Alstom's Wheel Rail Interface Study

How to determine optimal wheel profile for wheels & rails life optimization and reduction of noise

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Agenda

- Background
- Process
- Benefits

Wheel/Rail-Interface Study (WRIS®)

Background

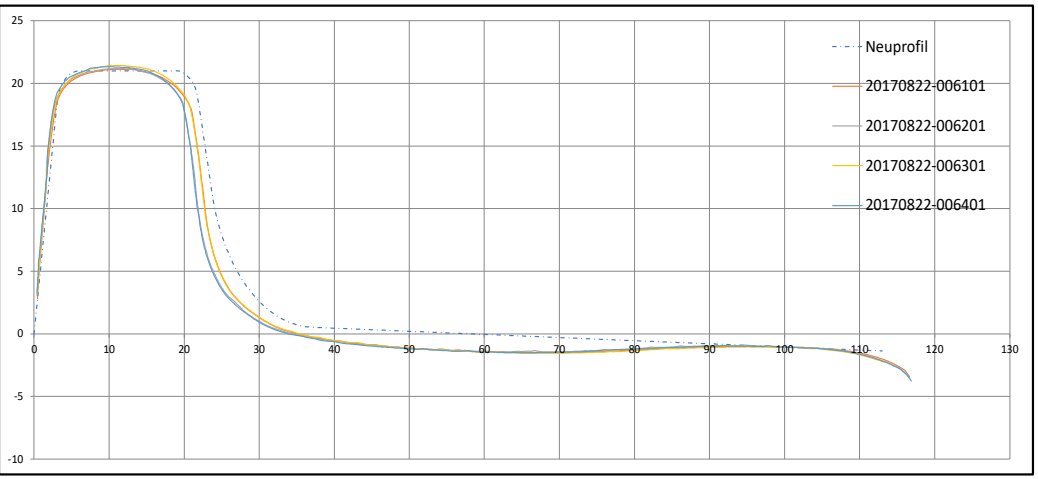
- A lot of railway operators are facing issues with excessive wear and noise
- They spend a lot of money to fight against the symptoms of this unwanted behavior instead of removing the source: a bad wheel/rail-interface
  - "Never change a running system"
- Solution: The Wheel/Rail-Interface Study (WRIS®), developed by Railway Dynamics Department in Siegen, Germany (>10 years)
- Over 30 customers worldwide

