deufrako

Deutsch-Französische Kooperation auf dem Gebiet der Verkehrsforschung

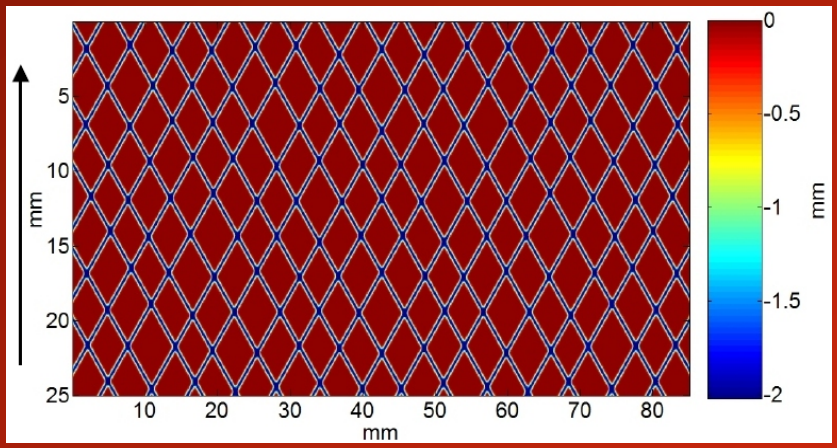
Coopération franco-allemande dans le domaine des transport terrestres guidés

"Optimal Dense Surface" (ODSurf)

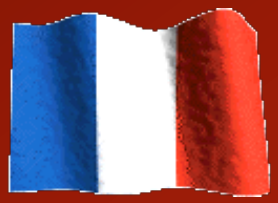
M. Bérengier (IFSTTAR-AME-LAE)

Objectives

- Continuation of the successful project P2RN
- Production of urban low noise dense pavements
- Improvement of DEUFRABASE



Partners



bast

MÜLLER-BBM

IFSTTAR

PREDIT

ADEME

UNIKASSEL VERSITÄT

OTTO QUAST

HEILIT+WOERNER

ECOLE NATIONALE DES PONTS ET CHAUSSEES

Technische Universität München

SF-Kooperation

COLAS

EUROVIA VINCI

ISAC Institut für Straßenwesen Aachen

ITA

ifam INSTITUT FÜR ANGEWANDTE MECHANIK

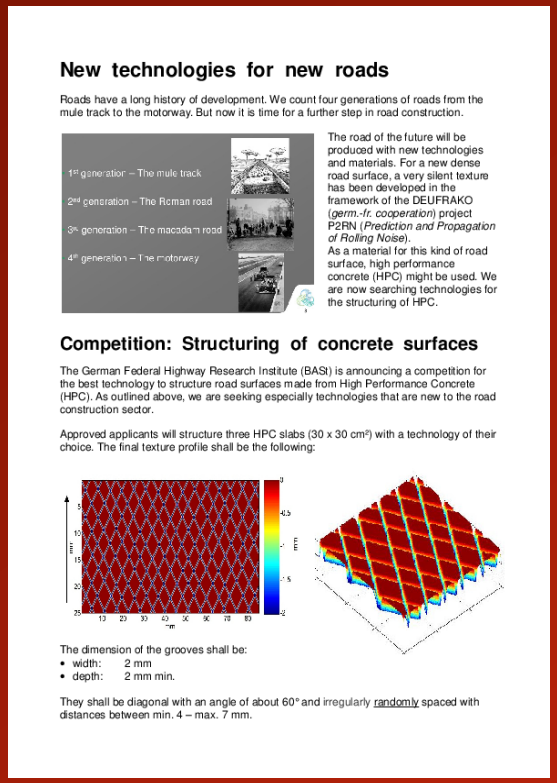
ITA

Funding

- BASt became funding institution for German partners
- BASt: 1.5 M€ for 4 projects & competition
- ADEME is the funding institution for French partners: 765 k€ (4 partners)
- Preliminary duration: 3 years (01/2012-12/2014) *(one year extension accepted – end : 12/2015)*

Competition "Structuring Technologies"

- Search for suitable structuring technologies
- Rather than „ordinary project"
- Bring innovation to road production
- Winner will (hopefully) be awarded a demonstration project



New technologies for new roads

Roads have a long history of development. We count four generations of roads from the mule track to the motorway. But now it is time for a further step in road construction.

The road of the future will be produced with new technologies and materials. For a new dense road surface, a very silent texture has been developed in the framework of the DEUFRAKO (*germ.-fr. cooperation*) project P2RN (*Prediction and Propagation of Rolling Noise*).
As a material for this kind of road surface, high performance concrete (HPC) might be used. We are now searching technologies for the structuring of HPC.

