



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

Noise source separation (WP7)

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Objective

- The Noise Source Separation has two goals:
 - Objective 1:
 - To support the improvement of existing methodologies for separating the contributions of vehicle and track to rolling noise
 - *Rolling noise separation methods work stream.*

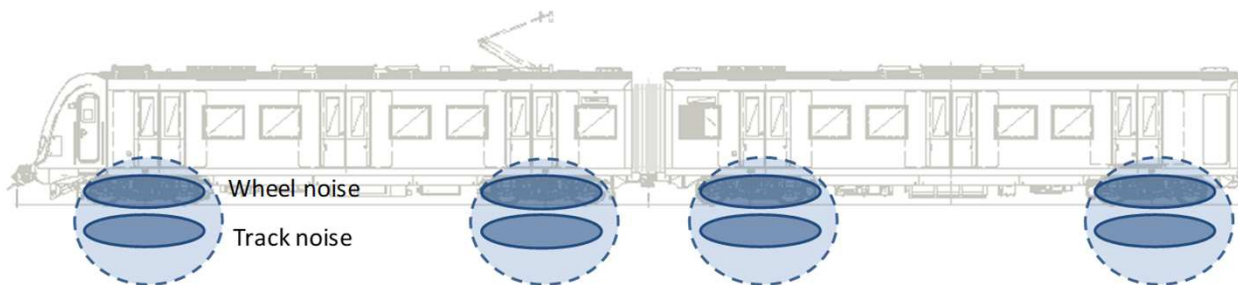


Figure 1. Graphical representation of WS1: Rolling noise separation methods.

Objective

- The Noise Source Separation has two goals:
 - Objective 2:
 - To support the development of innovative techniques to separate the different types of acoustic sources during pass-by
 - *Pass-by noise source separation techniques work stream.*

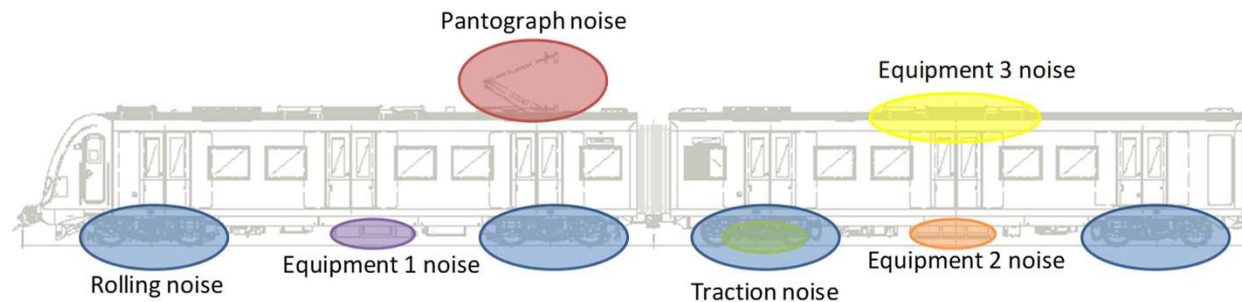


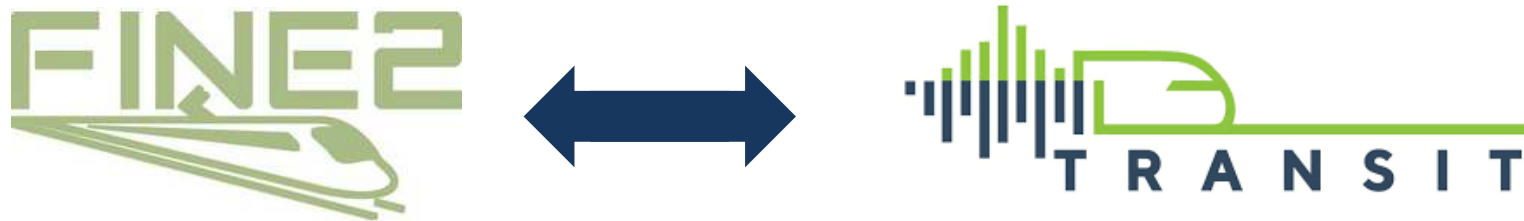
Figure 2. Graphical representation of WS2: Pass-by noise source separation techniques.

