

Vehicle influence on interior and exterior noise

Anders Frid

Bombardier Transportation



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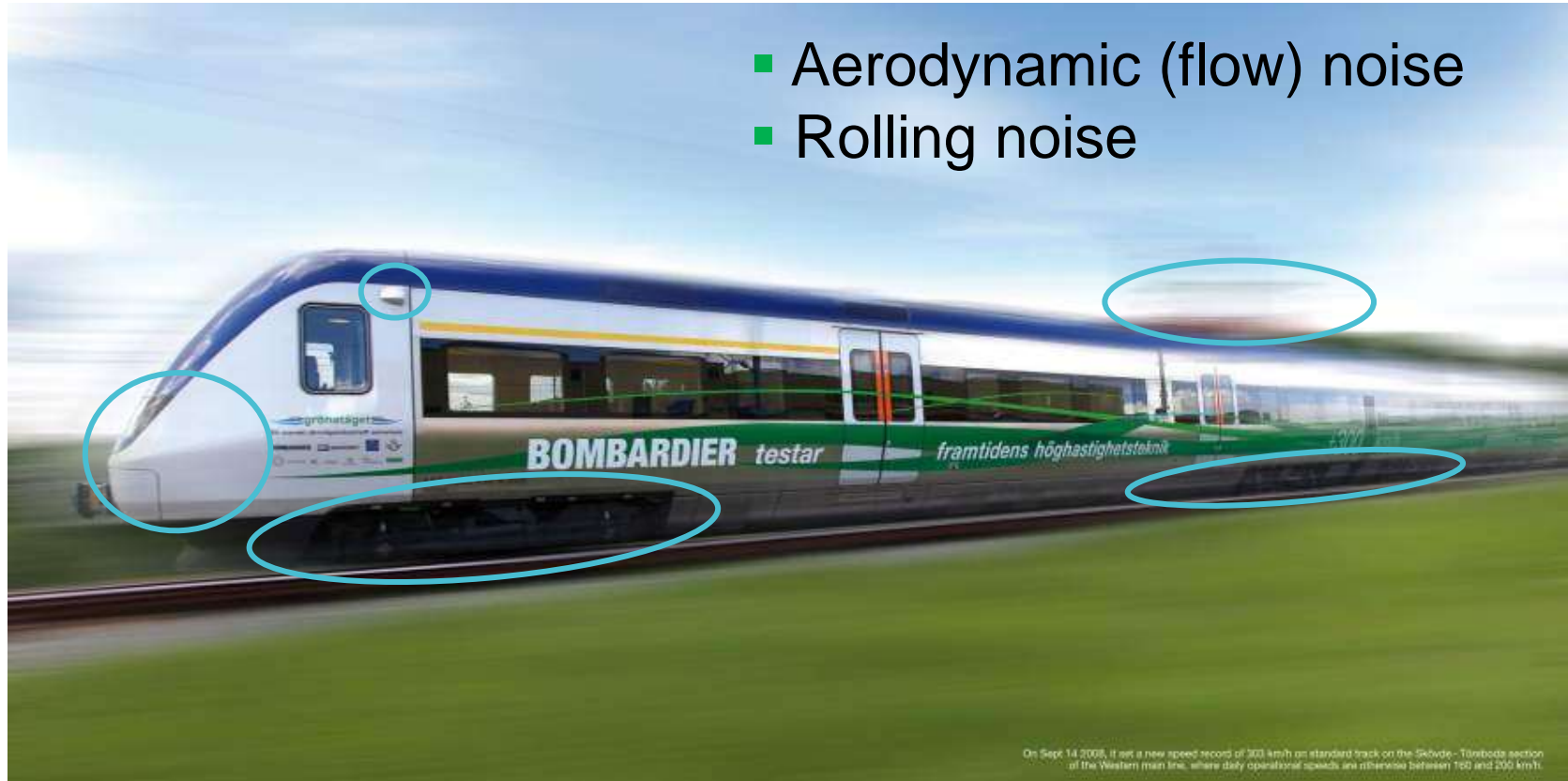