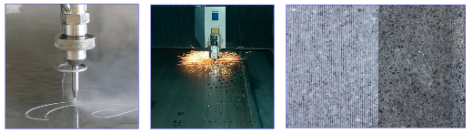
Competition: Structuring of concrete surfaces

The German Federal Highway Research Institute (BASt) is announcing a competition for the best technology to structure road surfaces made from High Performance Concrete (HPC). As outlined above, we are seeking especially technologies that are new to the road construction sector.

Approved applicants will structure three HPC slabs (30 x 30 cm²) with a technology of their choice. The final texture profile shall be the following:

The dimension of the grooves shall be:
- width: 2 mm
- depth: 2 mm min.

They shall be diagonal with an angle of about 60° and irregularly randomly spaced with distances between min. 4 – max. 7 mm.



Potential technologies for the structuring e. g. are:
- Grinding
- Water jet cutting
- Etching
- Laser cutting ...

The technologies shall be suitable to structure large areas with reasonable time and cost. Curvilinear grooves yielding a similar structure size of the plateaus are also conceivable. For the competition, tenderers send in a short description of how they intend to structure three HPC slabs of 30 x 30 cm² together with references to their previous work.

BASt will measure the textures of all slabs and the jury will choose those technologies that render the surface texture most similar to the P2RN surface.

Our international jury will choose a maximum of 10 best tenders who will structure three slabs each. These tender will be refunded with 15.000 € each.

It is planned that the winner(s) will have the opportunity to demonstrate the potential of their technologies in a new project on a large scale.

Submission of proposals is open until 31th Mai 2012.

Structuring takes place between 31th July 2012 and 30st September 2012.

The winner(s) will be declared in November 2012.

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German projects

- Development of noise-reducing road surfaces by using Ultra-high Performance Concrete (UHPC) precast slabs

German projects

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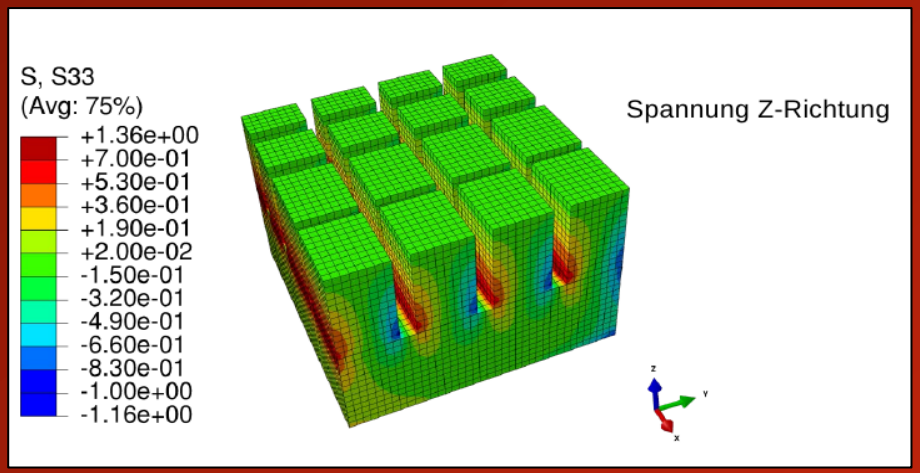
Lärmarmes Betonsteinpflaster

- Development of low-noise concrete block pavement

German projects

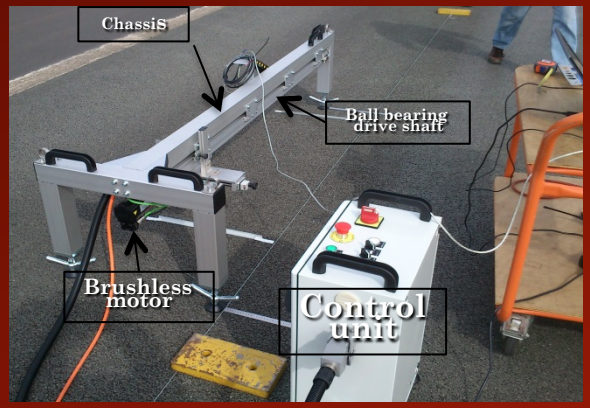


- Quiet innovative topcoat based on synthetics (LIDAK)