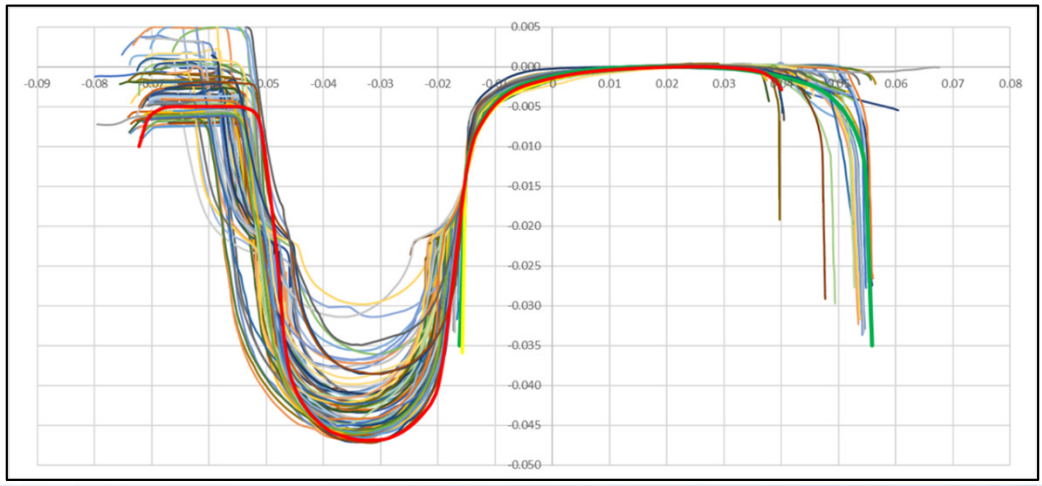
THE PROCESS

Recording and Analyzing the Situation

The initial analysis of the individual customers situation covers

- Measurements of the existing wheel and rail profiles

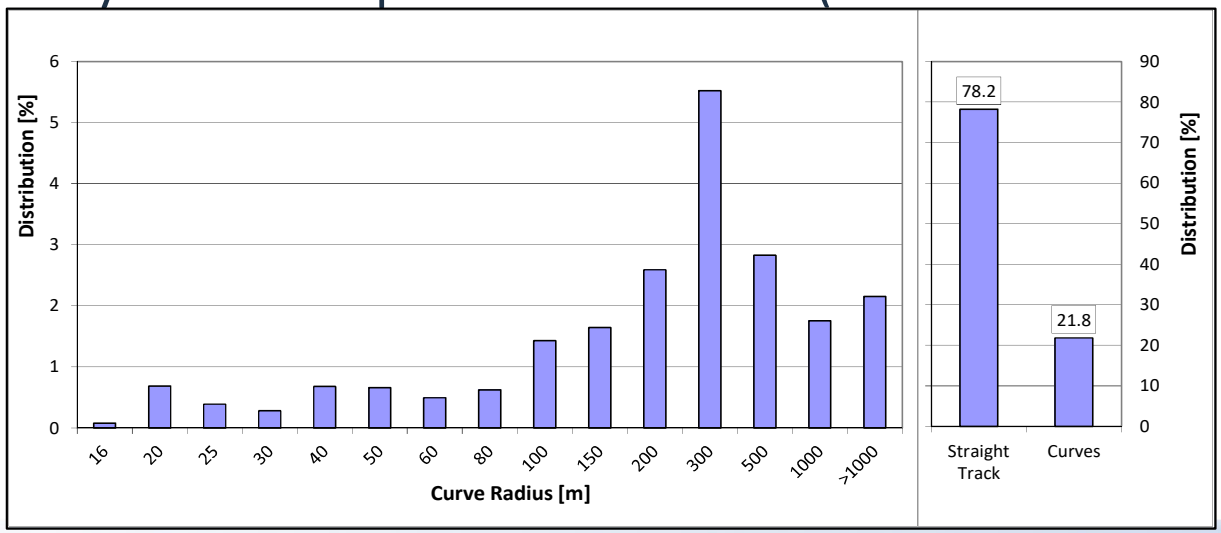




Recording and Analyzing the Situation

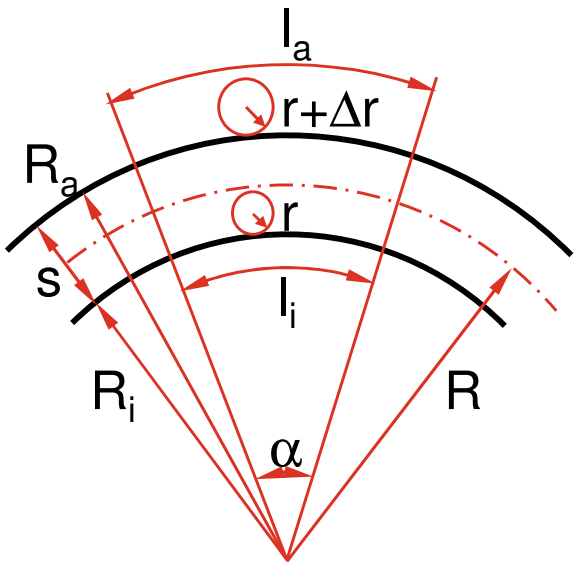
The initial analysis of the individual customers situation covers

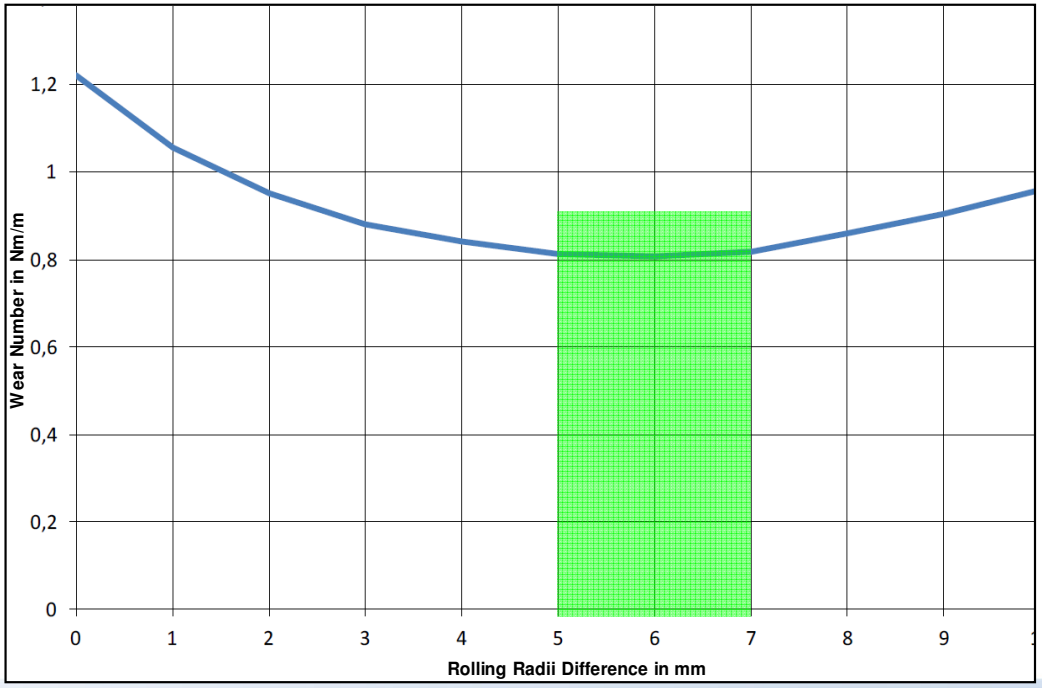
- Measurements of the existing wheel and rail profiles
- Rail track analysis in the operator's network (curve distribution, gauge, …)



Development of an optimized Wheel Profile (Wheelset)