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Main noise sources at 250 km/h

- Aerodynamic (flow) noise
- Rolling noise



Rolling noise reduction

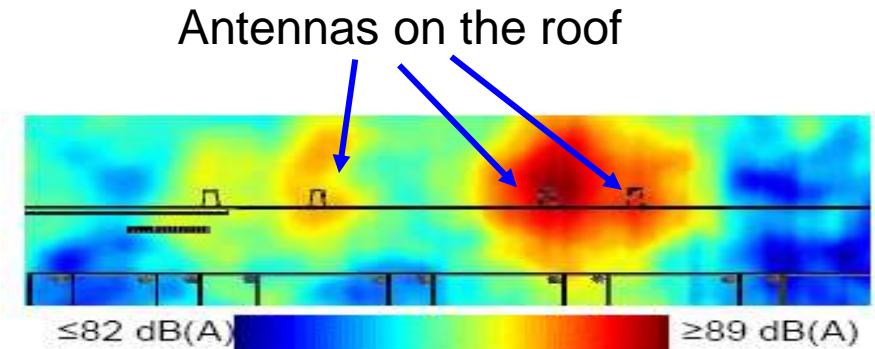
- Smooth running surfaces on rails and wheels
- Typically the track contribution exceeds vehicle contribution
- Vehicle based measures
 - Low noise wheel design
 - Wheel noise absorbers

Not investigated in the Gröna Tåget programme

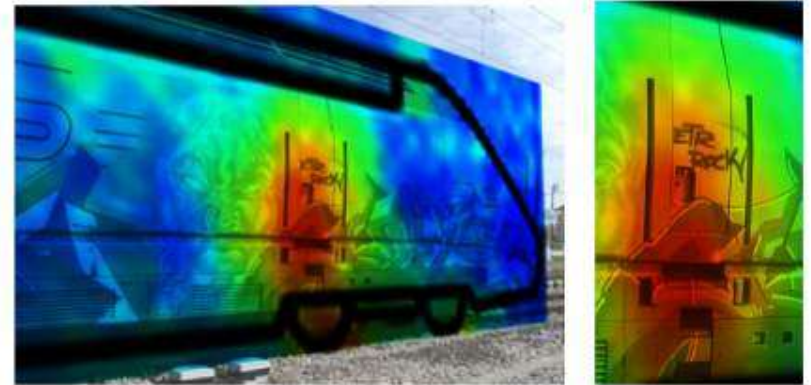


Aerodynamic noise reduction

- Smooth surfaces including closure of inter-car gaps
- Careful design of train front
- Careful design and integration of pantograph and other roof equipment
- **Bogie skirts**, in particular on leading bogie

