ROSANNE Final Event
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Measurement methods for the noise emission properties of road surfaces

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Work Package 2

Measurement methods for the noise emission properties of road surfaces

New procedure for characterizing noise properties of road surfaces in Europe

The ROSANNE project was funded in the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n°605368

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WP2 objectives

1. Analyze and combine available measurement methods like SPB and CPX into one consistent and harmonized characterization procedure
2. Facilitate comparison of road pavement noise emission data on the European level
3. Enable standardized measurement of noise emission data that can be included in European road noise prediction methods

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WP2 activities

- Task 2.1: Analysis and comparison of existing noise measurement methods
  → main output: report D2.3 on correlation between SPB and CPX results
- Task 2.2: Research on temperature influence and possible corrections
  → main output: report D2.2 (more details in the next presentation)
- Task 2.3: Development of the **noise characterization method (ROSANNE procedure)**
  → main output: proposal for a draft standard (D2.4)
- Task 2.4: Investigation of compatibility with noise calculation methods
  → main output: report D2.5 on compatibility with CNOSSOS-EU
- Task 2.5: Validation of the noise characterization method
  → main output: report D2.6 and update of the proposal for EN standard

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Objectives of the procedure

1. **Acoustic labelling:** determination of initial acoustic properties of generic or proprietary road surface products
2. **Conformity-of-production** (COP) assessment of newly laid surfaces (e.g. for compliance with acoustic labels, contract specifications, homogeneity assessment …)
3. **Monitoring** of the acoustic properties of road surfaces over the working lifetime (to improve surface maintenance/replacement policies and increase understanding of the acoustic durability of road surfaces

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Basic principles of the ROSANNE procedure

- The test method to be used is based on the close proximity method (CPX-method) as defined in ISO/FDIS 11819-2:2016
- **Road Surface Noise Label (RSNL)** is the label given to a certain road surface for one or more road speed categories. Where road category is "Low", "Medium" or "High", such that:

$$RSNL_{cat} = W_{P,cat} * L_{CPXP,vref} + W_{H,cat} * L_{CPXH,vref}$$

3 different road speed categories are defined:

- "**Low**" speed category corresponding to 50 km/h
- "**Medium**" speed category → 80 km/h
- "**High**" speed category → 110 km/h

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Basic principles of the ROSANNE procedure

- P1 and H1 are respectively the reference tyre for cars and for heavy vehicles (according to ISO/FDIS 11819-3)
- $W_{P,cat}$ and $W_{H,cat}$ have different values depending upon the mix of traffic for a given road speed category
- The values for $W_{P,cat}$ and $W_{H,cat}$ are fixed in a normative Annex:

Type of road speed category	$W_{P,cat}$	$W_{H,cat}$
Low speed category	0.90	0.10
Medium speed category	0.80	0.20
High speed category	0.70	0.30

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Acoustic characterization of a road surface type (1)

Acoustic characterization of the "initial" properties of a road surface type

→ **acoustic labelling**

- Label will be applied to "new" surfaces (can be applied to used surfaces)
- **General description:** material + physical properties: road surface type or proprietary name, date of laying, surface treatment, aggregate size, layer thickness, void content, open-graded/ dense/ absorbing, binder type, …
- **Test site selection**: laid using different day batches and by different crews
- **Minimum number of test sections** for noise labelling: 3 to 5 sections
- **Length of the test sections:** minimum of 200 m without interruption
- **Age of the test sections**: between 2 and 6 months after paving, prior to winter maintenance practices
- **Traffic volume**: at least 50.000 vehicle passages occurred

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Acoustic characterization of a road surface type (2)

- **Homogeneity of test sections:** 90% of the measured segments shall not differ by more than 0.5 dB from the average value of the test section
- Number of **repetitions**: 2 measurements for each reference tyre
- Test **tyres**: depending on the intended use for the road surfaces type (e.g. for motorways P1 and H1)
- Reference **speeds**: speed categories where the label is expected to be used + determination of speed coefficient
- **Results**: for each reference speed used, LCPXP (and LCPXH if measured) determined as the arithmetic average of all of test sections
  - average value(s) for each road speed category expected to be used
  - 1/3 octave band frequency spectra shall also be reported