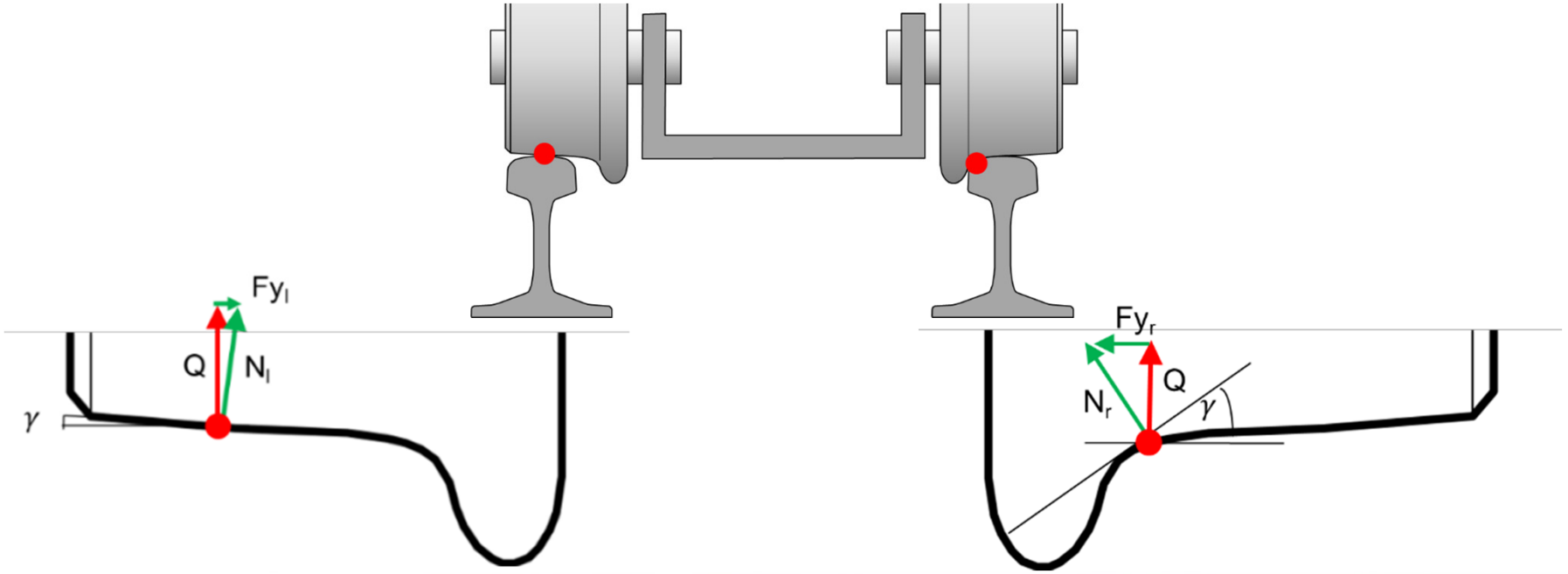
- Determination of an optimized rolling radii difference





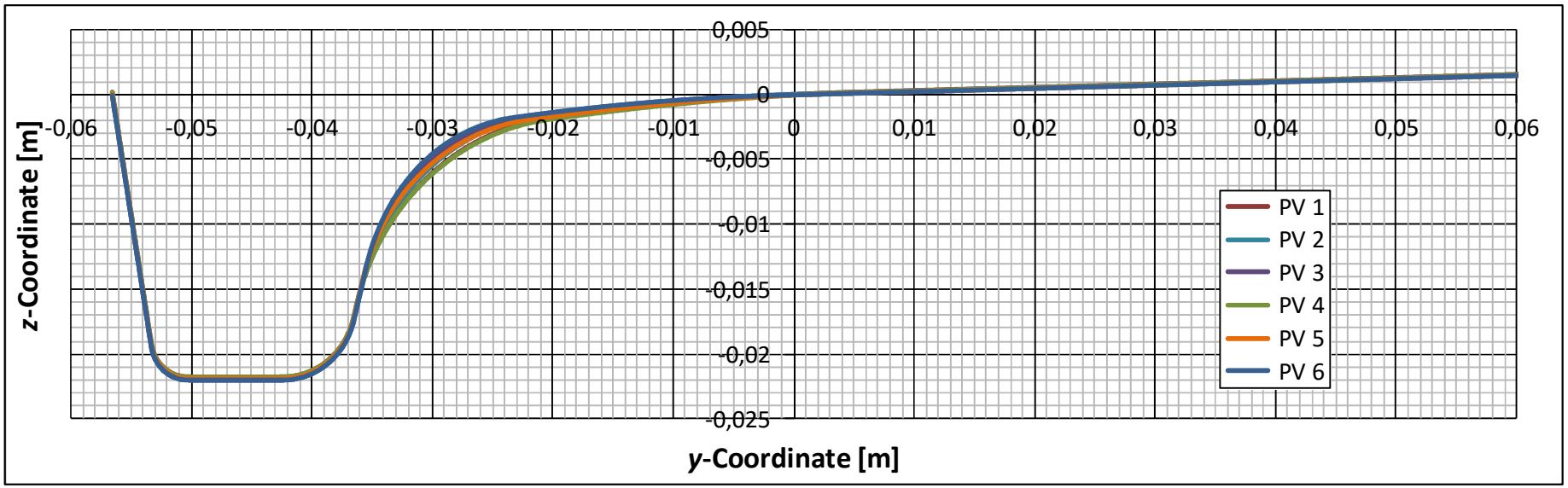
Development of an optimized Wheel Profile (Independent Wheels)

