminating \odot sound environments [13] Based on max values so no repeatable measurements for discriminating N_{Lmax>} \odot Good sound environments in the vicinity of traffic signals 80 [7] Good discriminating \bigcirc for NL95>65 sound environments in the vicinity of traffic signals [7]

Emergence indicators



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Emergence indicators

		Physical descriptive power	Perceptive descriptive power
	L _{1,A} ,	🖾 Good for discriminating sound	😑 No consensus
		environments based on emergences [8]	
	MI_{LA50}	🗇 Good for discriminating sound	😑 No consensus
s.	+10	environments based on emergences [8]	
tor	MI _{LLF5}	🗇 Good for discriminating sound	😑 No consensus
са	0+15	environments based on emergences [8]	
ndi	\mathbf{CF}	🖾 Good for discriminating sound	😑 No consensus
s ii		environments [13]	
Based on max values so no repeatable measurements		Based on max values so no repeatable	
		measurements	
erg	N _{Lmax>}	Good for discriminating sound	😑 No consensus
environments in the vicinity of traffic signals		environments in the vicinity of traffic signals	
H		[7]	
	N _{L95>65}	🗇 Good for discriminating sound	😑 No consensus
		environments in the vicinity of traffic signals	
		[7]	



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Emergence indicators

		Physical descriptive power	Perceptive descriptive power	Noise mitigation
ces indicators	L _{1,A} ,	🗇 Good for discriminating sound	😑 No consensus	😑 Estimated with
		environments based on emergences [8]		Dynamic modelling
	MI _{LA50}	🖾 Good for discriminating sound	😑 No consensus	😑 Estimated with
	+10	environments based on emergences [8]		Dynamic modelling
	MI _{LLF5}	© Good for discriminating sound	😑 No consensus	😑 Estimated with
	0+15	environments based on emergences [8]		Dynamic modelling
	CF	© Good for discriminating sound	😑 No consensus	😣 No current model
		environments [13]		allows its estimation
		Based on max values so no repeatable		
gen		measurements		
erg	N _{Lmax>}	🗇 Good for discriminating sound	😑 No consensus	😑 Really specific to
Em	80	environments in the vicinity of traffic signals		urban corridors
		[7]		
	N _{L95>65}	🗇 Good for discriminating sound	😑 No consensus	😑 Really specific to
		environments in the vicinity of traffic signals		urban corridors
		[7]		



Discussion

- Difficulty to highlight an optimal set of ٠ indicators for characterizing and evaluating urban sound environments
- High correlations between indicators add some partiality in the choices made