Modelling improvement

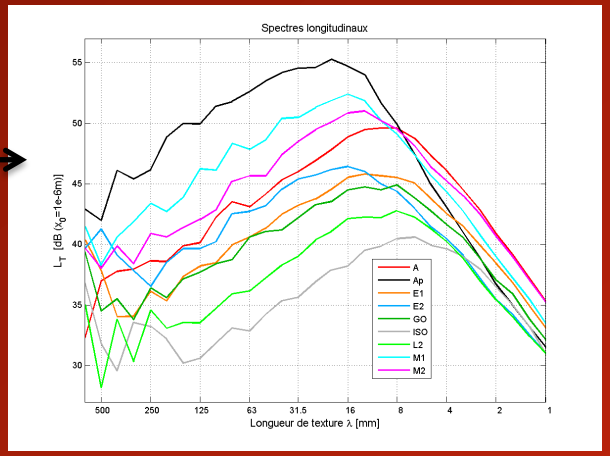
- 3D Surface texture measurement
- Measurement of the absorption of pavements
- Dynamical modelling of tyre-road noise contact
- Air pumping modelling
- Improvement of the horn effect modelling
- Experimental validation on new conventional pavements and optimized ODSurf pavements.

Modelling improvement:
3D Surface texture measurement (LAE)



ODSurf texture measurements

Qualitative comparaison to P2RN texture measurements (2007)

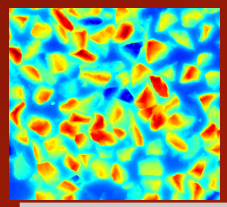


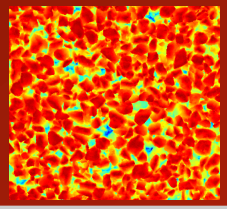

A' - SD 8/10

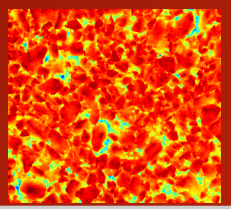

A - PAC 0/6

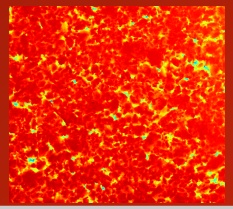

E1 - DAC 0/10

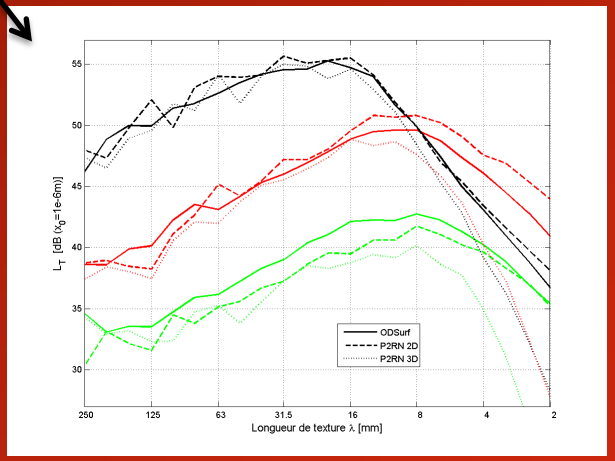

ISO Surface











Modelling improvement:
Noise measurement (LAE)

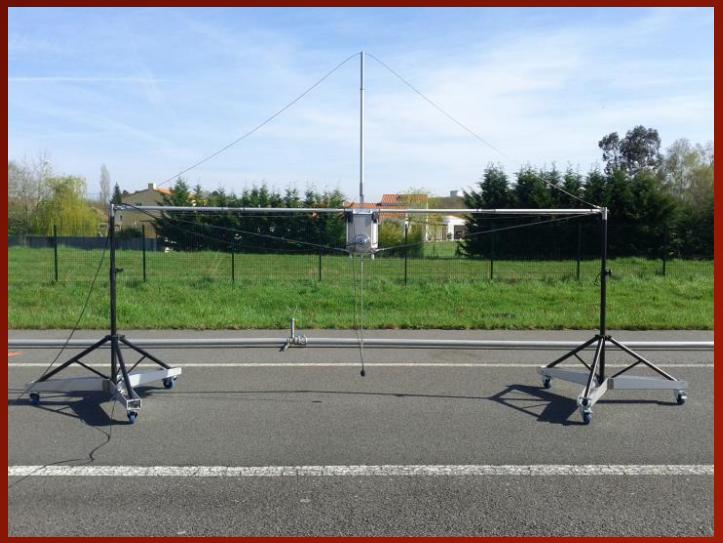
Surface	Type	T_{air} (°C)	$L_{Amax,ref}$ (dB(A))	Slope a_{CB}	$L_{Aeq,ref}$ (dB(A))	Slope a_{CPX}
A	PA 0/6	16.6	73.7	20.0	96.1	20.2
M2	VTAC 0/6	14.7	73.0	22.5	96.1	23.5
E1	DAC 0/10	18.5	74.9	31.2	96.7	32.7
E2	DAC 0/10	15.7	78.1	32.0	99.4	34.1
G0	SAC 0/10	15.6	76.1	30.1	97.5	29.9
ISO	DAC 0/8	14.6	75.0	30.6	98.8	34.2
L2	SA 0/4	18.0	75.5	33.4	97.4	30.8
M1	VTAC 0/10	17.2	78.2	31.5	99.1	31.2
A'	SD 8/10	18.1	83.3	35.6	103.2	36.8
F	Colgrip®	17.6	78.0	35.9	98.4	34.1