- Determination of contact angle difference



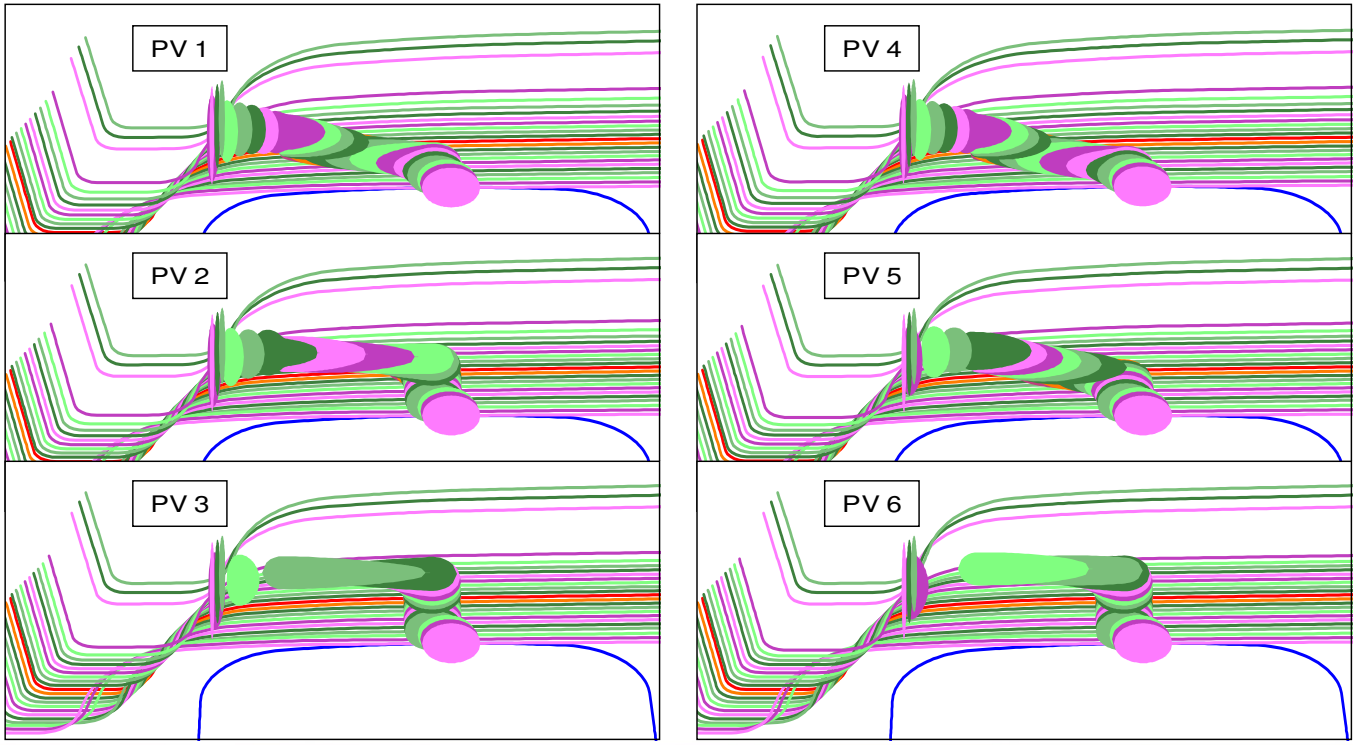
Development of an optimized Wheel Profile

- Recommendation for Standard rail profile(s)
- Development of new wheel profile(s)



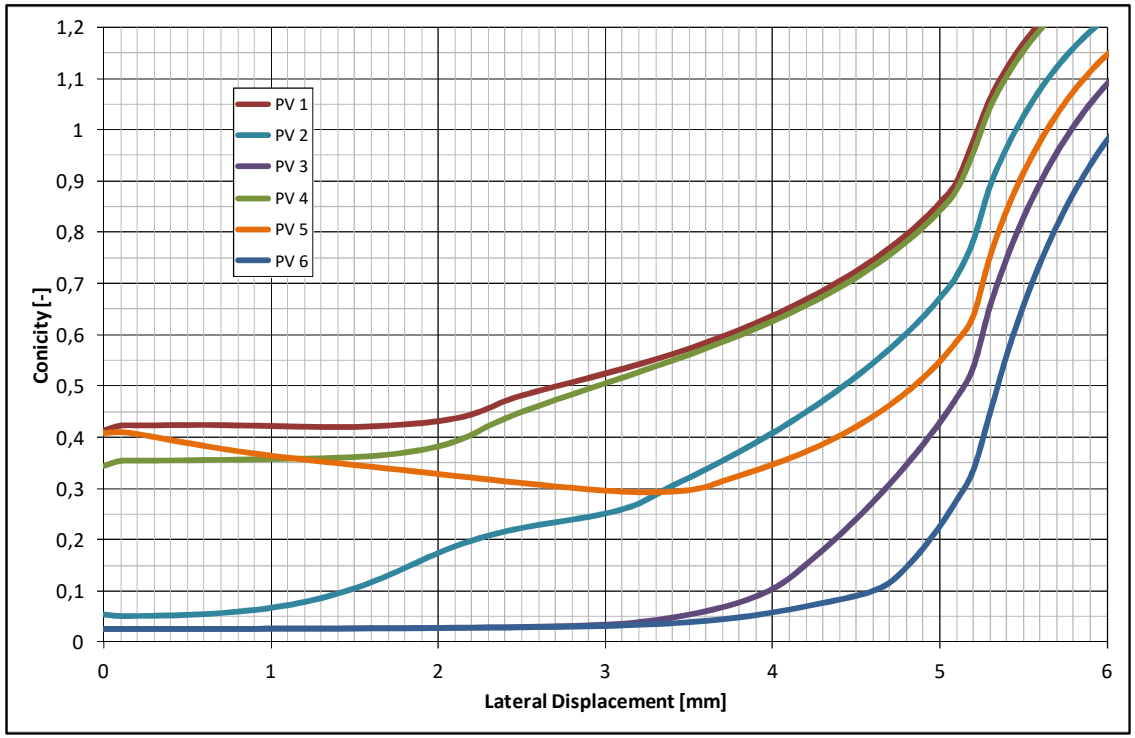
Development of an optimized Wheel Profile

- Select appropriate wheel profile(s) for the entire fleet regarding:
  - Contact point distribution



