# THE LOW-NOISE POTENTIAL OF LOW-VIBRATION TRACK

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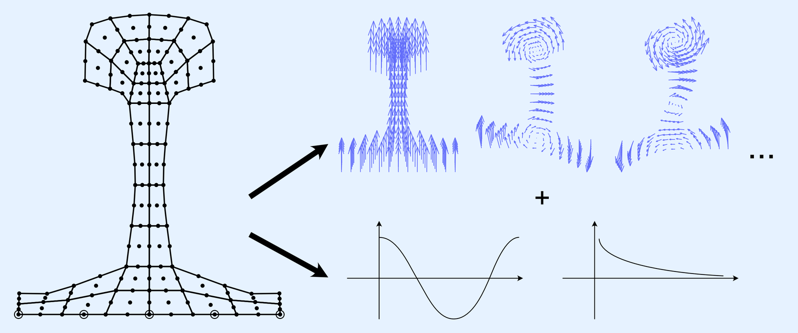
## INTRODUCTION

- Low-vibration track (LVT) is a non-ballasted (slab) track developed for reducing ground vibrations
- Vibration and noise are excited by wheel and rail roughness in rolling contact
- Slab tracks produce higher rolling noise than ballasted tracks
- Why? Lower rail pad stiffness in slab tracks → decoupling of the rail
- LVT has a two-stage elastic support → allows tuning involved elasticities

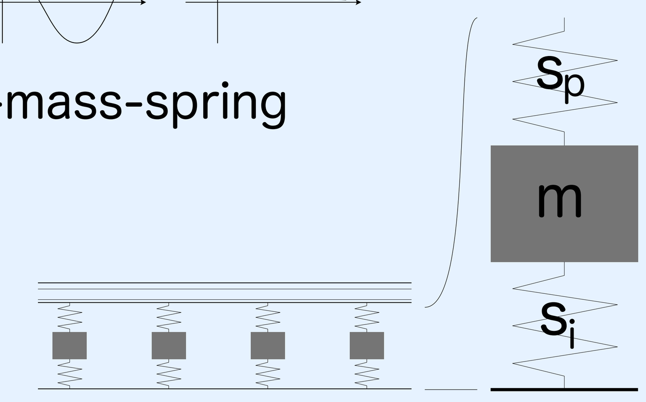
Can we tune the two elasticities to preserve low ground vibration and reduce radiated airborne noise?

## METHODS

- Track decay rate (TDR) is noise indicator
- Higher decay → shorter rail section radiates
- Rail modeled as infinite waveguide (WFEM)



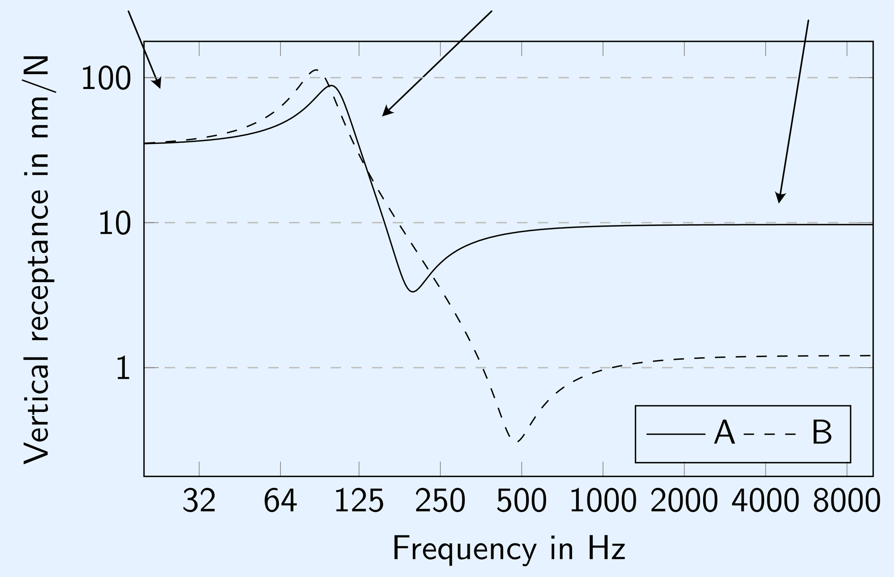
- WFEM coupled to spring-mass-spring system at each rail seat

