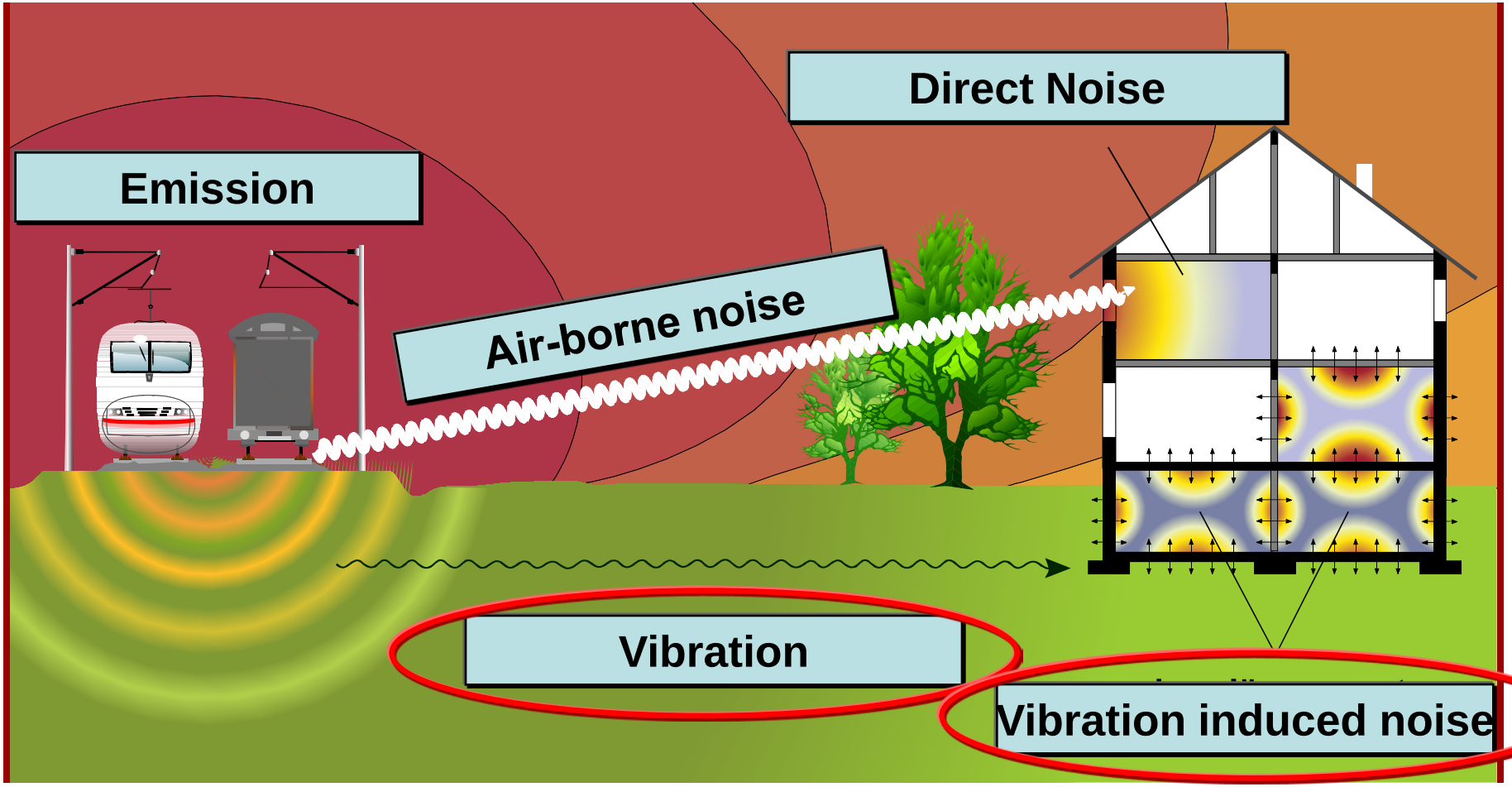
railway induced vibration abatement solutions

8th UIC Railway Noise Workshop

Bernd Asmussen (UIC/DB Systemtechnik)

Paris, 11th June, 2013


Direct Noise
Emission
Air-borne noise
Vibration
Vibration induced noise

What's the problem ?

- Public sensitivity to vibration issues has increased in recent years
- Opposition to new lines is as much about the effects of vibration as about noise
- Vibration mitigation features heavily in the cost of railway infrastructure projects
- Complaints about vibrations and vibration-induced noise increase where noise barriers have been built
- Lack of established solutions for vibration from surface railways

Ensure that in the coming years the expansion of rail transport in the EU is not hindered by public opposition on the grounds of vibration.

Innovative solutions for hot-spots

Low vibration rolling stock

Clear assessment procedures and descriptors

RIVAS Consortium:

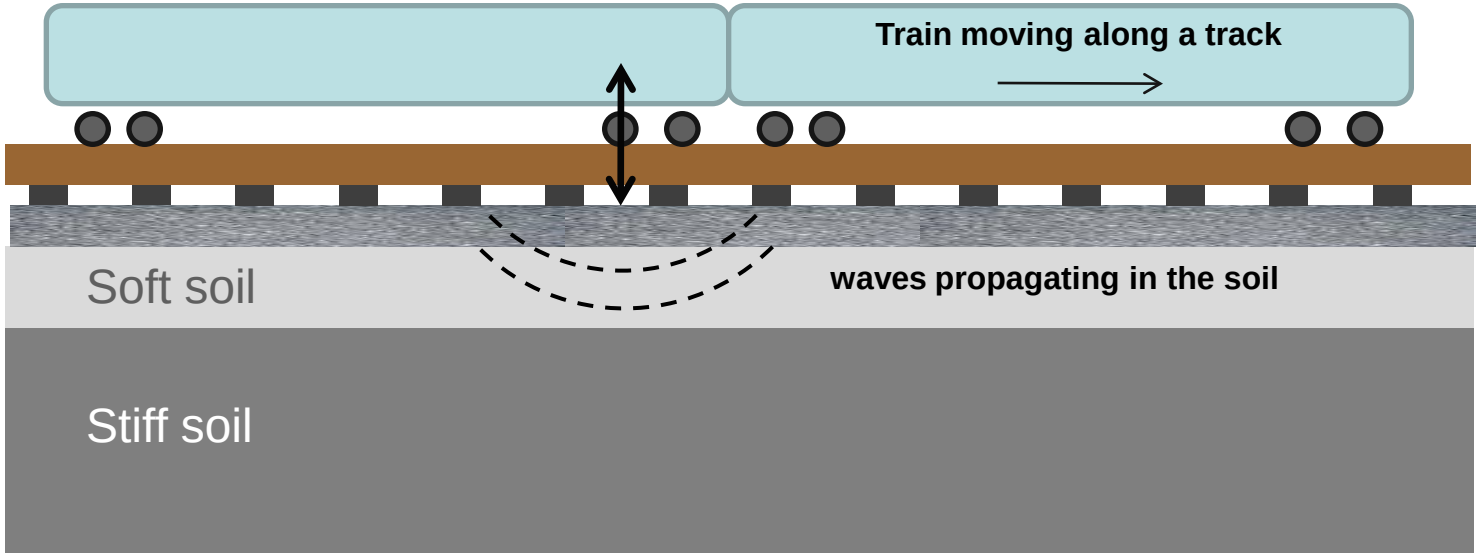
End users	Suppliers	Research institutes	Consultants
■ ADIF	■ Alstom	■ BAM	■ D2S
■ DB	■ Bombardier	■ CEDEX	■ Satis
■ RATP	■ Eiffage	■ Chalmers Univ.	■ TÜV Rheinland
■ SBB	■ Keller Grundb.	■ CSTB	■ Vibratec
■ SNCF	■ Lucchini	■ ISVR	■ Prose
■ Trafikverket	■ Pandrol	■ KU Leuven	
■ UIC	■ Railone		
	■ Sateba		
	■ UNIFE		