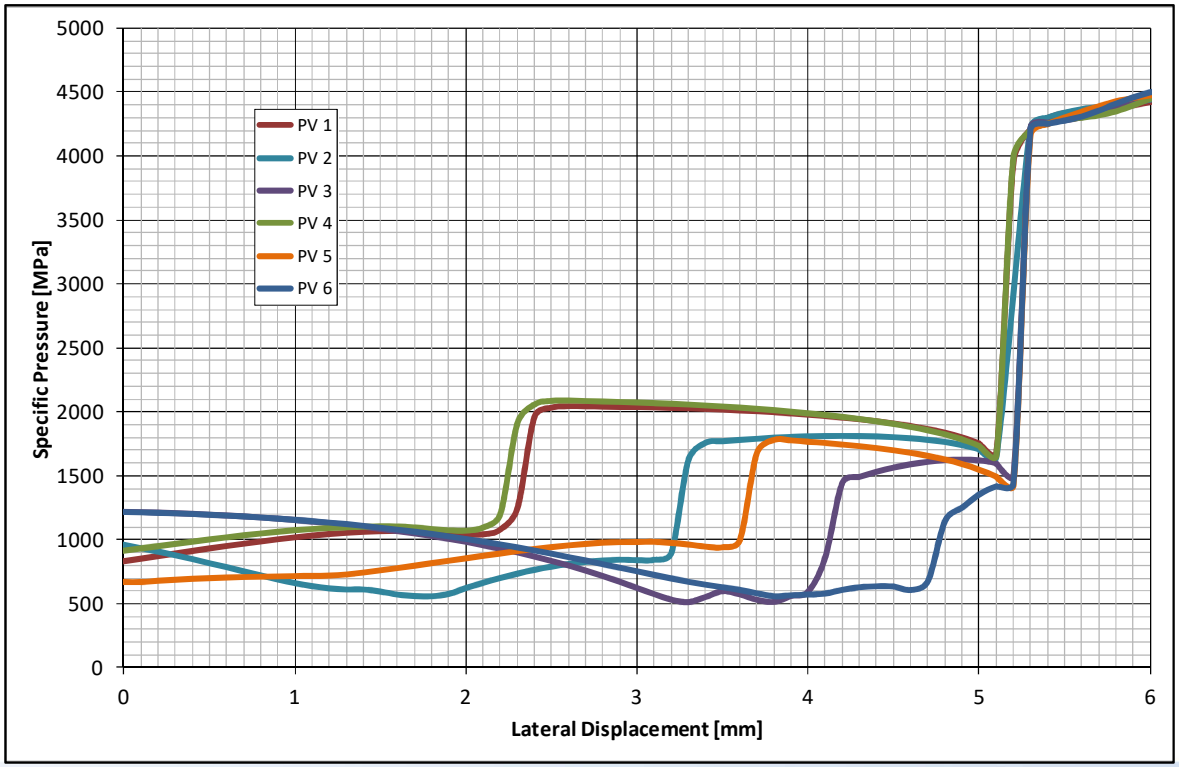
Development of an optimized Wheel Profile

- Select appropriate wheel profile(s) for the entire fleet regarding:
  - Contact point distribution
  - Conicity



Development of an optimized Wheel Profile

- Select appropriate wheel profile(s) for the entire fleet regarding:
  - Contact point distribution
  - Conicity
  - Specific Pressure