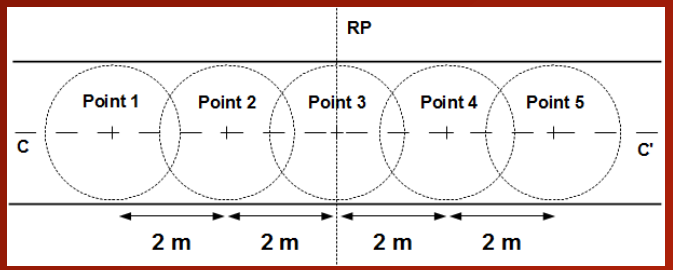
$$L_{Amax}(V) = L_{Amax,ref} + a_{CB} \log_{10}(V/V_{ref})$$

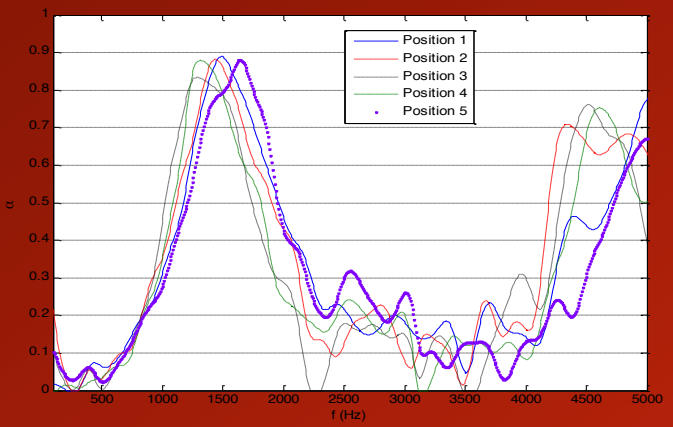
$$L_{Aeq}(V) = L_{Aeq,ref} + a_{CPX} \log_{10}(V/V_{ref})$$

+ Etudes Spectrales

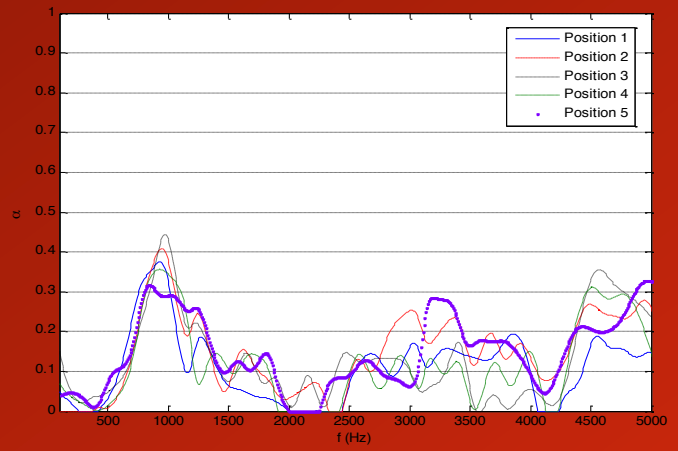
Modelling improvement:
Absorption measurement (LAE)