Coordination : **UIC**
Administrative Coordination: **TÜV Rheinland**

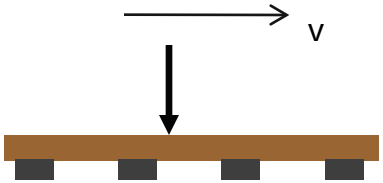
Focus and main objectives:

- **Innovative solutions for vibration mitigation at source**
- **Technologies for reduction of vibration on the propagation path**
- **Standardized test procedures for vibration mitigation measures**
- **Focus on freight traffic / open lines / ballasted track**
- **Slab track and other modes of rail traffic included**
- **Validation of mitigation measures in laboratory tests and field tests**

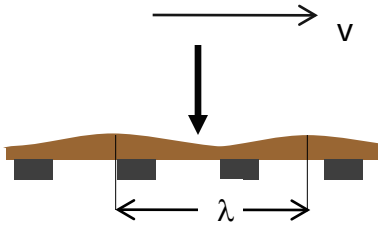
Train induced vibrations:

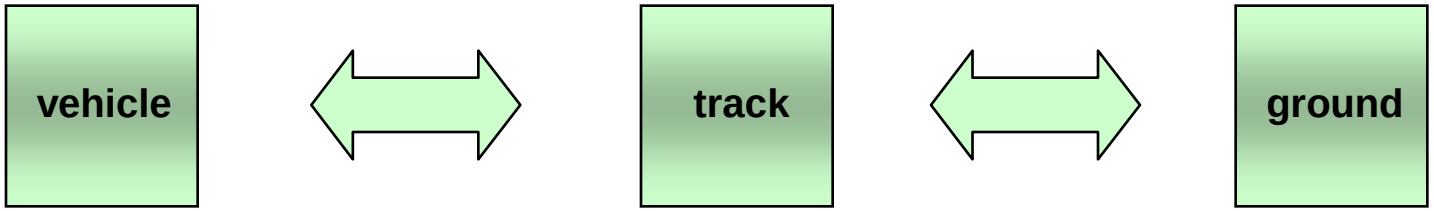


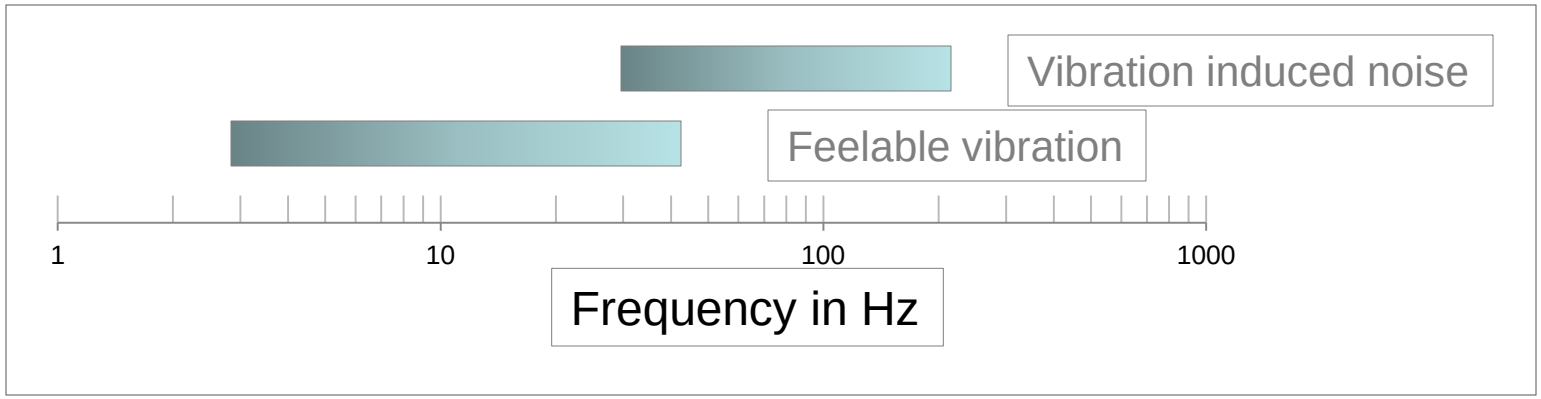
Quasi-static axle load

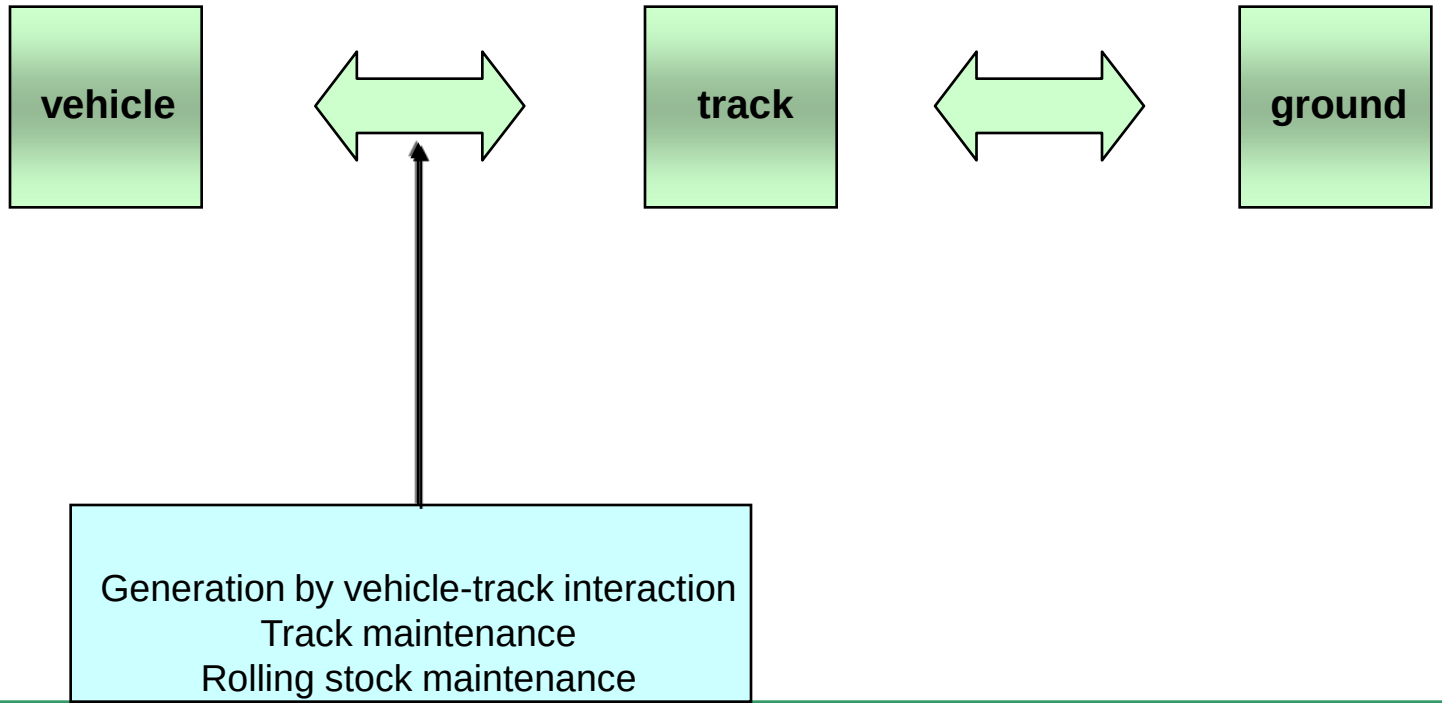


Dynamic load f = v/λ

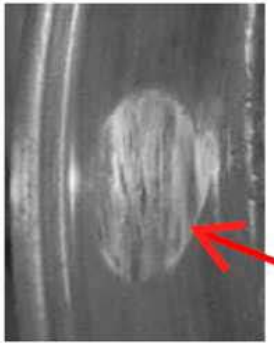


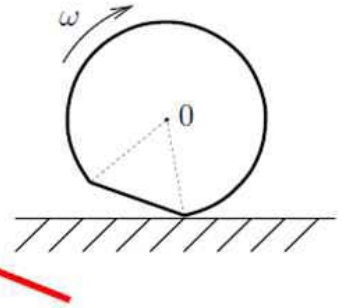

vehicle
track
ground


Vibration induced noise
Feelable vibration
1
10
100
1000
Frequency in Hz


vehicle
track
ground
Generation by vehicle-track interaction
Track maintenance
Rolling stock maintenance