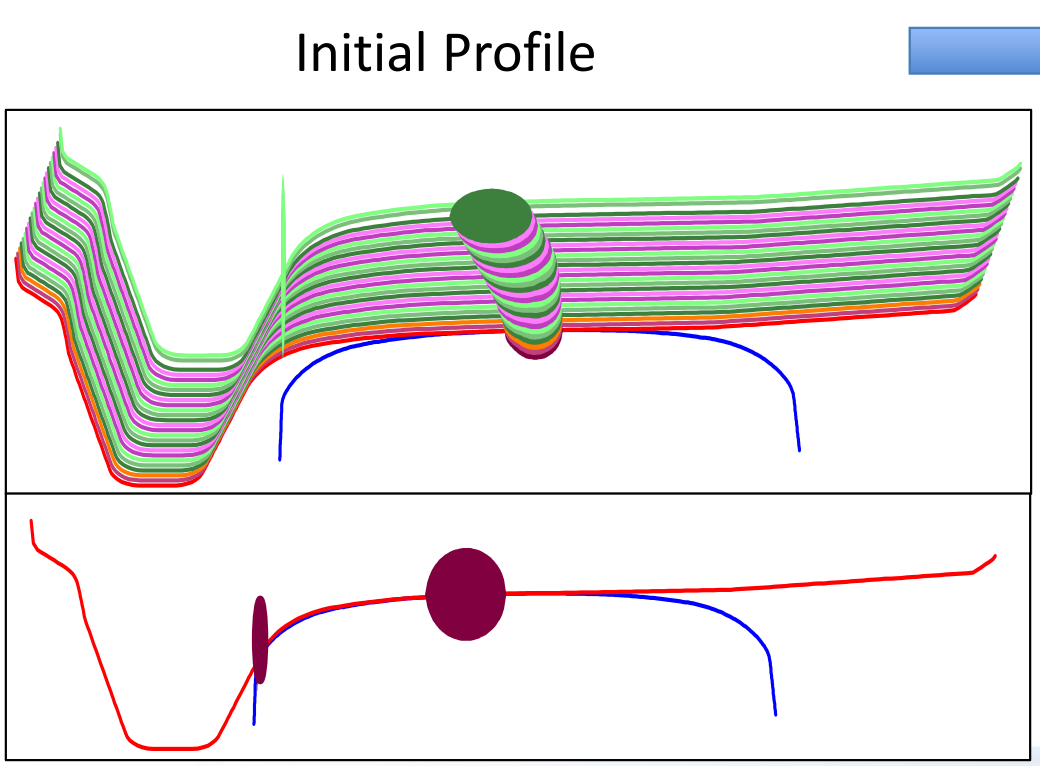


Development of an optimized Wheel Profile

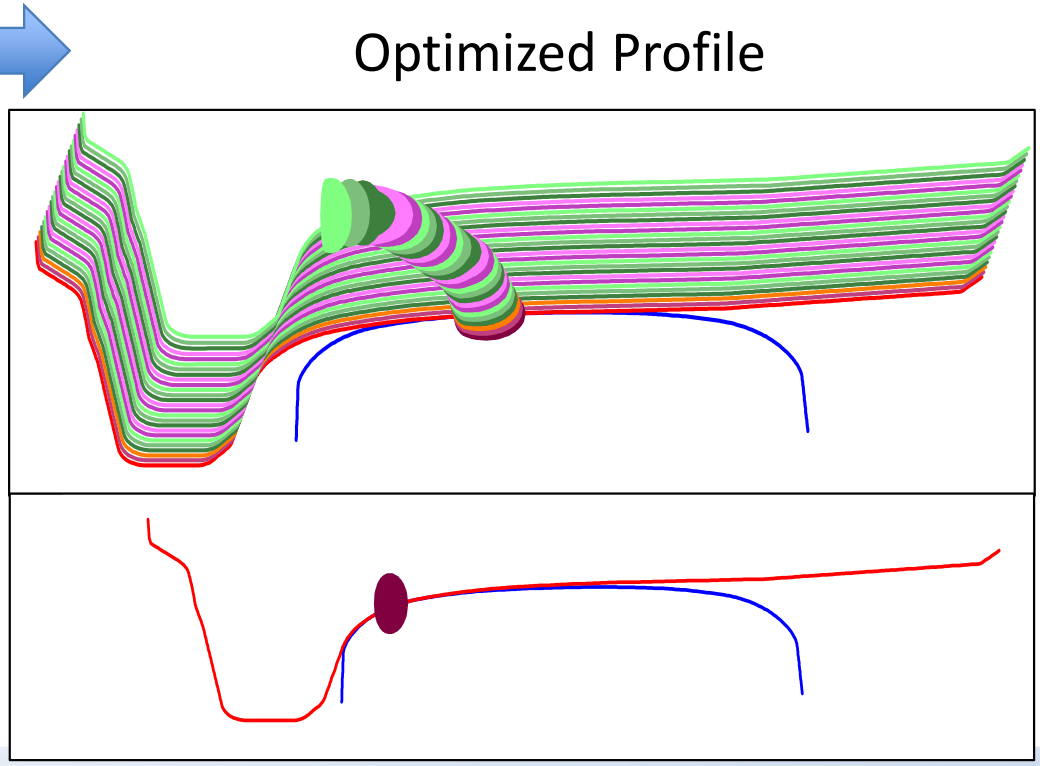
- Select appropriate wheel profile(s) for the entire fleet regarding:
  - Contact point distribution
  - Conicity
  - Specific Pressure
  - Rolling Contact Fatigue (RCF)
  - Track guidance