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ROSANNE procedure for Conformity-of-production (COP)

COP measurements using intended to **assess compliance** of a newly laid road surface with **RSNL** (Road Surface Acoustic Label)

- Description of road surface type: same detail as for labelling
- Age and traffic volume: same detail as for labelling (2 to 6 months after paving, no winter maintenance, at least 50.000 vehicles, …)
- Number of repetitions: same detail as for labelling (2 meas. per tyre)
- Test tyres: tyre P1 is mandatory (tyre H1 optional)
- Reference speed: 1 single reference speed (relevant for intended use)
- Results: overall level for all 20m segments in the road section shall be reported (not deviate more than 2.0 dB from RSNL for 90% of the segments)

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ROSANNE procedure for acoustic monitoring

Routine monitoring of the acoustic performance

- Description of road surface type: same details as for COP
- Age of road section and frequency of acoustic monitoring:
  - dense surfaces: after 3 and 5 years after laying + every 3 years
  - for porous surfaces: after 1, 3 , 5 years after laying + every 3 y.
- Number of repetitions: same detail as for labelling (2 meas. per tyre)
- Test tyres: tyre P1 is mandatory (tyre H1 optional)
- Reference speed: 1 single reference speed (relevant for intended use)
- Results: overall CPX levels reported for every segment
- Comparison with results of previous measurements (e.g. COP results)

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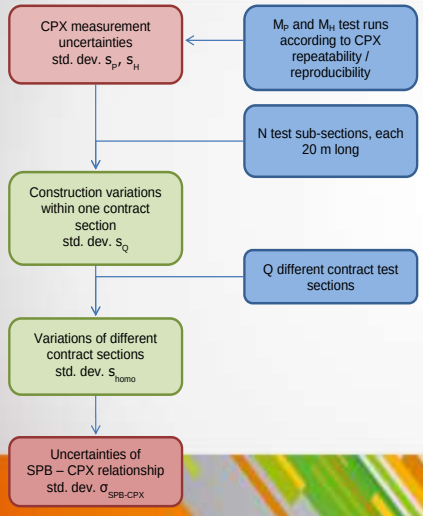
Analysis of the uncertainties related to the overall procedure



Sources of uncertainty related to the procedure for road surface characterization:

- red: unwanted (measurement) uncertainties: S_P, S_H
- green: acoustic variations of the road surface types: S_Q, S_{homo}
- blue: inputs for correct determination of uncertainties and variations: M_P, M_H, N, Q

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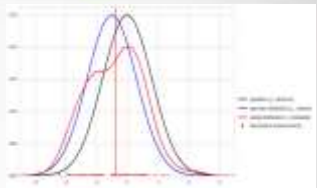
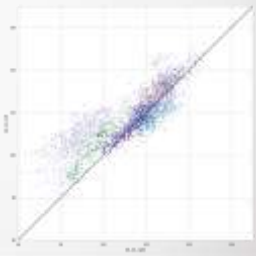
Statistical evaluation of the ROSANNE procedure

- Institutes providing measurement data: AIT, BASt, BRRC, DRD, TUG
- Surface groups considered: CC, CCG, DAC, DPAC, DSH, EACC, OGAC, PAC, SMA
- Selected surfaces: SMA 0/8, SMA 0/1, EACC 0/8, DPAC 6/11 + DPAC11/16
- Min/max age: age groups, e.g. 2-6 months, 6-12 month, etc.
- Min/max segment length: minimum 200 m
- Measurement speed: 80 km/h
- Measurement tire: P1 (ASTM SRTT)