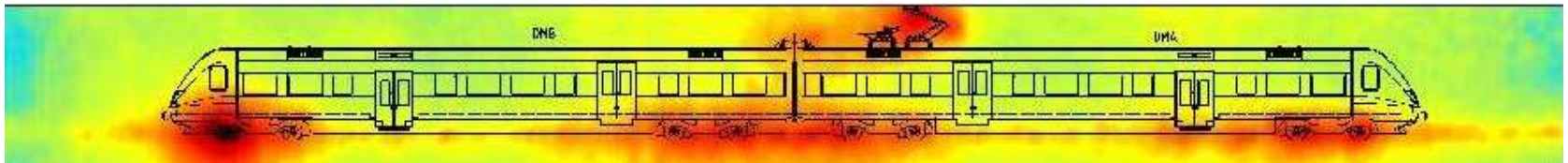


Handrails and footsteps



Source identification - mic array

- “Acoustic camera”
- 96 microphones
- Pantograph
- Leading bogie
- Wheel-rail

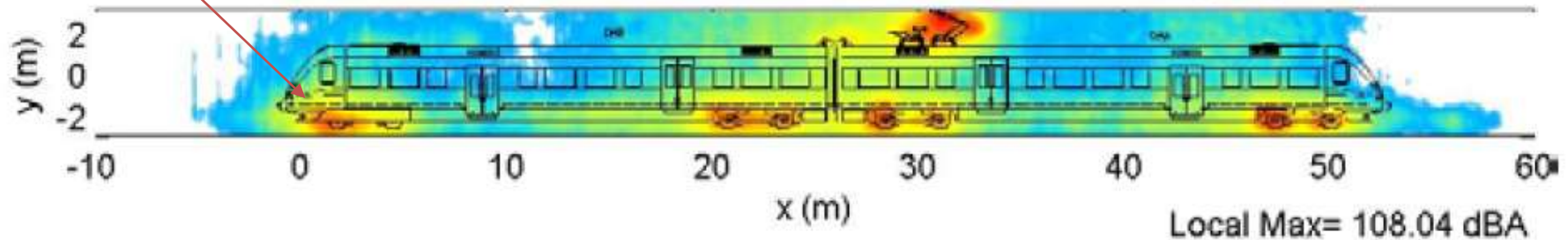


Results from mic array

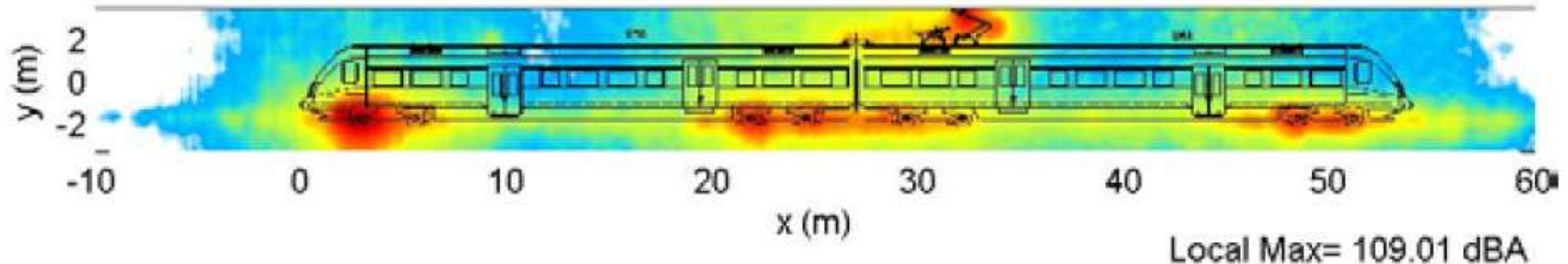
275 km/h (w and w/o bogie skirt on leading bogie)