Development of an optimized Wheel Profile

Initial Profile

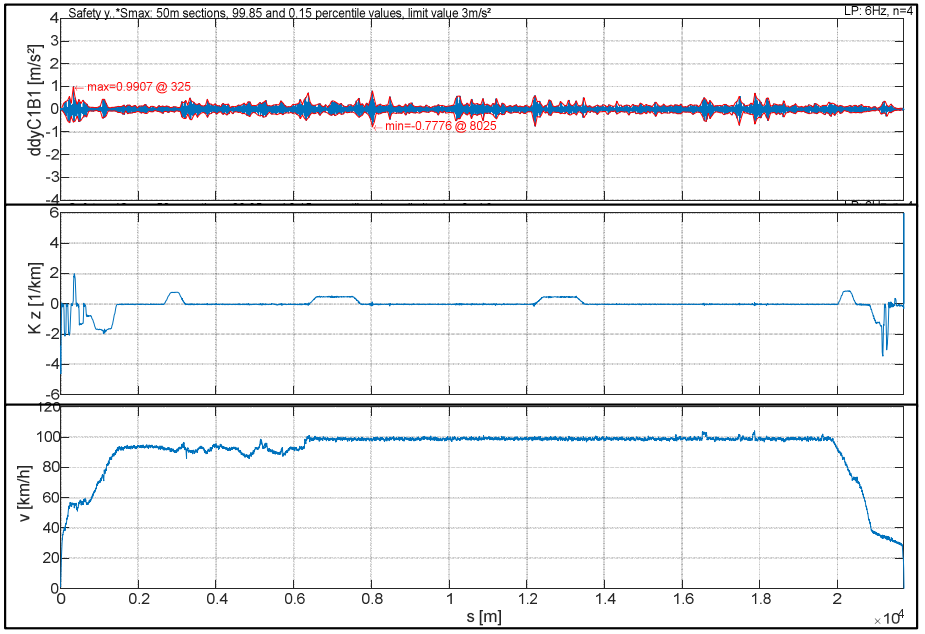


Optimized Profile



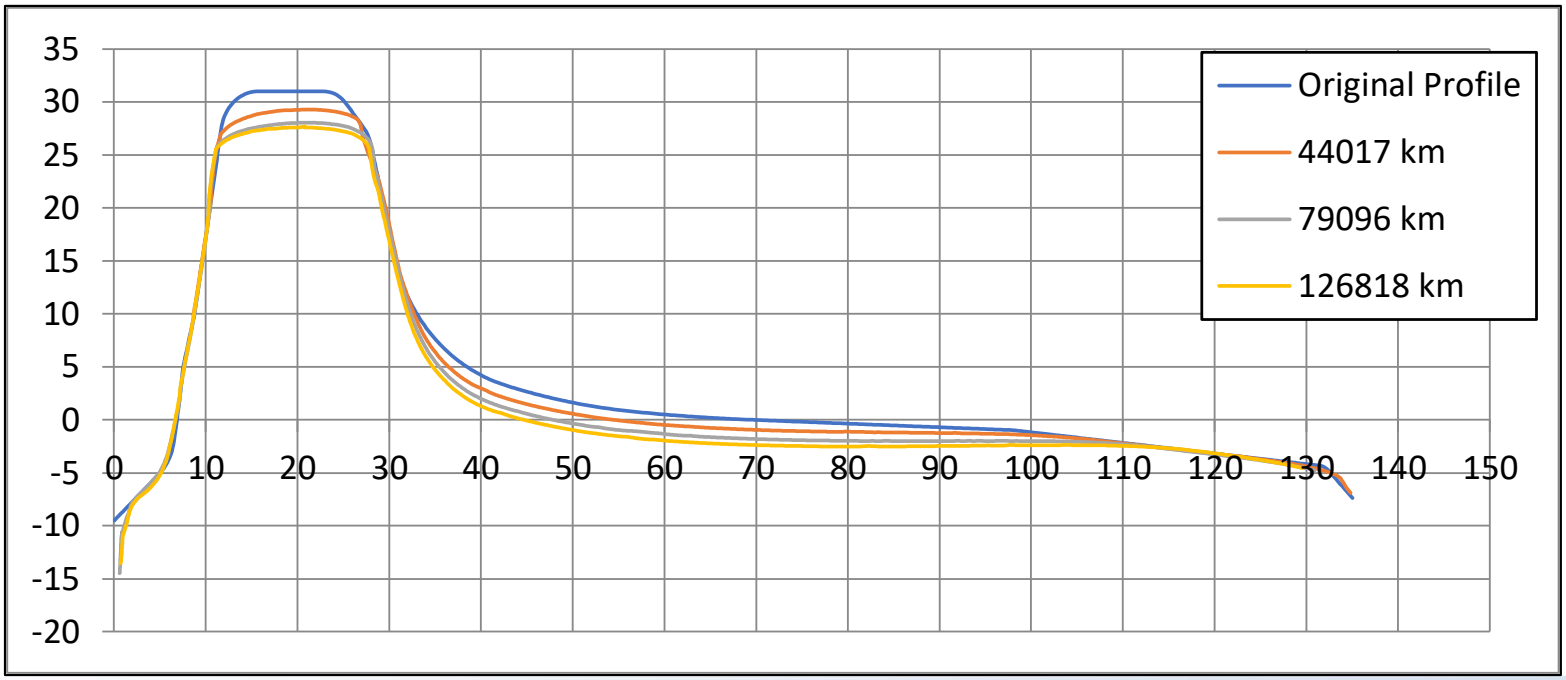
Validation of new Wheel Profile(s) in Operation

- Dynamic on-track measurements to ensure performance with optimized wheel profile
  - Ride comfort
  - Hunting
  - …