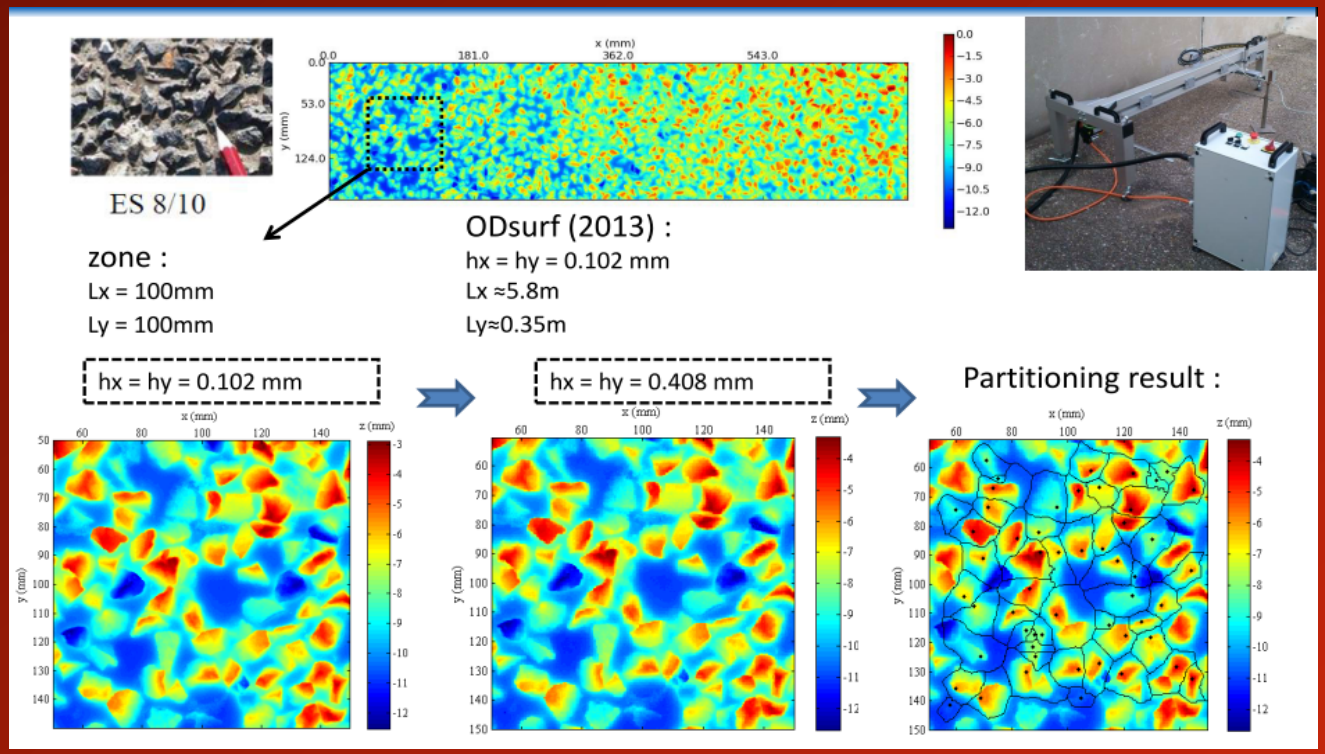
BBDr 0/6



BBTM 0/6

Modelling improvement:
Multi-asperity approach (LAE)

Partitioning method (Python code)

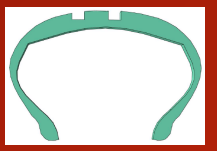


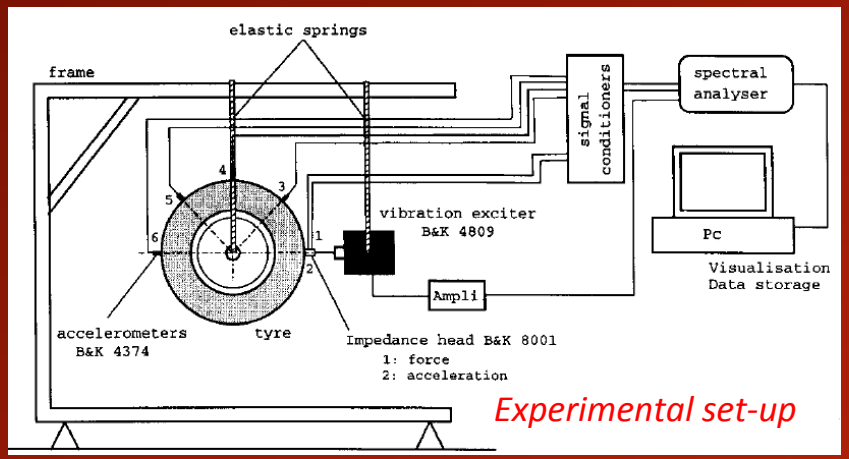
Modelling improvement:
Dynamic contact problem (ENPC)