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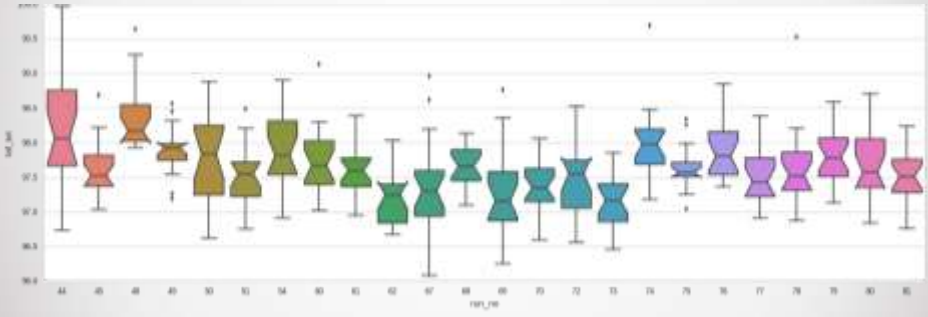
Homogeneity within a contract section

Example of the results variability within the same test section (same location, same section lengths, different temperatures)



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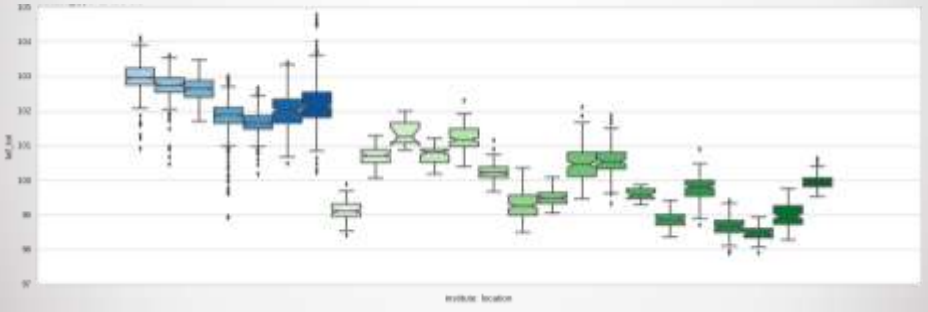
Homogeneity of different sections

Example of results variations of different test sections of nominally the same road surface type (measurements performed by different institutions on different locations)



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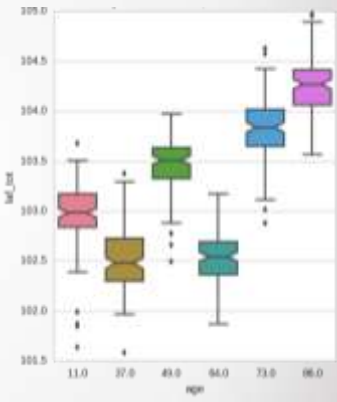
Ageing effect

- Example of the ageing effect for a specific road surface (same test section and location, same section lengths, same test institution)
- Data available only for some specific road surfaces
- Need for clear and practicable monitoring procedure
- More details on the statistical evaluation can be found in report D2.6



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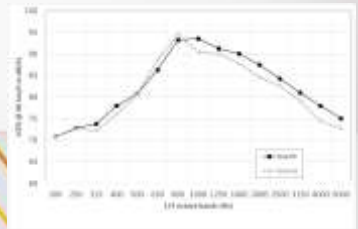
Compatibility with CNOSSOS-EU calculation model

- A cross-comparison of main features in the ROSANNE characterization procedure and the CNOSSOS-EU road noise emission model have been performed with respect to road surface effect (see D2.5 for more details)
- Both systems are broadly consistent and complementary:
  - ROSANNE procedure can be used to assess the noise reduction at the source while CNOSSOS-EU assesses environmental benefit
  - ROSANNE can provide accurate and efficient road surface corrections as input for noise mapping purposes with CNOSSOS-EU
  - ROSANNE can provide a "virtual reference surface" spectrum and other surface corrections

Averaged measured CPX spectra at 80 km/h on DAC 0/11 and SMA 0/11 as a first proposal for a ROSANNE virtual reference spectrum (IFSTTAR)



Summary

- In this work a new procedure for noise characterization of road surfaces in Europe was summarized
- The procedure has been developed within the frame of the ongoing EU-FP7 project ROSANNE
- The ROSANNE procedure is compatible with CNOSSOS-EU
- The ROSANNE procedure will be submitted to CEN/ TC227 / WG5 for possible adoption as a future EN standard
- More detailed information can be found in the ROSANNE reports on the project website: http://rosanne-project.eu/

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