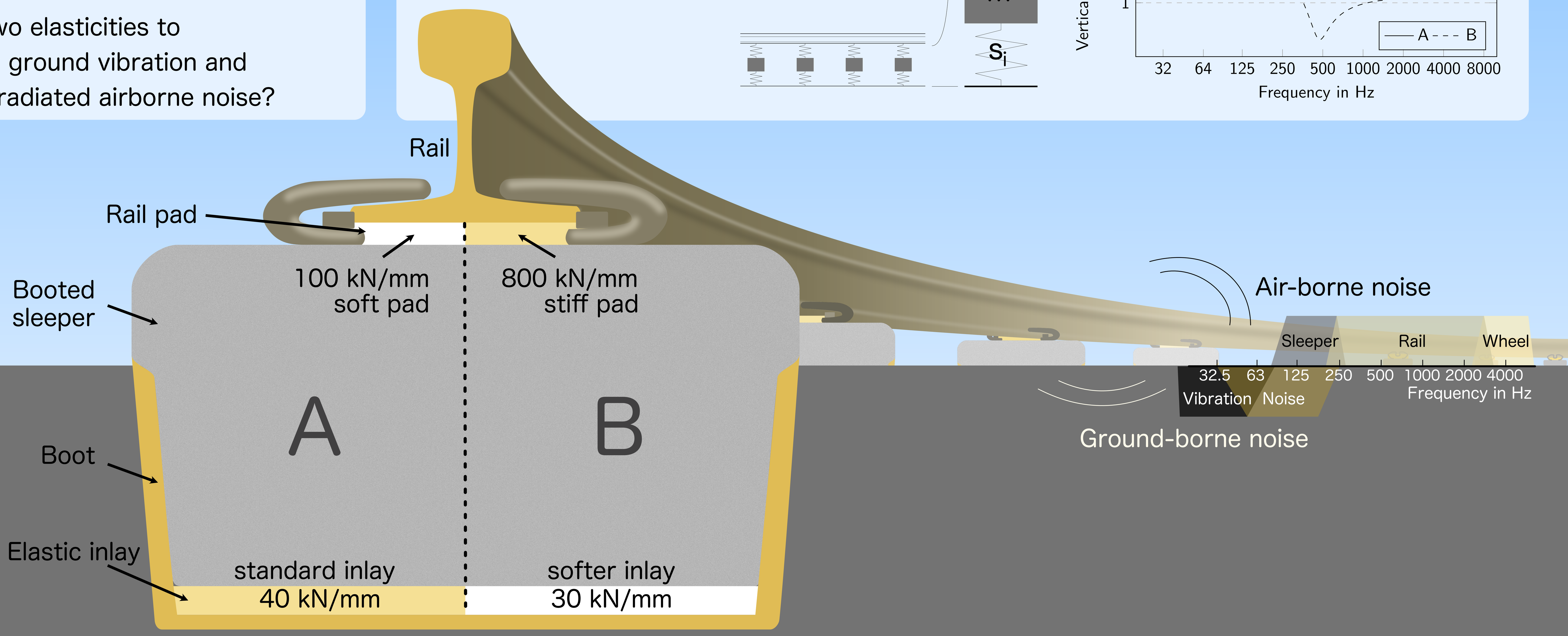



- Receptance R under the rail foot is modeled as

$$R = \frac{1}{s_i - \omega^2 m} + \frac{1}{s_p}$$

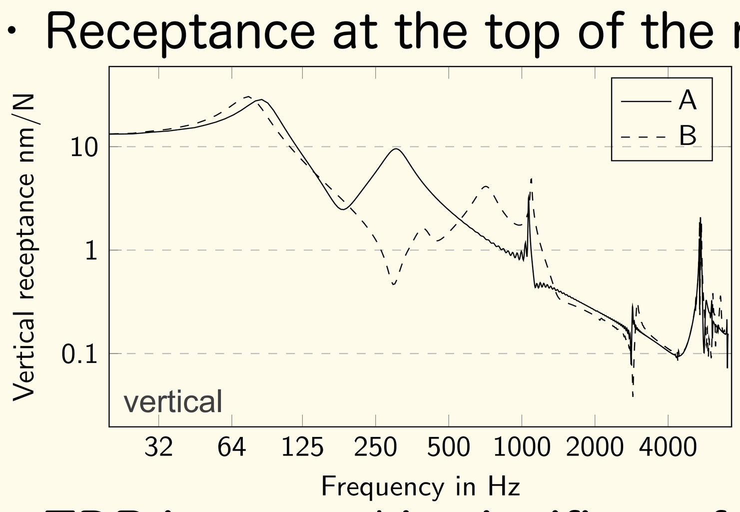
Inlay stiffness; Sleeper mass; Rail pad stiffness