Analytical models / Periodic 3D model

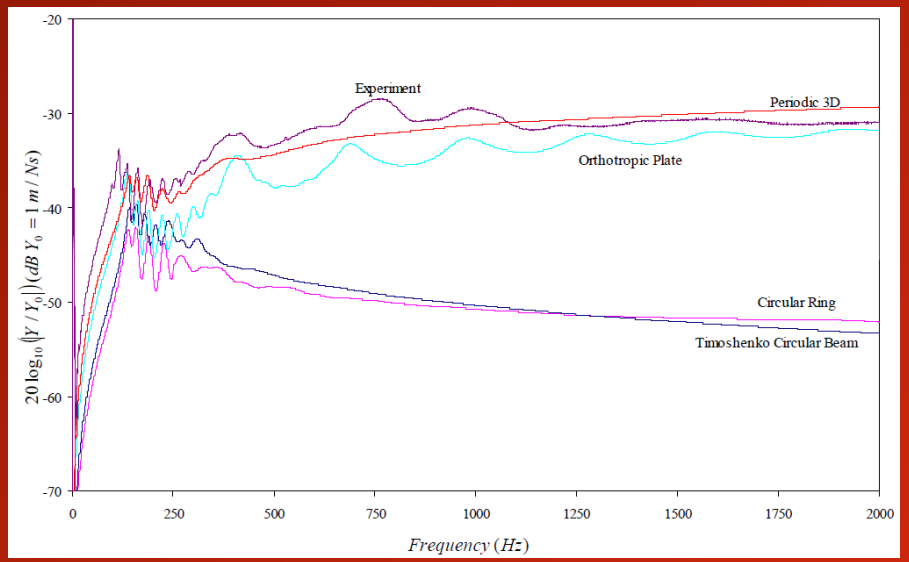
Without and with inflation pressure

Without and with tyre patterns

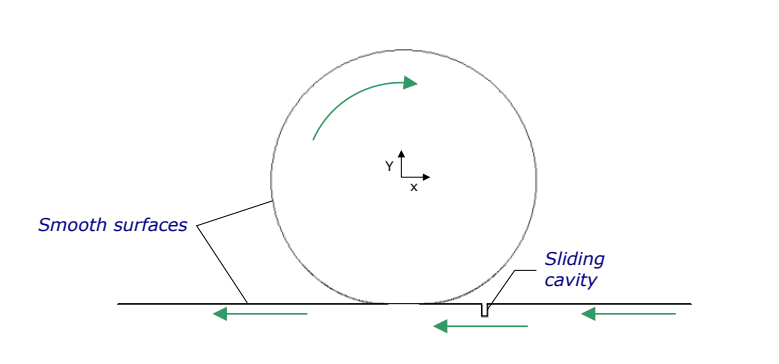




Experimental set-up



Modelling improvement:
Air pumping (LAE)

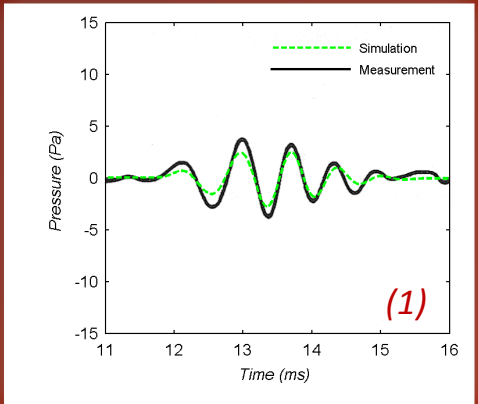


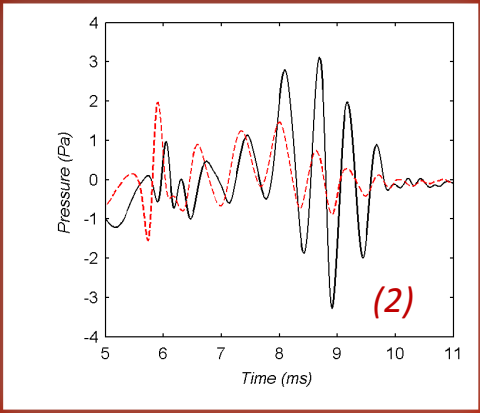
Cylindrical cavity (1)

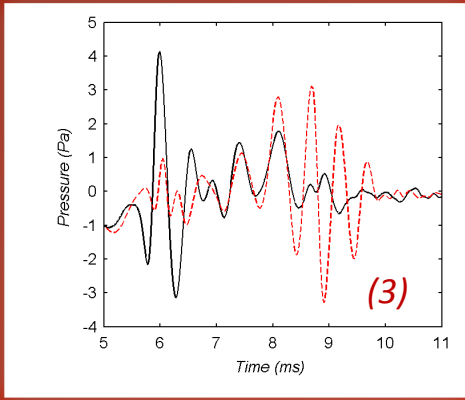
Open transversal groove (2)

Ventilated transversal groove (3)