source: Nielsen, 2008

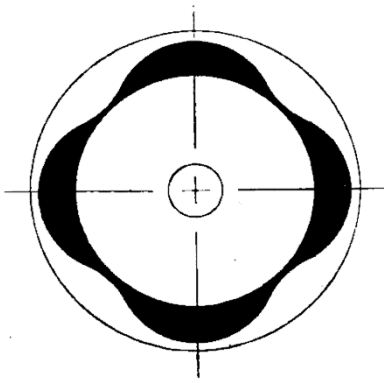


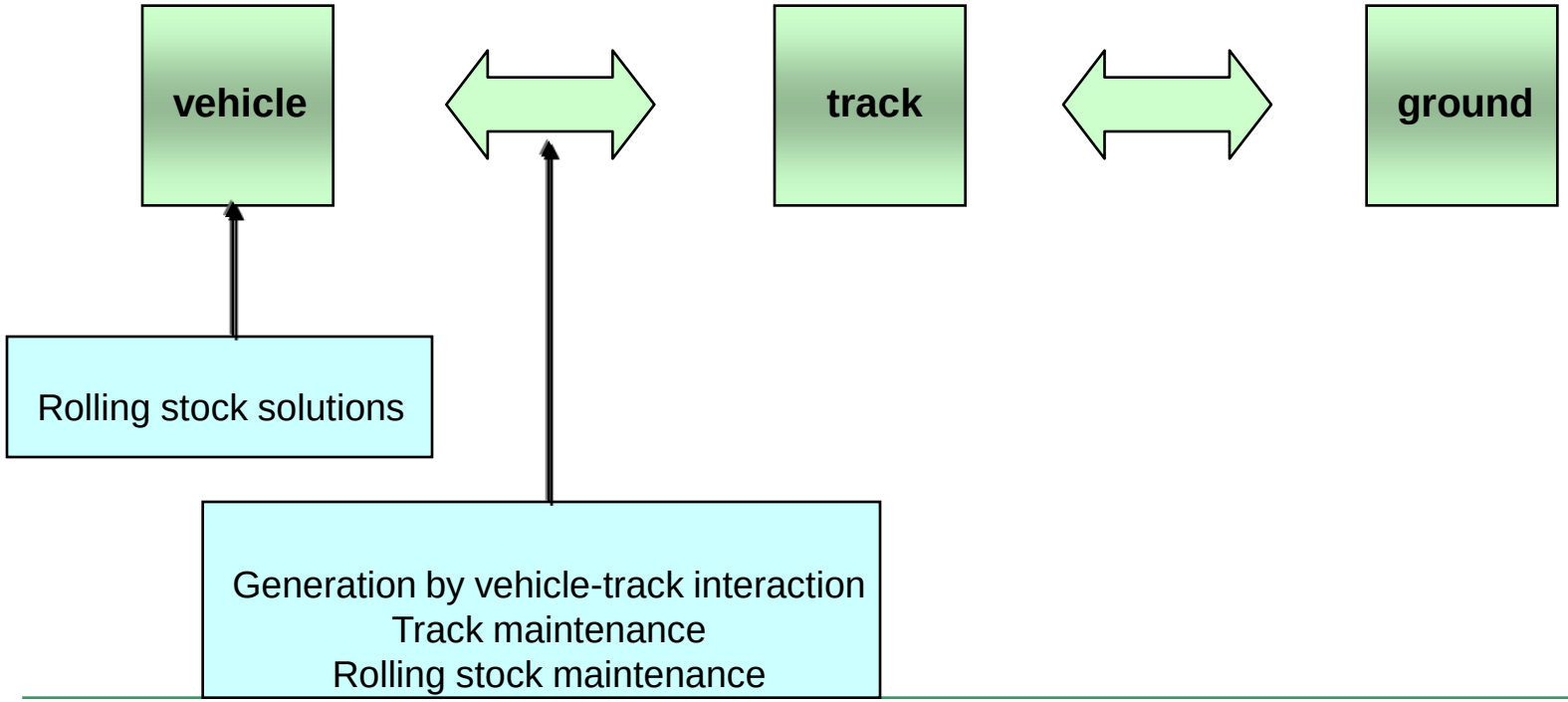


Identification of rail and wheel defects

Impact on vibration

Optimization of maintenance strategies

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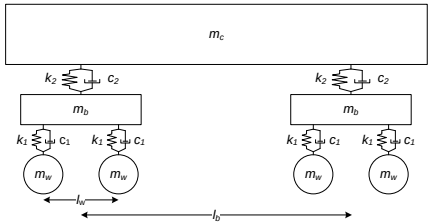
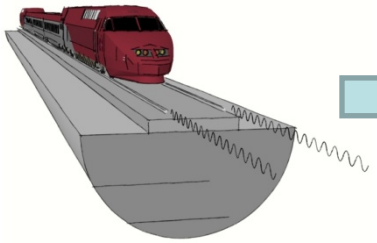
Matlab multi-body model



Doubledecker coach
freight wagon

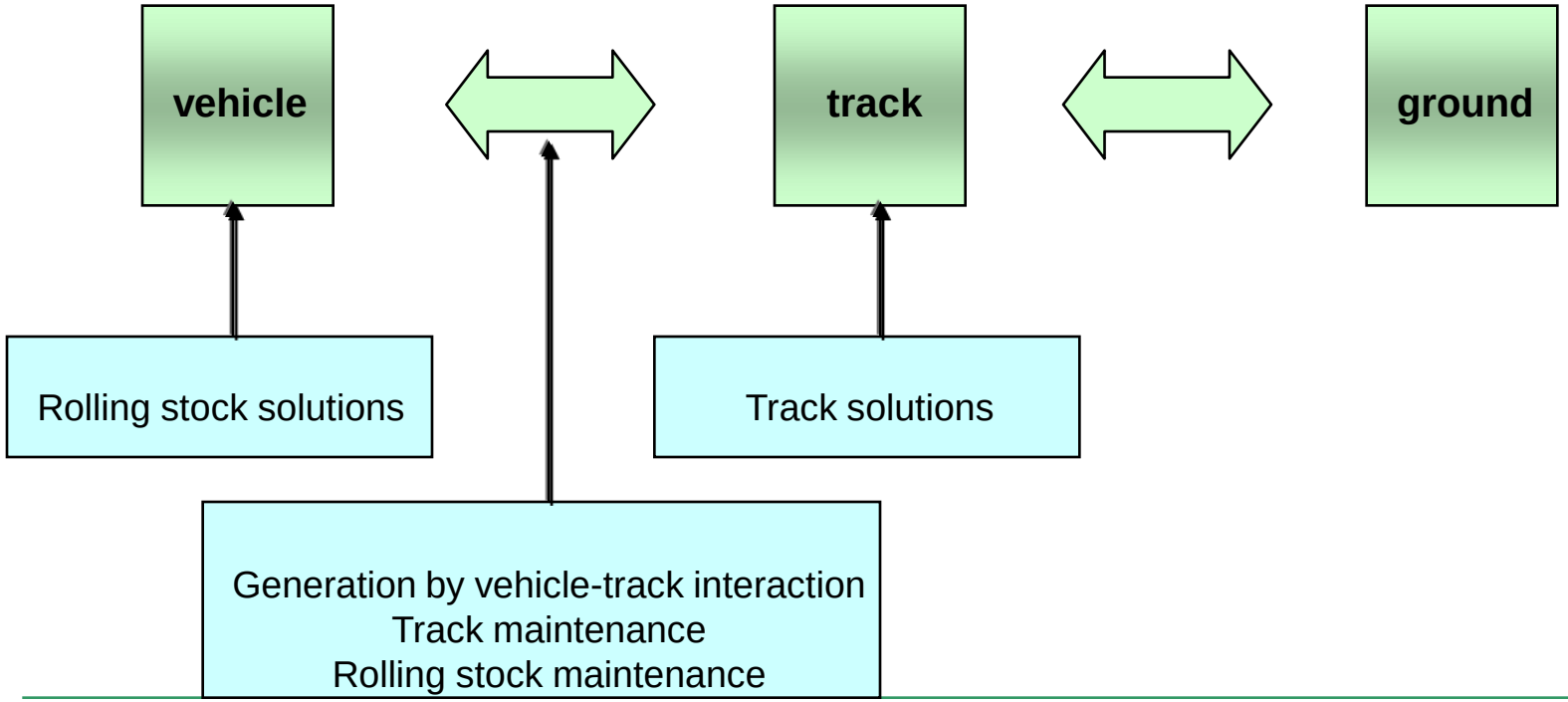
TRAFFIC



<u>Parameter influence</u>
- Mass
- Suspension
- Geometry

<u>For different</u>
- Soils
- Excitations

- Influence of vehicle parameters on vibration emission investigated
- Optimise measures for the vehicles to reduce vibration taking into account functional constraints and cost efficiency aspects
- Design guide for low vibration vehicles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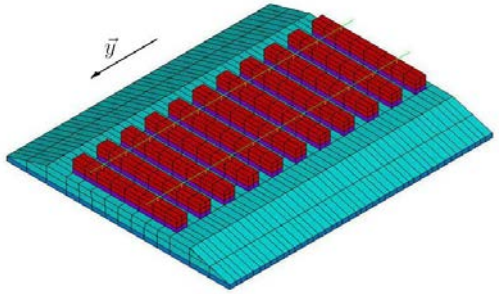
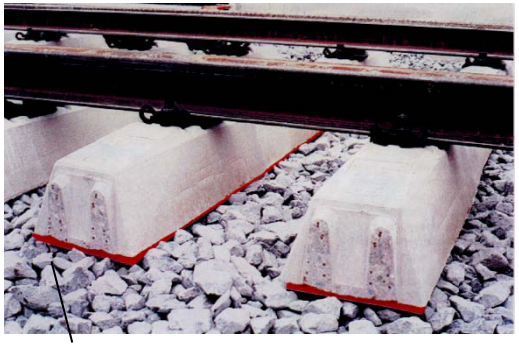
Finite-Element Simulation