Objective

- The goals are related but different
 - The methods applicable for one objective differ from the techniques applied for the other objective
 - The idea of grouping both work streams on a same work package is to try to reduce testing campaigns and efforts as much as possible

Objective

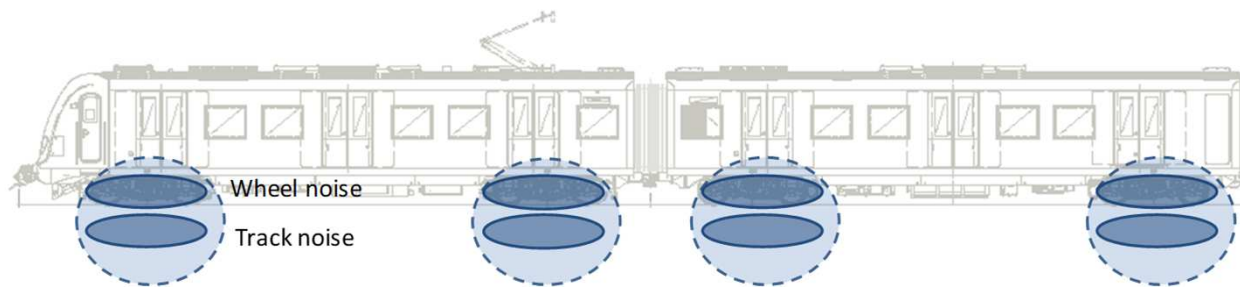
- These objectives will be achieved in a close collaboration with S2R Open Call TRANSIT.



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

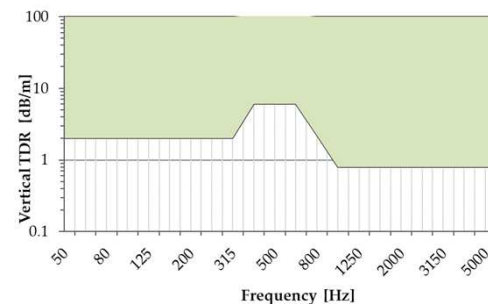
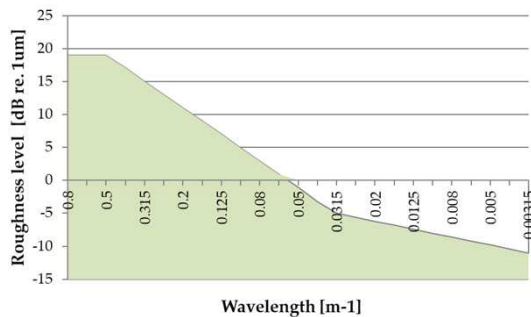
TRANSIT partners, composed of research centres, universities and consultancies, will enhance existing methods and propose new techniques based on their knowledge and experience.

Rolling noise separation methods



Background

- In the effort of reducing rolling noise one key question is the separation of the noise radiated by the wheel from that radiated by the track.
- The current Technical Specification for the Interoperability Noise relies on the use of a **reference track** to quantify the vehicle noise. The reference track is defined by
 - an upper limit of the rail roughness and
 - a lower limit of the track decay rate.



- This does not assure that the track contribution is negligible.
 - Different reference tracks may lead to different pass-by noise results.
 - This may cause different pass-by noise results with the same vehicle on different reference tracks

Background

- TSI Noise homologation test procedure shows inadequacies when it comes to quantifying the vehicle noise
- An improvement would first be the enhancement of test methods that allow separating noise from the wheel and from the track during a pass-by.

Background

- Roll2Rail was dedicated to developing methods for better characterisation of rolling noise



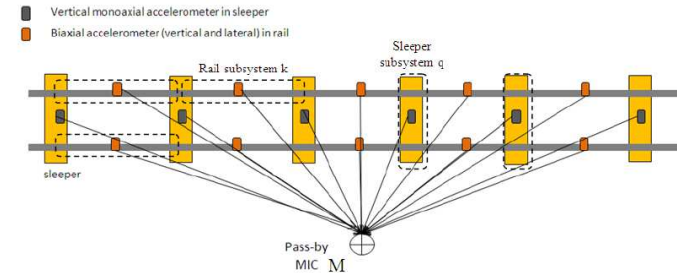
- General conclusions from Roll2Rail:
 - Methods need to be further enhanced to make them suitable for certification procedures
 - Simplify instrumentation and track access
 - Improve accuracy of the results

Methods enhanced by TRANSIT



Advanced Transfer Path Analysis (ICR)

- Experimental method that gives the sound pressure at a target position as the sum of the contribution of N subsystems
- Two-step method: Impact tests + pass-by test

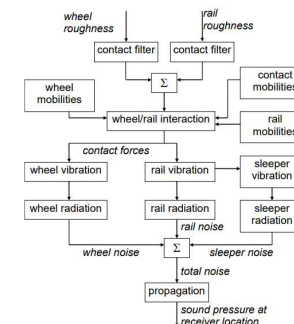


Pass-by analysis (TNO)

- Experimental method that uses an accelerometer on the rail and a trackside microphone to measure the combined vehicle+track transfer function
- To separate vehicle and track components:
 - Measure the combined vehicle-track transfer function with a quiet vehicle
 - Measure the vehicle and track transfer functions statically.