Groove center /20 cm to the rear

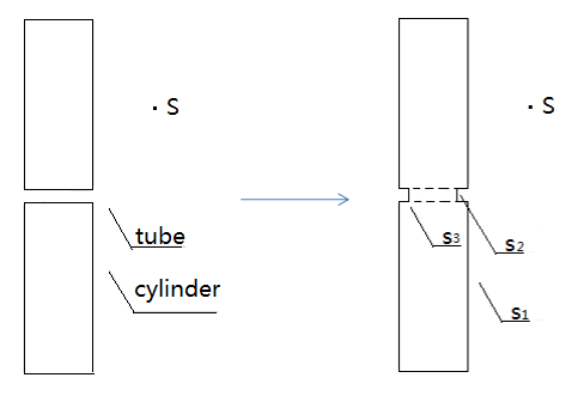




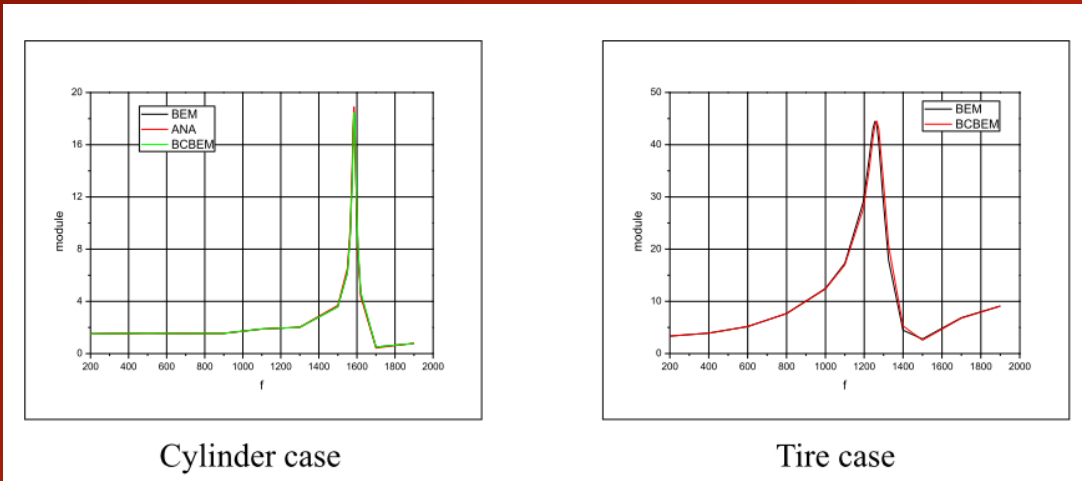


Modelling improvement:
Horn effect (ENPC)

Effect of the tyre treads on horn effect



Example : Cylinder / Parallel groove



Cylinder case

Tire case

+ Absorption effect of the pavement

Modelling improvement:
Validation

- Validation on a Colas 0/4 Nanosoft (Mouvaux - 59)
- Validation on an Eurovia low noise pavement (Villeneuve sur Lot - 47)
- Validation on the German sites.