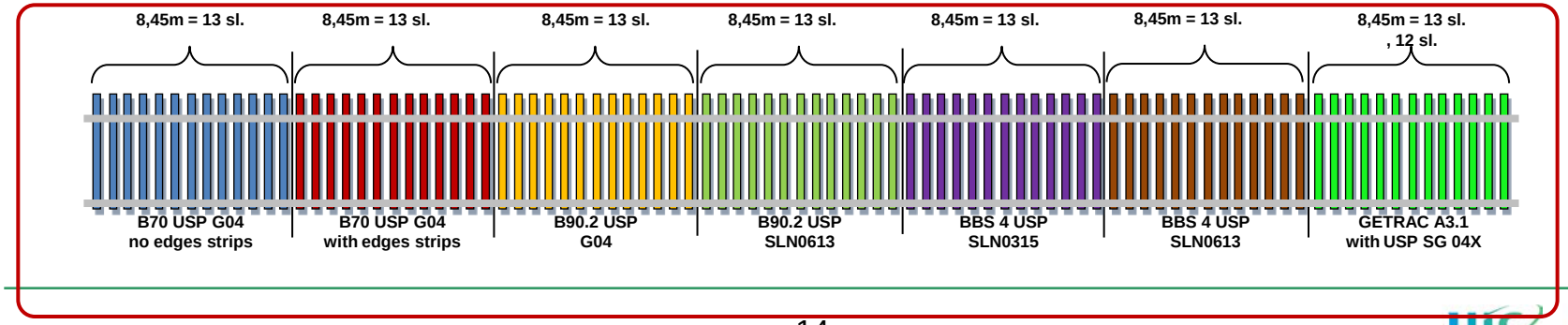
Very soft rail fastening systems (<30 N/mm)

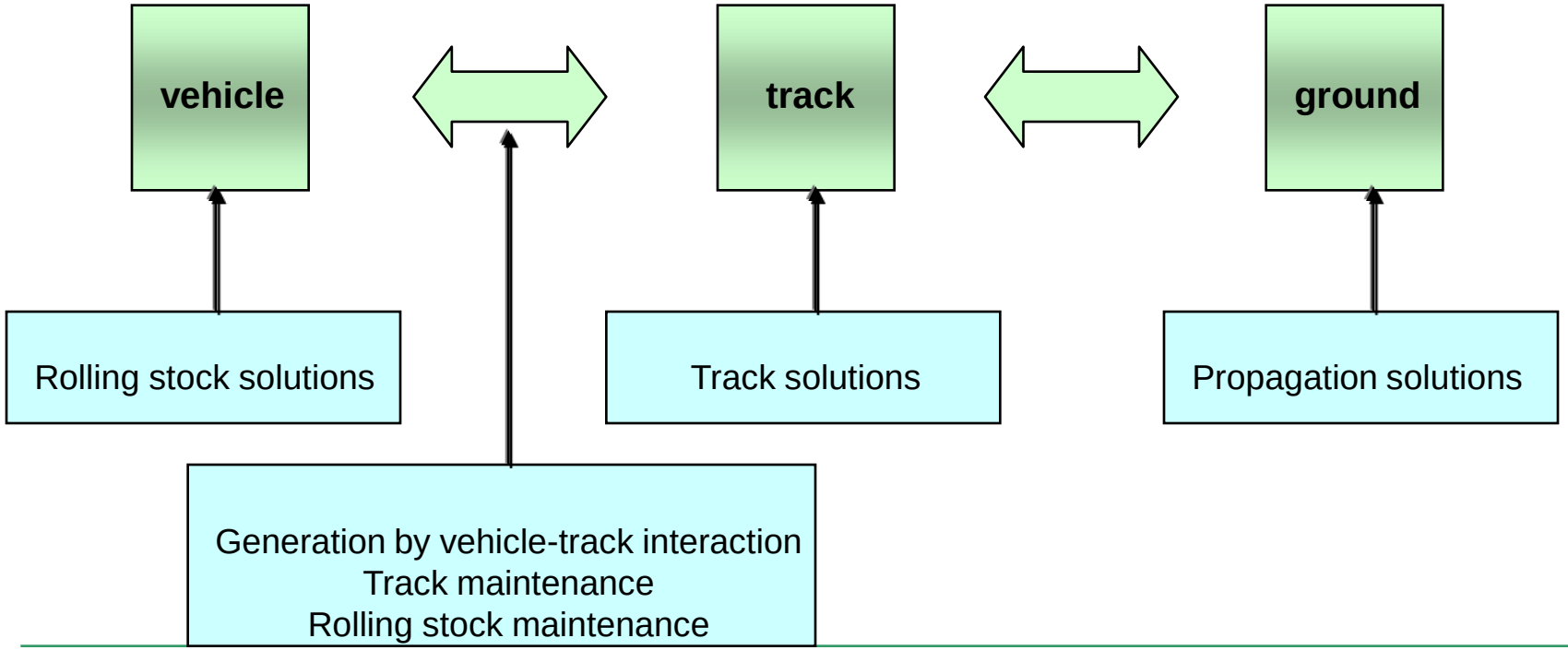
Under sleeper pads (USP)



- Soft USP in combination with wide sleeper
- Effect of USP in switches
- Track stability of curves with USP
- Slab track with soft USP

Test of various sleeper / USP combinations

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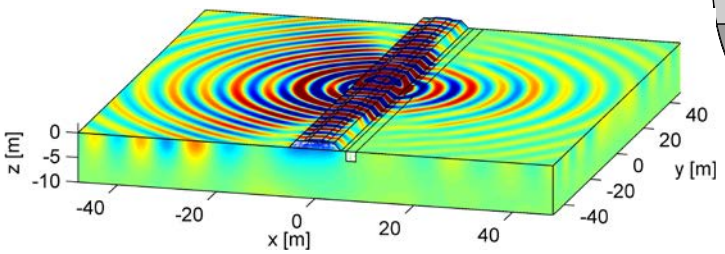
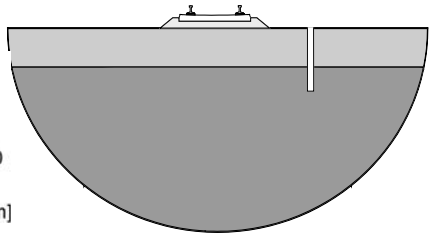
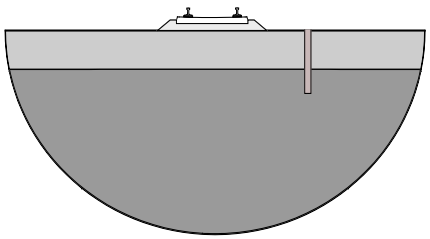
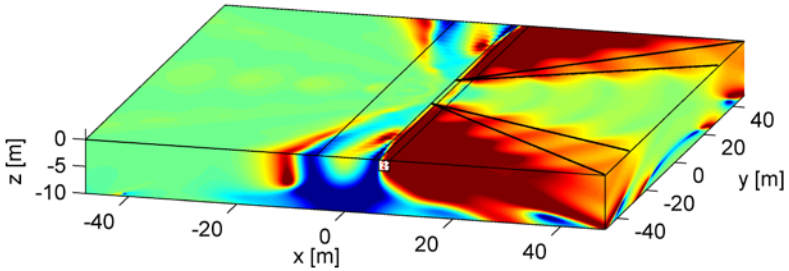


