Furthering Improvements in Integrated Mobility Management (I2M),
Noise and Vibration (N&V), and Energy in Shift2Rail

UIC meeting Noise – 02-11-2021

Presenter(s): Rita Caminal Barderi
Email: rita.caminal-barderi@alstomgroup.com
Validation of railway exterior noise simulation

• The aim of the project is to validate and improve the exterior noise simulations

• The physical phenomena to take into account are the noise diffraction, the ground absorption, the train equipment directivity and propagation
Validation of railway exterior noise simulation

The work is focused in the following questions:

• Are the current exterior noise simulations tools from the train manufacturers/operators good enough to allow the virtual certification?

• Which is the uncertainty linked to the exterior noise simulations?

• Can this uncertainty be reduced with new methodologies of train equipment characterization?
Validation of railway exterior noise simulation

The work uses what was already learned from previous projects.

ACOUTRAIN (specially WP3, WP4 and WP5)

S2R FINE-1

SILENCE

FINE-2 WP6

The added value with respect to the previous work done on ACOUTRAIN is to focus the effort on the train integration.

It will be done by means of measuring the same sources stand alone and installed on the train.
Validation of railway exterior noise simulation

- The validation is done in a close collaboration with S2R Open Call TRANSIT.

FINE-2 partners, composed of rolling stock manufacturers and operators, bring the vision and the needs of the industry.

TRANSIT partners, composed of research centres, universities and consultancies, will enhance existing methods and propose new techniques based on their knowledge and experience.
FINE-2 WP6 activities


Can the simulation results be improved with the new techniques proposed by TRANSIT?
FINE-2 WP6 activities

Matrix of reference cases depending on type of noise and train integration. All tests to be done in static to avoid rolling noise (covered by FINE-2 WP7).

<table>
<thead>
<tr>
<th>Type of noise</th>
<th>Cooling noise</th>
<th>Electro magnetic noise</th>
<th>Mechanical noise</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bogie area</td>
<td></td>
<td></td>
<td></td>
<td>Loudspeaker test</td>
</tr>
<tr>
<td>On the roof with/without roof fairings</td>
<td>HVAC, cooling unit, etc.</td>
<td>Auxiliary converter, main transformer, traction inverter, etc.</td>
<td>Main air compressor, Diesel powerpack</td>
<td></td>
</tr>
<tr>
<td>Underframe with/without skirts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reference cases

- HVAC saloon installed on the underframe
- Speaker in the bogie area
- HVAC Cabin on the roof

Already measured

- Without skirts
- Without roof cover

Grant Agreement Number: 881791
Reference cases

- Auxiliary converter on the underframe
- Main transformer on the roof
- HVAC or motor cooling on the roof
- With roof fairings
- Without skirts
- Without roof fairings
FINE-2 WP6 activities

MEASUREMENTS

SOURCE STAND ALONE

• Measurements performed by TRANSIT are with microphone array and ISO 9614-2, including source directivity information
• Measurements performed by FINE-2 participants are in terms of SWL according to ISO 9614-2 when possible, otherwise ISO 3744
FINE-2 WP6 activities

MEASUREMENTS

SOURCE MOUNTED ON THE TRAIN

• Measurements of sound pressure level around the train. The source under test is isolated from the rest by switching off the other equipment.

• Transfer function from the equipment surfaces and the microphones with KTH methodology. See TRANSIT deliverable D1.1 Validated procedure for source characterization based on equivalent monopoles and tests involving generic sources.
# FINE-2 WP6 activities

<table>
<thead>
<tr>
<th>SIMULATION SOURCE MOUNTED ON THE TRAIN</th>
</tr>
</thead>
</table>

## FINE-2 participants

<table>
<thead>
<tr>
<th>Used tool for simulation</th>
<th>Alstom/ Bombardier</th>
<th>CAF</th>
<th>SNCF</th>
<th>TRV (KTH)</th>
<th>TRANSIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITARE</td>
<td>BRAINS</td>
<td>TrainNoiS</td>
<td>Train noise expert</td>
<td>Finite element (Comsol Multiphysics)</td>
<td>Vibratec</td>
</tr>
<tr>
<td>Analytical tool</td>
<td>Analytical tool</td>
<td>Analytical tool</td>
<td>Analytical tool in third octave bands. Diffraction is not taken into account, reflexion on the ground is considered.</td>
<td>Narrow band</td>
<td></td>
</tr>
<tr>
<td>in third octave bands. Box source, monopole, dipole, fan, air inlet/outlet, etc.</td>
<td>in third octave bands. Point sources as monopole or dipole.</td>
<td>in third octave bands.</td>
<td>in third octave bands.</td>
<td>Boundary Energy Element Method (BEEM) for medium to high frequencies ([500-5000] Hz)</td>
<td></td>
</tr>
</tbody>
</table>

**Small description**

- Analytical tool in third octave bands. Point sources as monopole or dipole.
- Analytical tool in third octave bands. Diffraction is not taken into account, reflexion on the ground is considered.
- Narrow band
FINE-2 WP6 activities

The assessed cases will be done for a specific train:

• Averaged positions at 7.5 m from the track centre when the train is at standstill according to ISO 3095
• Starting noise during acceleration according to ISO 3095
• Pass-by at 80 kph, 200 kph and 320 kph according to ISO 3095
Conclusions

The simulation results will be compared with the validation requirements and the uncertainty.

Depending the results, two possible options:
- Simulations or source characterization from FINE-2 participants need to be improved with more advanced techniques.
- Simulations results are already acceptable and could be used in the future for Virtual Certification.
Thank You for Your Attention