Rolling noise simulations with TWINS (ISVR)

- Use rolling noise simulations to deduce the track and vehicle contribution to rolling noise
- Experimental inputs required; TDR, roughness, wheel modal analysis, track parameters,...



Work structure

- I. Specify the requirements to be fulfilled by the separation methods.
 - Integration on future certification procedures
 - https://projects.shift2rail.org/s2r_ipcc_n.aspx?p=fine-2

- II. Specify three vehicle scenarios for TRANSIT to test the enhanced methods

- III. Analyse the strengths and weaknesses of the methodologies proposed

- IV. Analyse the possibility of proposing an updated methodology for a better vehicle characterisation in current pass-by noise homologation procedures.

Test campaigns



CAF test campaign
When: October-November 2021
Where: Spain
Train type: Metro



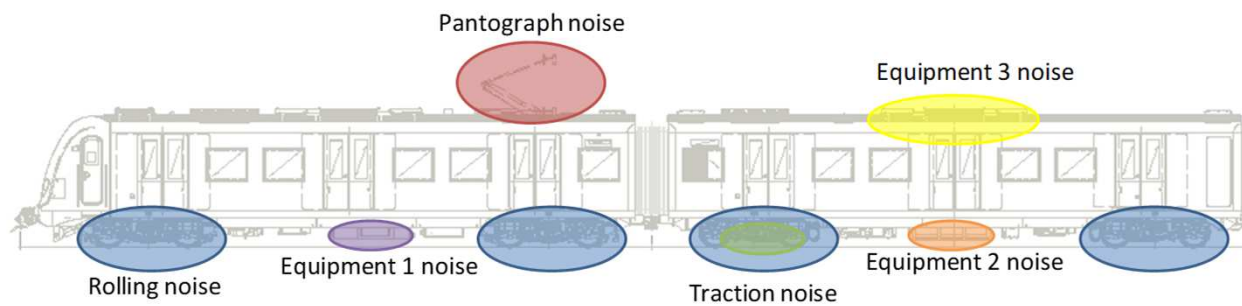
TALGO test campaign
When: January 2022
Where: Spain
Train type: High-speed



ALSTOM test campaign
When: December 2021
Where: Czech Republic
Train type: Regional



Pass-by noise source separation techniques



Background



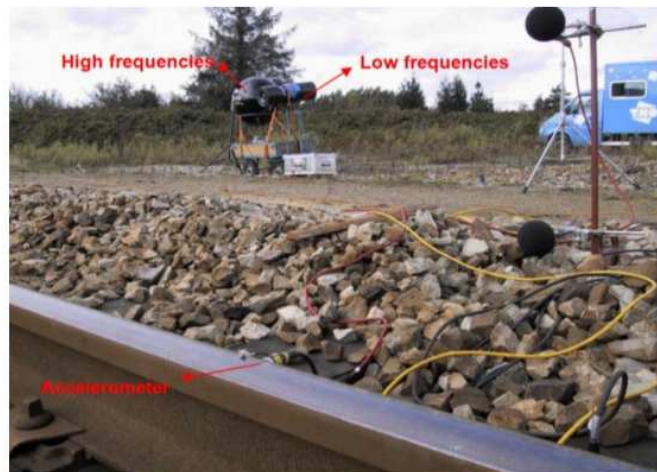
- There is a need to further develop techniques to separate the different types of acoustic sources during pass-by
 - Identifying the main noise contributors is relevant for source ranking prior to mitigation measure implementation.
 - seek for methods that can provide the inputs for exterior noise simulation tools

Methods enhanced by TRANSIT



Microphone array methods (TU Berlin)

- Identify the contributions from different noise sources by finding the best source distribution that fits the sound pressure measurement on the microphone array.
- Propagation models can vary significantly



Pass-by analysis (TNO)

- Experimental method that uses an accelerometer on the rail and a trackside microphone to measure the combined vehicle+track transfer function
- It assumes that that any spectral deviations from the rolling noise transfer functions are due to other sources.
 - Low-frequency → aerodynamic sources
 - Mid-frequency → traction sources

Work structure

- I. Specify the requirements to be fulfilled by the separation methods.
 - Results able to feed exterior noise simulation tools
 - https://projects.shift2rail.org/s2r_ipcc_n.aspx?p=fine-2

- II. Specify two vehicle scenarios for TRANSIT to test the enhanced methods

- III. Analyse the strengths and weaknesses of the methodologies proposed

Next steps

Next steps

- Excute the two remaining test campainings
 - January 2022

- Perform a SWOT analysis of the methods applied for both WS
 - December 2022

- Analyse the possibility of proposing an updated methodology for a better vehicle characterisation in current pass-by noise homologation procedures
 - May 2023



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Thank You for Your Attention



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