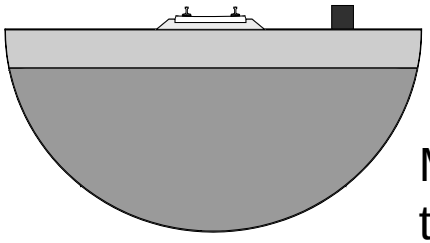


Open trench



Buried wall barrier

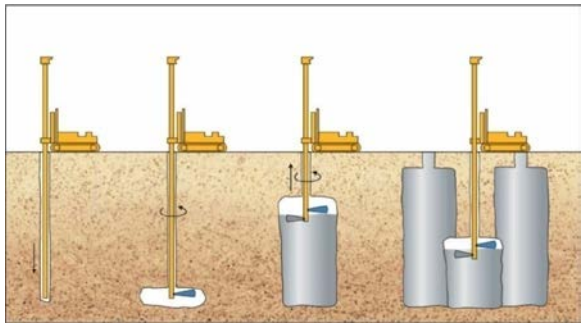


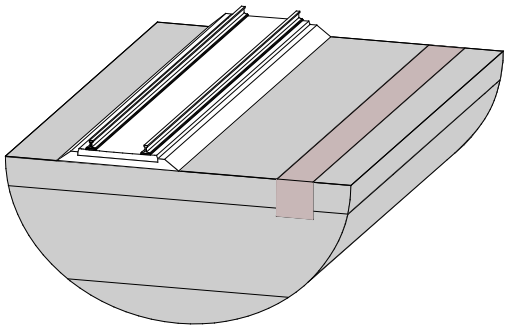


Masses next to track.

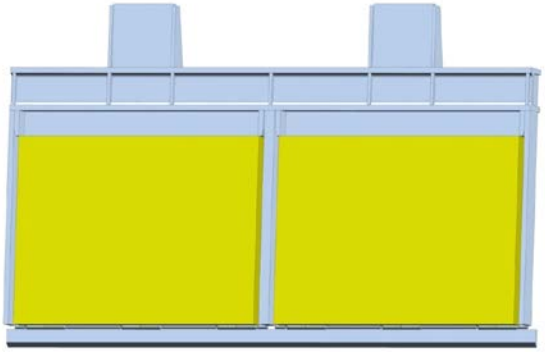
Design studies and field tests

Stiff wave barrier
Jet grouting technique
Field test in Spain (2013)