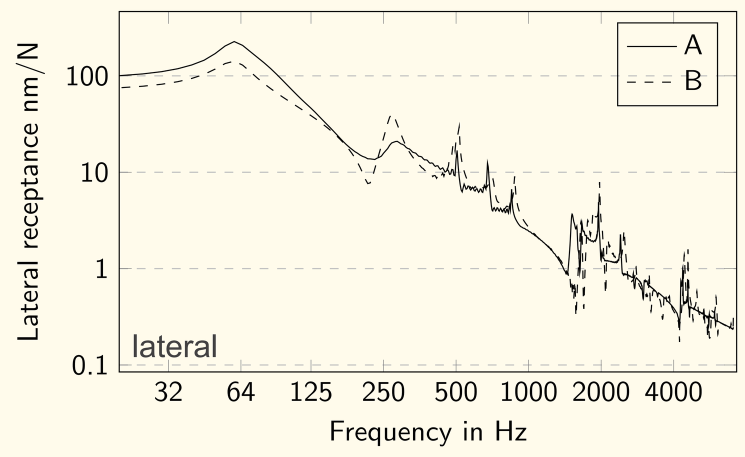


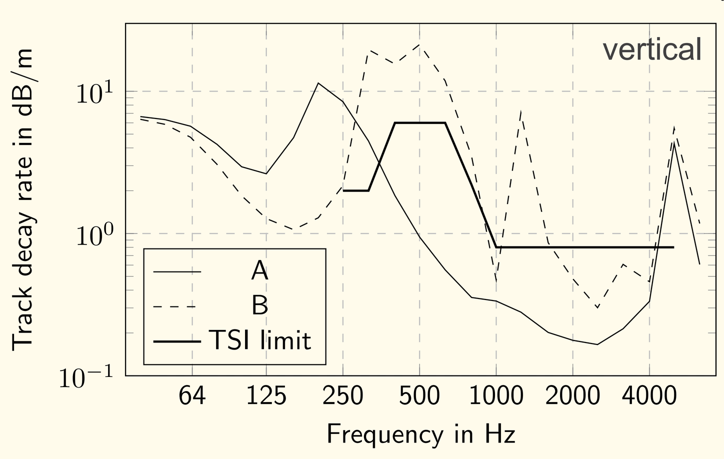

## RESULTS

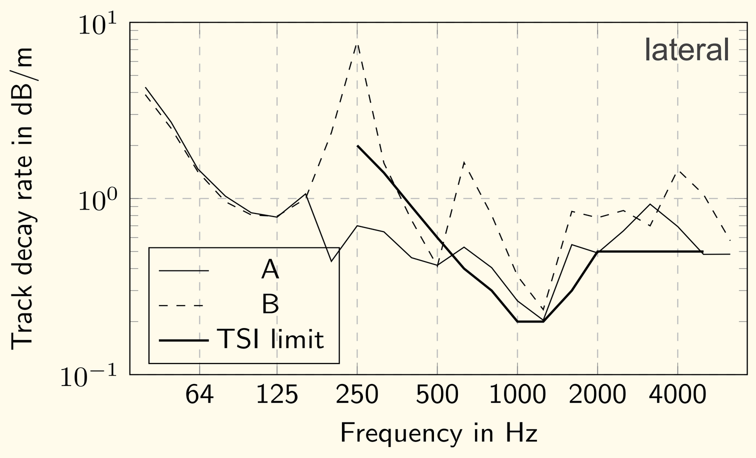
- Receptance at the top of the rail is maintained below 100 Hz



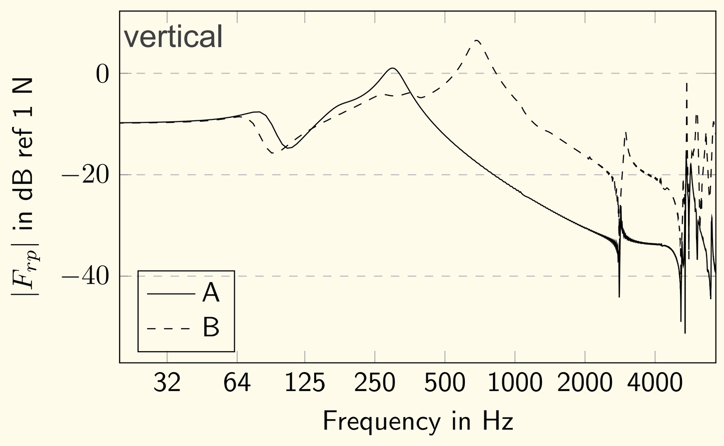




- TDR increased in significant frequency range
- Fulfills the TSI limit in more 1/3 oct bands




- Increased forces on the rail seats and sleepers




The increased TDR between 250 Hz and 2000 Hz indicates a lower sound radiation from the track.
The stronger coupling between the rail and the sleeper leads to higher forces on the sleeper and indirectly on the wheel-rail contact.

## DISCUSSION

- Soft suspension at low frequencies maintained
- Increasing pad stiffness is known to reduce radiated noise from track
- Problem: increasing contact forces → higher chance of corrugation → noise
- Possibly higher costs for rail grinding
- However, comparatively low investment costs compared to noise barriers, etc.
- Could be used on tracks where other noise reduction methods are unfeasible
- Further research: quantifying sound pressure difference and comparing to actual measurements in cooperation with SBB

## CONCLUSIONS

- Developed a model for predicting TDR on LVT
- Increasing rail pad stiffness and compensating by decreasing inlay stiffness → higher TDR in relevant frequency range while maintaining soft response at low frequencies
- Further investigation into the effect of increased contact forces recommended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The current study is part of the ongoing activities in CHARMEC – Chalmers Railway Mechanics (charmec.chalmers.se)
Parts of the study have been funded from the European Union's Horizon 2020 research and innovation programme in the In2Track3 project under grant agreements No 101012456. The computations were performed on resources provided by the Swedish National Infrastructure for Computing (SNIC) at HPC2N. The valuable support from SBB is kindly acknowledged.



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DAGA 2021 Wien