		Direct of description and the	Describe description operation	Notes and dealed and
	T	Highly, impacted by paica paaks [4]	Correlated to long term health affects	Noise mitigation
uerge tic die store	144	Hidar the cound levels dynamics [7]	ral	modalling
		Same I value whatever the cound	191	modening
		variation are [15]		
	Liter	A-weisthing often criticized for	A-weigthing does not fulfil nercentive	Statimated with Static
- A.	+1908	underestimating low fragmancies at sound	ranniraments [23]	modalling
		levels encountered in cities	requirements [25]	modeling
indicators	Las	Describes background noise [50]	😑 Does not emerge from studies	😑 Estimated with
	200	Cow range of variation in urban context		Dynamic modelling
	Late	Good for discriminating sound	S Very good correlation with perceived	Estimated with
	Len	environments [15]	sound intensity and sound pleasantness:	Dynamic modelling
			outperforms Lam [24]	- ,
1	L10	Describes high noise levels [50]	Outperforms LAm [25]	😑 Estimated with
-8				Dynamic modelling
4	L10-L9	Describes the amplitude of noise variation	No consensus concerning the	Estimated with
2	0.	(Boulevard vs irregular traffic street)	perceptive effects ([24],[34],[28])	Dynamic modelling
	Ls-Los	· · · ·		
	GLAcq,1s	Describes the width of the sound levels	😑 No consensus concerning the	Estimated with
n		distribution	perceptive effects	Dynamic modelling
-		Good for discriminating sound		
		environments [15]		
		Assumes a normal distribution of LAcq.13		
2		values		0 0 0 0
-8	ÒLAcq.is	Discrimination of traffic situation based on	O Difficult to handle and relate with	Estimated with
-8		1-s dynamics [51], although its discriminative	effects	Dynamic modelling
2	01	power is not proved		C Retirected with
.8	Slope	Discrimination of road traffic situations	S in musical context acknowledged as a	Estimated with Demonsion and alling
1	10	[11]	Sound quanty descriptor	Dynamic modelling
-	15-III		link to sound quality	
	SCC	Good for discriminating sound	No consensus concerning the	😑 Estimated with
		environments based on their spectral content	nercentive effects	Dynamic modelling
		[15].	,,	
		Highly unstable.		
5	TFSD	öNever investigated	Related to perceived birds time of	😌 No current model
-	mcan,4kH	-	presence [34]	allows its estimation
4			🖯 Only appears in one paper	
	TFSD	⊘Never investigated	Related to perceived voices time of	😌 No current mode
E	mcan,500		presence [34]	allows its estimation
	Ha		🖯 Only appears in one paper	
2	Lr,	Related to road traffic time of presence	Low frequencies and tonal components	Estimated with
5	with f	(f=65 Hz,125 Hz) [34]	increase annoyance [20,21]	Dynamic modelling
	freque	Good for discriminating sound		
	ncy of	environments frequency content [13]		
	intere	Spectrum described through a large number		
	st	Good for discriminating sound	Navar investigated	🖴 Estimated with
	Li,A,	anvironments based on amergencer [2]	Crever myesugared	Dynamic modelling
	Mixer	Good for discriminating sound	Navar investigated	A Estimated with
-	ANILASO	anvironments based on amergences [9]	C rest investigated	Dynamic modelling
5	MILLE	Good for discriminating sound	SNever investigated	Estimated with
E.	0-15	environments based on emergences [8]		Dynamic modelling
1	CF	Good for discriminating sound	SNever investigated	😇 No current mode
-		environments [13]	-	allows its estimation
		Sased on max values so no repeatable		
		measurements		
F	NLaw	Good for discriminating sound	öNever investigated	😑 Really specific to
Bme	80	environments in the vicinity of traffic signals	-	urban corridors
		[7]		
	NL95>65	Good for discriminating sound	SNever investigated	😑 Really specific to
		environments in the vicinity of traffic signals		urban corridors
		[7]		

Introduction Physical characterization

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Can et al. Comparison of noise indicators, 23-August-2016

Discussion

- Difficulty to highlight an optimal set of indicators for characterizing and evaluating urban sound environments
- High correlations between indicators add some partiality in the choices made
- Categorization and indicators number reduction
- Aims to reduce the number of indicators based on reduce the number of indicators for a similar relevance Tells which indicators are meaningless to use co-join

Example of set of indicators :

- Torija et al., JASA (2013): CF, L_{eq,25Hz}, L_{eq,31.5Hz}, L_{eq,125Hz} $L_{eq,5kHz}, L_{eq,10kHz}, L_{eq,16kHz} \text{ and } L_{eq,20kHz}, \text{ statistical indicate}$ • Can et al. AAA (2015): L_{50,A}, $\sigma_{LAeq,1s}$, SGC, + L_{1,A}, MI_{LA56}