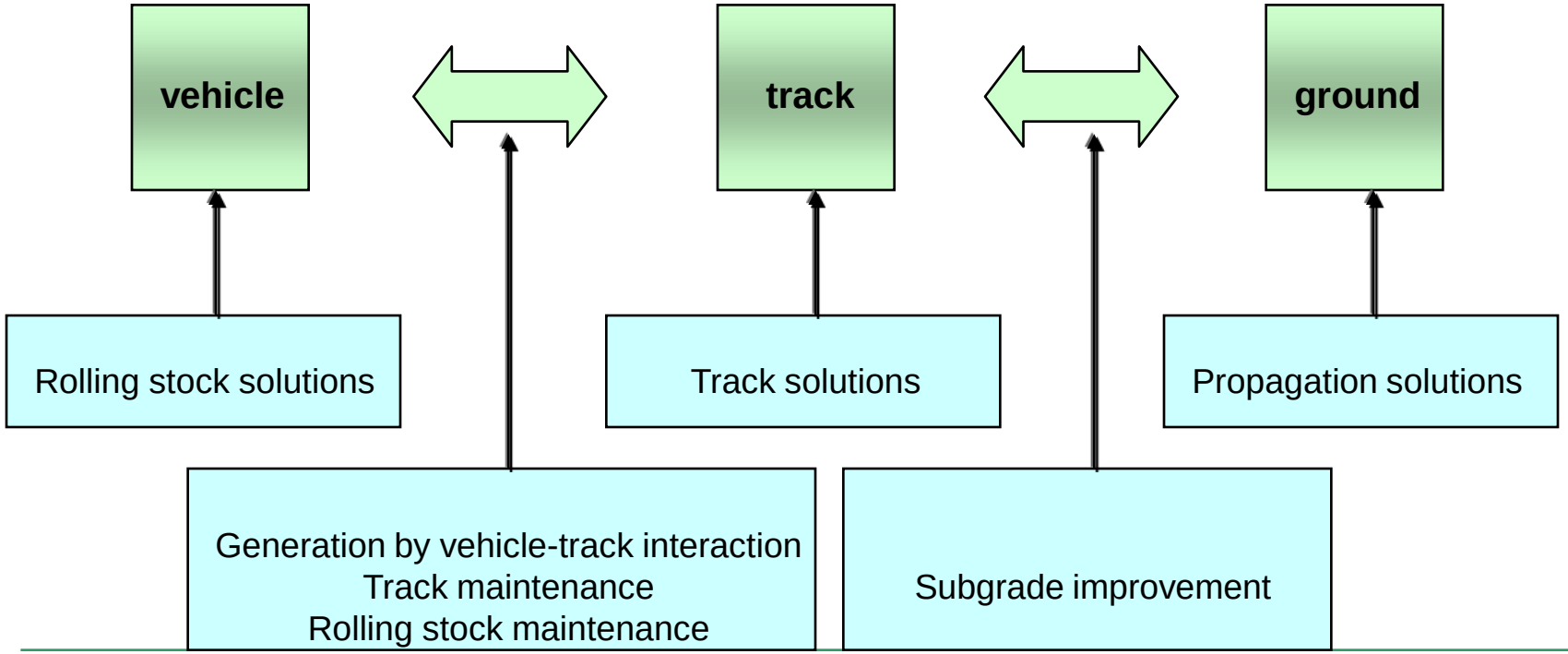




Soft trench
Field test in Switzerland



Sheet pile wall
Field test in Sweden


vehicle
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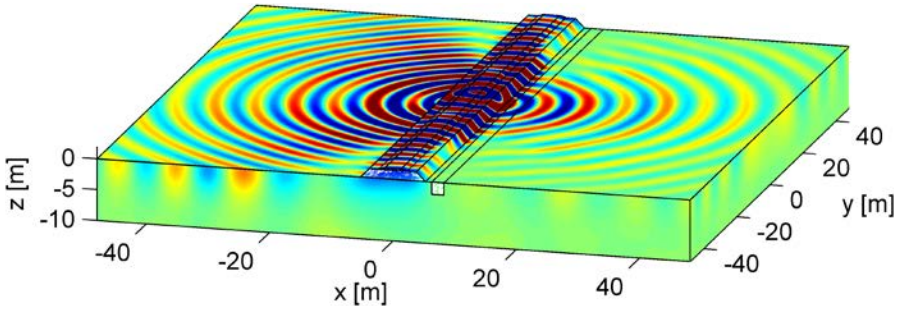
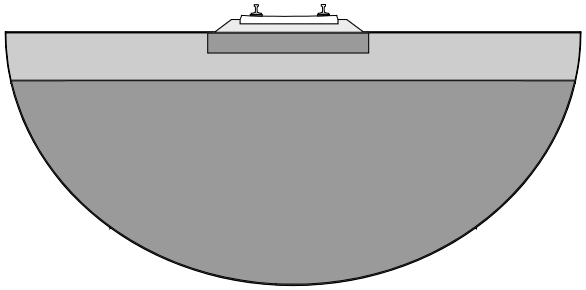
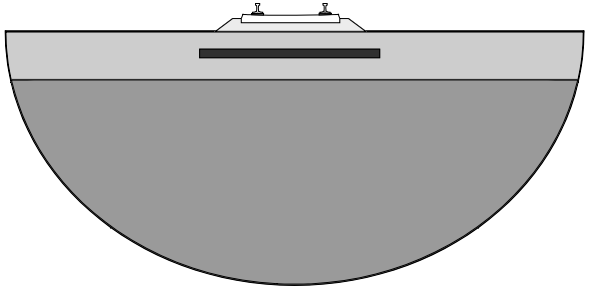
Subgrade improvement

Design studies:

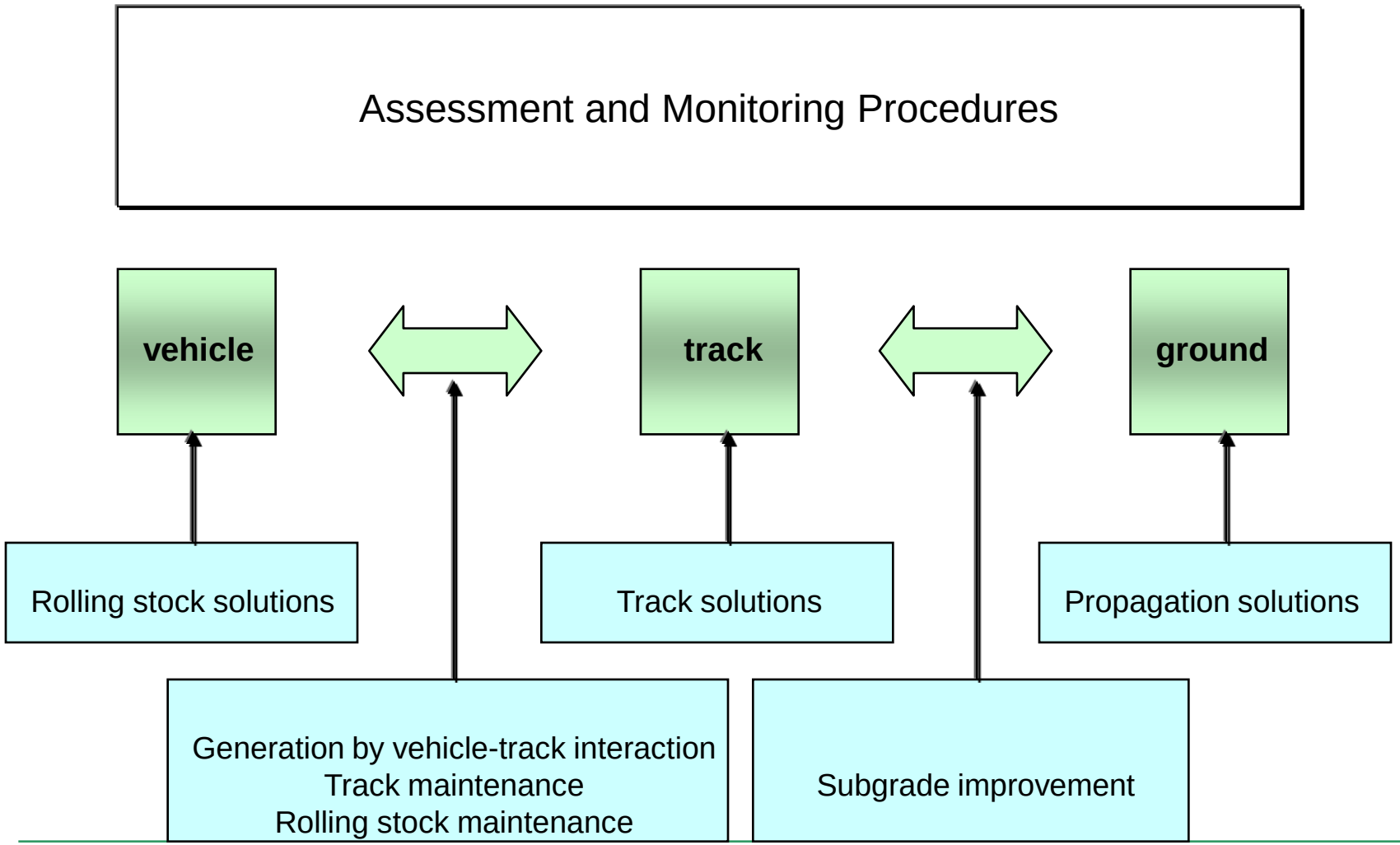




Stiffening under track



Wave impeding block


Assessment and Monitoring Procedures
vehicle
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Rolling stock solutions
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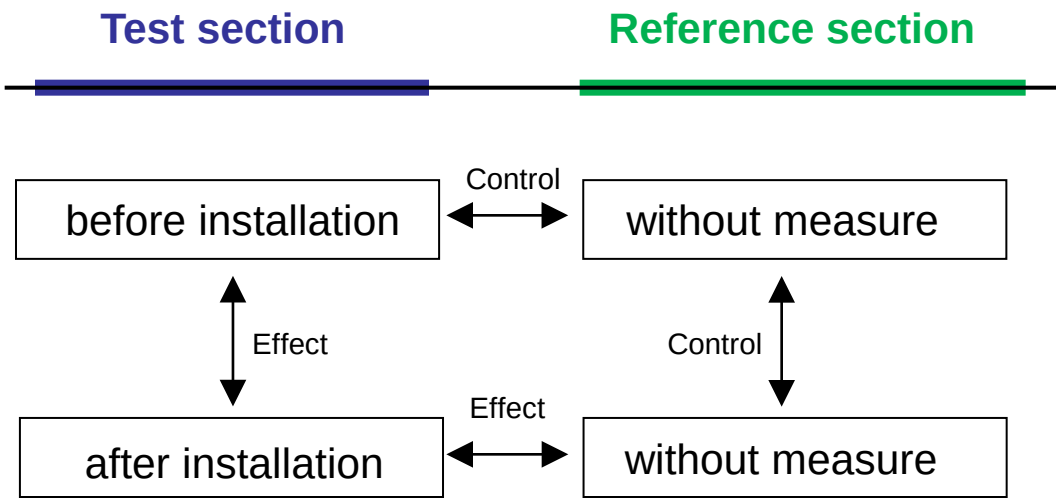
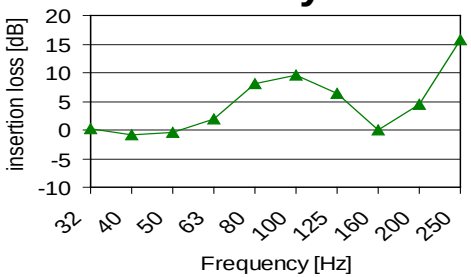
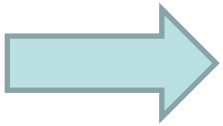