-5 dB

<- 275km/h R503 - Sum of 12 bands: 250Hz->3150Hz - W3 [-2 2]m



<- 275km/h R706 - Sum of 12 bands: 250Hz->3150Hz - W3 [-2 2]m



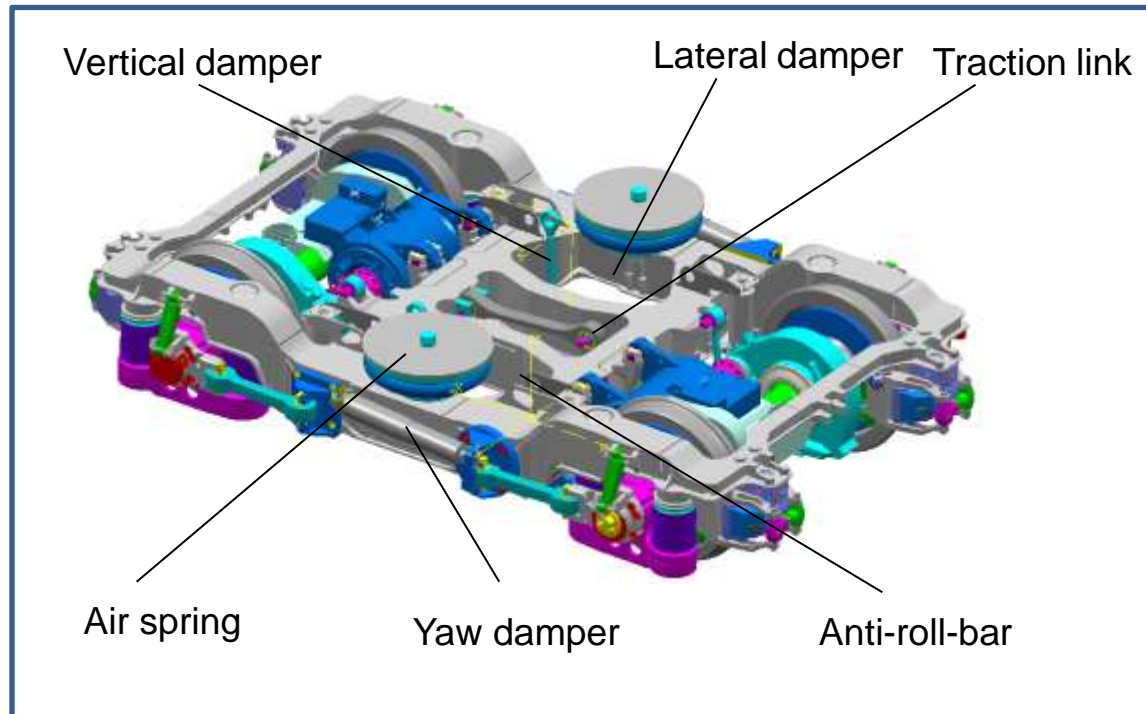
Bogie skirt

- Reduced aerodynamic noise from leading bogie cut-out
- Shielding of bogie generated noise
- Difficult to put bogie skirts on existing trains due to gauge limits – an option only for new train designs
- Considerable noise reduction for exterior noise - no interior noise increase noticed



Interior noise

- Identification and ranking of structure-borne noise transmission paths
- Influence of
 - *Soft bushings*
 - *Mechatronic bogie*
 - Bogie skirts
 - PM traction motor



Transmission path analysis

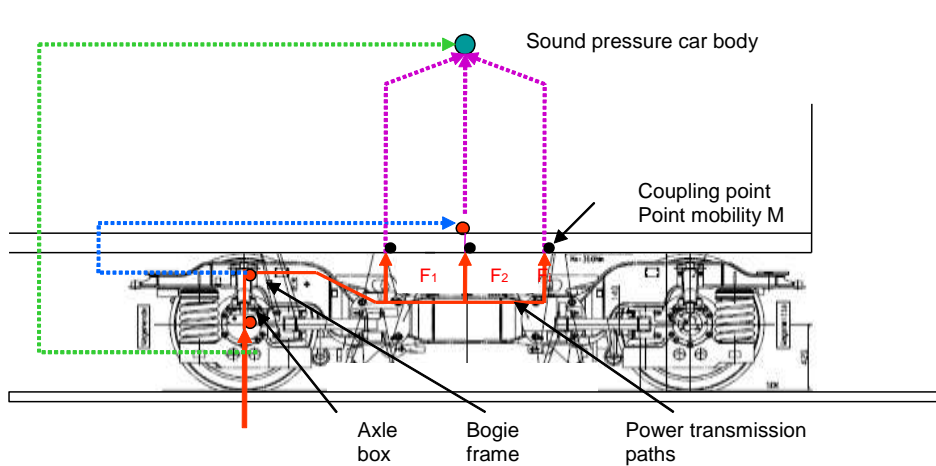
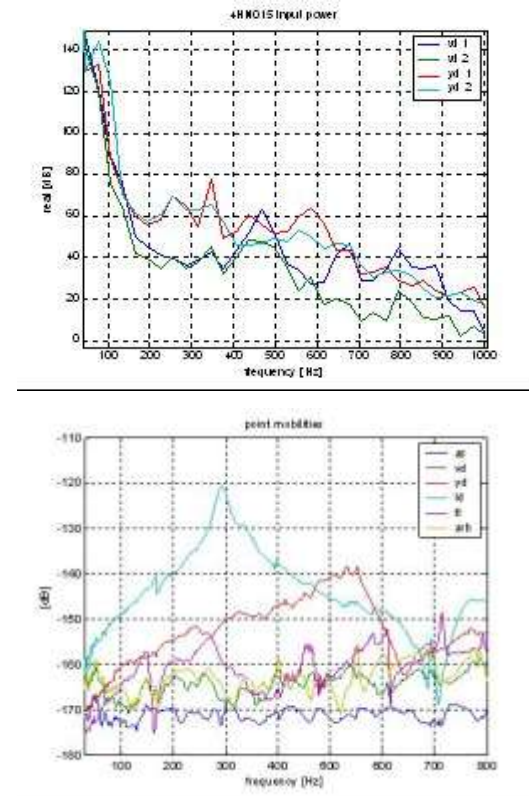