		Physical description memory	Benerative description memory	Notes mitiantics
<u> </u>	Im	Highly impacted by noise peaks [4]	Correlated to long term health effects	Estimated with Static
dicators	+	Hides the sound levels dynamics [7]	[3]	modelling
		Same L _{co} value whatever the sound		
		variation are [15]		
	Losos.	A-weighing often criticized for	O A-weighing does not fulfil perceptive	SEstimated with Static
		underestimating low frequencies at sound	requirements [23]	modelling
		levels encountered in cities		
ical indicators	Loo	Describes background noise [50]	😑 Does not emerge from studies	Estimated with
		Low range of variation in urban context		Dynamic modelling
	L50,	Good for discriminating sound	Solvery good correlation with perceived	Estimated with
	L50,A	environments [15]	sound intensity and sound pleasantness;	Dynamic modelling
	-	C Describes high active levels [50]	outperforms LAcq [24]	O Notice at a suith
	L10	Bescribes high horse levels [50]	Guipertorms LAm [25]	Dumamia modelling
- 3	LoLo	Describes the emplitude of noise variation	No contantus concerning the	Estimated with
3	L10-L9	(Boulavard vs irramilar traffic streat)	parcantiva affacts ([24] [34] [28])	Dynamic modalling
•-	Le-Lee	(Doulevald vs hiegulai traffic sueet)	perceptive effects ([24],[34],[20])	Dynamic modening
	GLAm is	Describes the width of the sound levels	No consensus concerning the	Estimated with
n	02200	distribution	perceptive effects	Dynamic modelling
<u> </u>		Good for discriminating sound		· ·
- A		environments [15]		
1.3		Assumes a normal distribution of L _{Arq,1}		
		values		
-8	δLAcq.1s	Discrimination of traffic situation based on	O Difficult to handle and relate with	Estimated with
-2		1-s dynamics [51], although its discriminative	effects	Dynamic modelling
2	01	power is not proved		C Retirected with
	Slope	Discrimination of foad traffic situations	Sin musical context acknowledged as a	Estimated with
1.2	10	[11]	Sound quality descriptor	Dynamic modelling
	13-III		link to sound quality	
	SGC	Good for discriminating sound	No consensus concerning the	Estimated with
		environments based on their spectral content	perceptive effects	Dynamic modelling
		[15].		
		⊖Highly unstable.		
5	TFSD	♂Never investigated	Related to perceived birds time of	So No current model
2	mcan,4kH		presence [34]	allows its estimation
11	TECD	Name investigated	Contry appears in one paper	A No succent model
12	11.20	Vivever investigated	presence [34]	allows its astimation
18	MCLA,SUU		Only annears in one namer	anows its estimation
12	L ₁	Related to road traffic time of presence	Control of the second s	😑 Estimated with
, A	with f	(f=65 Hz,125 Hz) [34]	increase annoyance [20,21]	Dynamic modelling
-	freque	Good for discriminating sound		· ·
	ncy of	environments frequency content [13]		
1	intere	Spectrum described through a large number		
	st	of indicators		
	L1,A,	Good for discriminating sound	v Never investigated	Estimated with
	10	environments based on emergences [8]	Navas investigated	Dynamic modelling
	NILLASO	anvironments based on amergences [9]	 TAGAGET HEAD REPORT 	Dunamic modalling
5	Mur	Good for discriminating sound	SNever investigated	Estimated with
1	0-15	environments based on emergences [8]		Dynamic modelling
1	CF	Good for discriminating sound	SNever investigated	😇 No current model
-		environments [13]		allows its estimation
8		Sased on max values so no repeatable		
		measurements		
a a a a a a a a a a a a a a a a a a a	Nime	Good for discriminating sound	SNever investigated	😑 Really specific to
	80	environments in the vicinity of traffic signals		urban corridors
1				A 1.1
	NL95>65	Good for discriminating sound	v wever investigated	 Really specific to
1		environments in the vicinity of traffic signals		urbail corridors
<u> </u>	,,		I	







Static road traffic modeling

L_{Aeq} Not best indicator for sound pleasantness Discriminates poorly sound environments



Dynamic road traffic modeling

- Energetic dimension:
- Temporal dimension:

σ_{LAeq,1s}, L₁₀-L₉₀

• Spectral dimension:



Useful in categorization context No consensus concerning perceptive effects

Useful in categorization context Not often mentioned as relevant in the perception context

L_{125Hz} Sound sources indicators: TFSD Sources not taken into account in current modeling

• Emergences indicators:

 $L_{A1,} MI_{LA50+10}, MI_{LL50+15}$

Drawback: too complex for communication





Thank you for your attention

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This research is part of the GRAFIC project funded by ADEME (French Environment and Energy Management Agency)