Rolling stock maintenance
Subgrade improvement



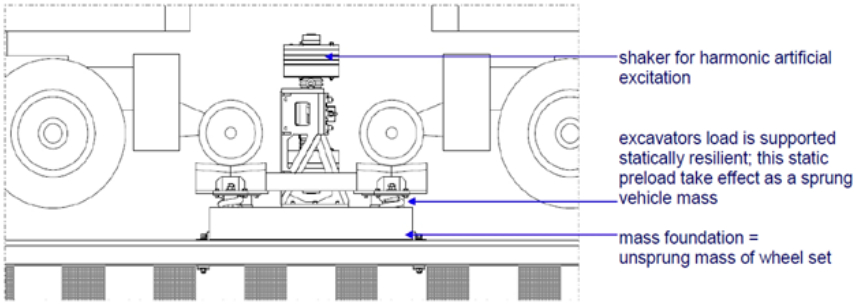
Efficiency





Costs (CBA/LCC) **Description of annoyance**

Efficient test procedure ➔ artificial excitation



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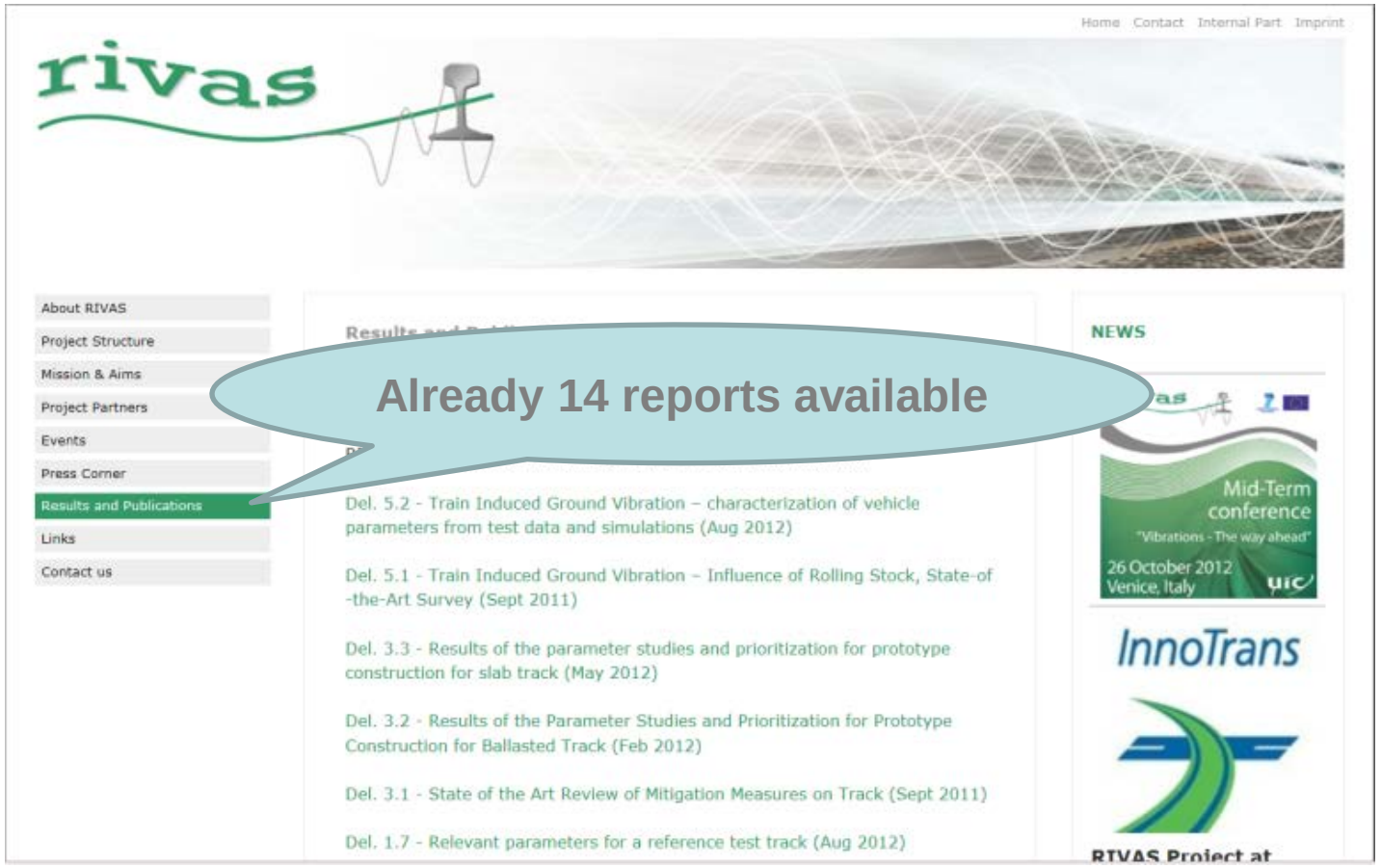

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