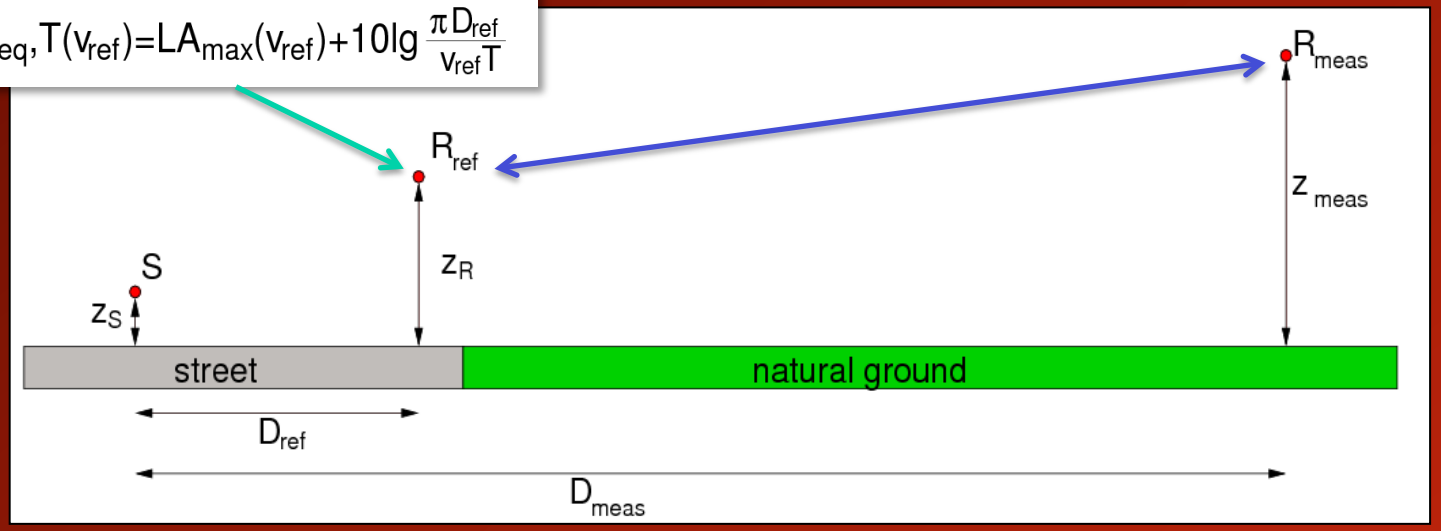
DEUFRABASE Update

- Extension of the database to urban configurations
- Determination of the acoustic characteristics following adapted approaches (TLM)
- Sound level attenuations and Tr (function of the pavement)
- Development of a new interface using the Ifsttar I-Simpa software

DEUFRABASE Update
Principle

$$LA_{eq,T}(v,D) = LA_{eq,T}(v_{ref}) + \text{attenuation(ground, topo, meteo)}$$

$$LA_{eq,T}(v_{ref}) = LA_{max}(v_{ref}) + 10\lg \frac{\pi D_{ref}}{v_{ref} T}$$



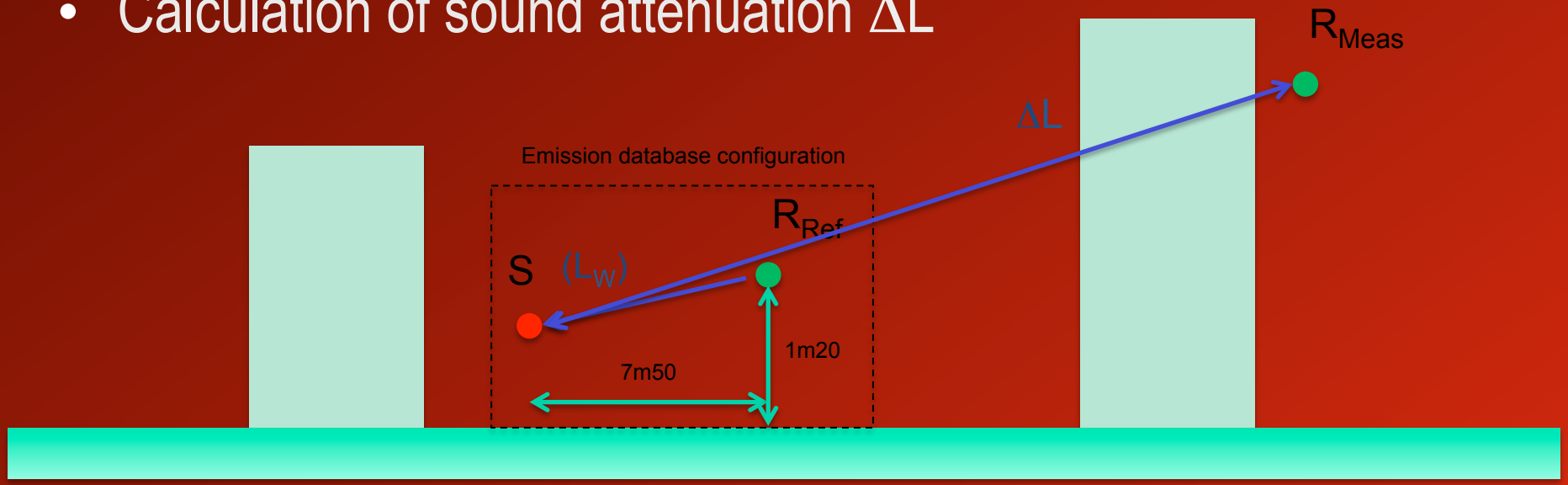
$$LA_{eq}(T) = 10\lg\left(\frac{1}{T}\left(n_{pc} * 10^{0.1 LA_{eq}(pc)} + n_{ht} * 10^{0.1 LA_{eq}(ht)}\right)\right)$$

$$L_{den} = 10\lg\left(\frac{12}{24} * 10^{0.1 L_d} + \frac{4}{24} * 10^{0.1 L_e + 5} + \frac{8}{24} * 10^{0.1 L_n + 10}\right)$$

Extension of DEUFRABASE to urban configurations

For various urban configurations

- Source = emission database
- Calculation of Lw
- Calculation of sound attenuation ΔL



Conclusion and Outlook

- Development of new updated models (other mechanisms)
- Experimental validation on French and German sites (to be carried out)
- DEUFRABASE upgrading
- Joint workshops to disseminate the knowledge
- Bringing innovations on the road