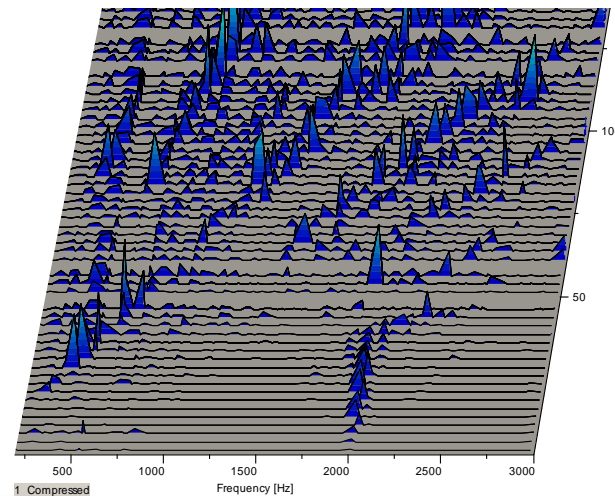
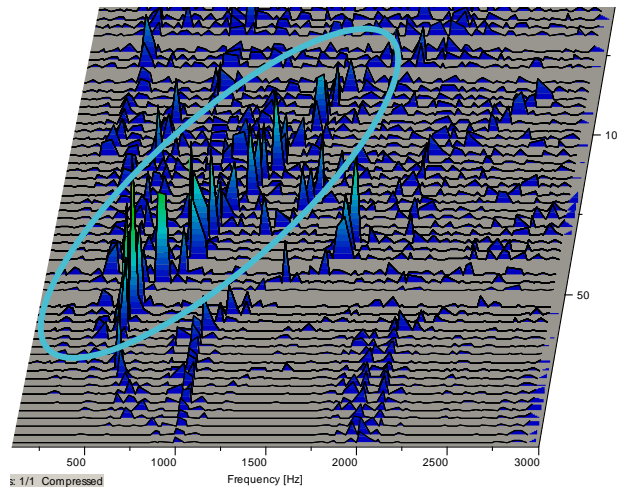
Figure 5.2.3: Analysis of the transmission behaviour of the bogie

- Dominating paths
 - Yaw damper
 - Vertical damper



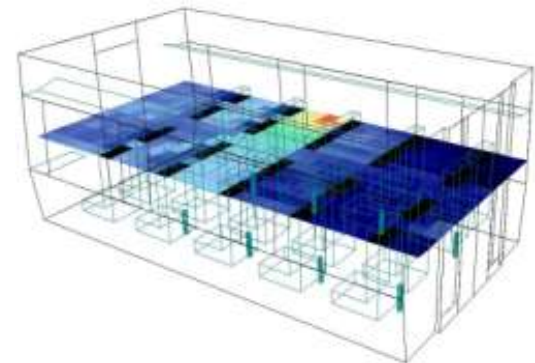
Influence of PM motor

- Traction motor noise is relevant only for interior noise
- Negligible contribution at high train speeds
- The PM motor tends to be quieter than conventional asynchronous motors in speed interval 0-70 km/h (see spectrograms below)



Future scenarios

- More relevant to speak about **sound quality** than dBAs to describe the interior sound comfort
- No benefit to go below 65 dBA for future limit settings
- Balance between privacy and conversation intelligibility of importance
- Possibly use artificial masking sound





Thank You!

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