Validation of new Wheel Profile(s) in Operation

- Regular wheel and rail profile measurements after implementation



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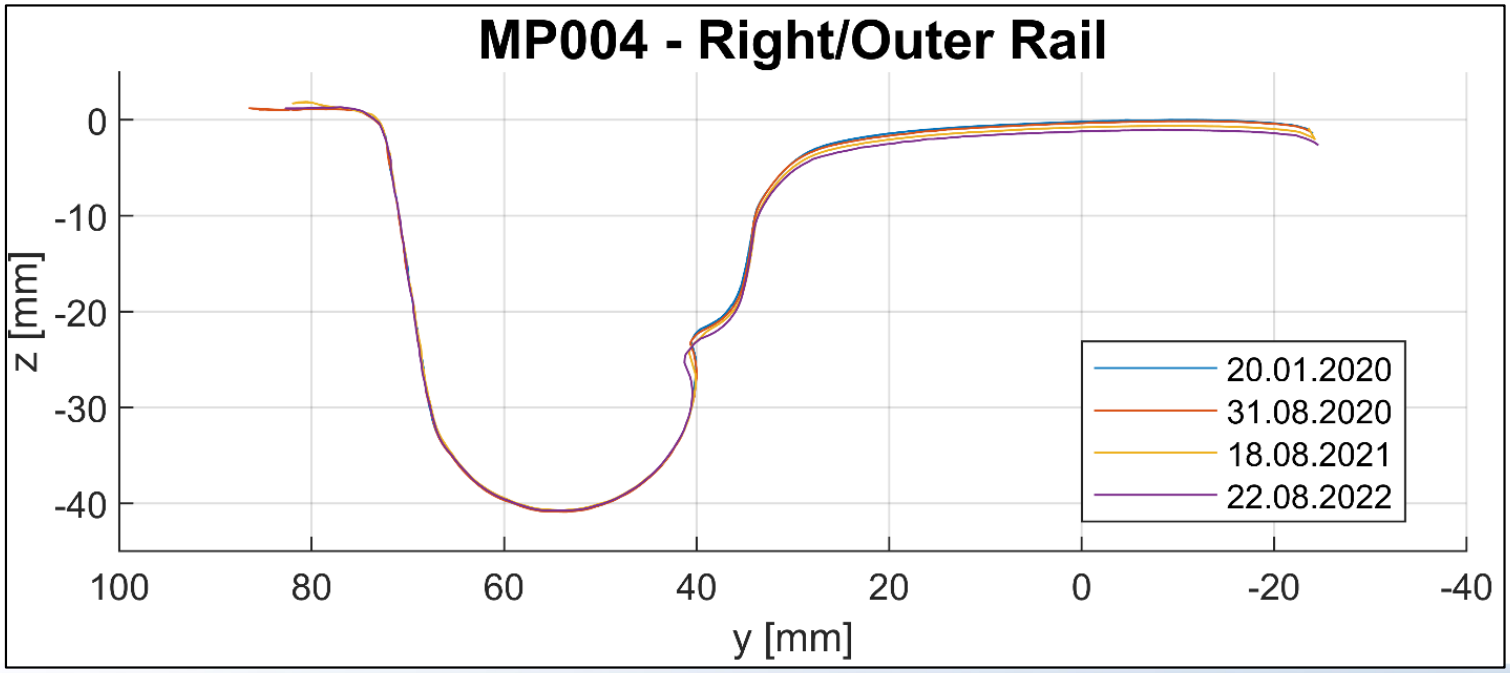
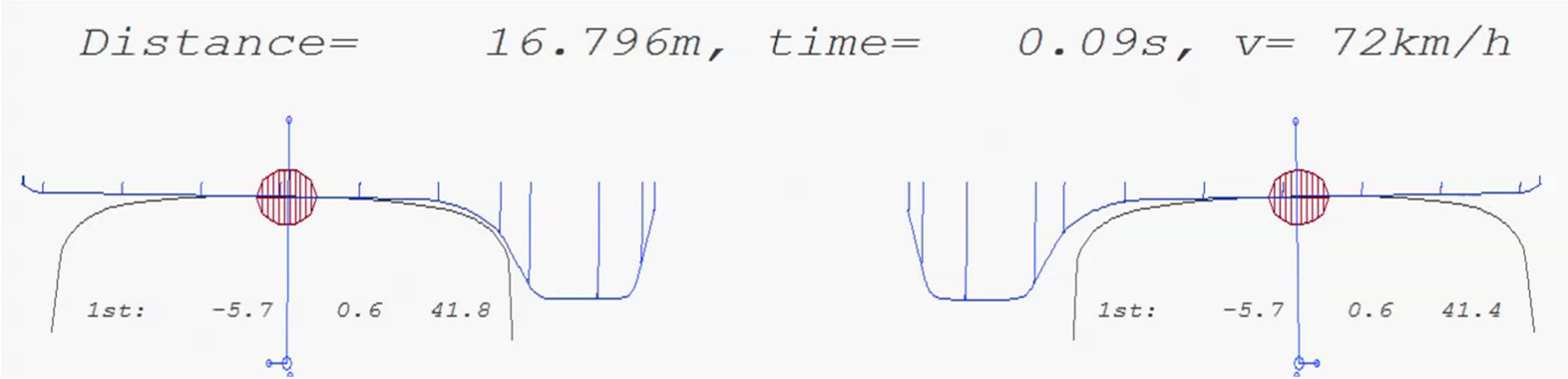


ADDITIONAL TASK / SUPPORT

Wear Simulations with the Help of MBS Simulation

- Wear development of optimized wheel profile in advance
- Origin of corrugation due to two-point contact (R=500m)



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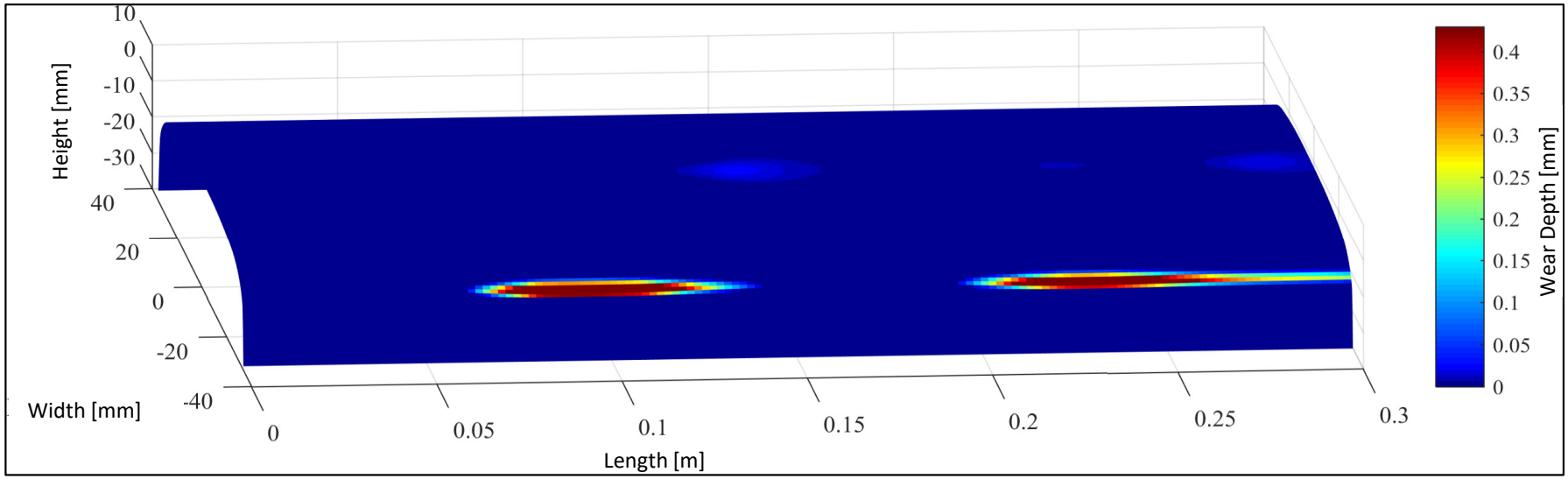
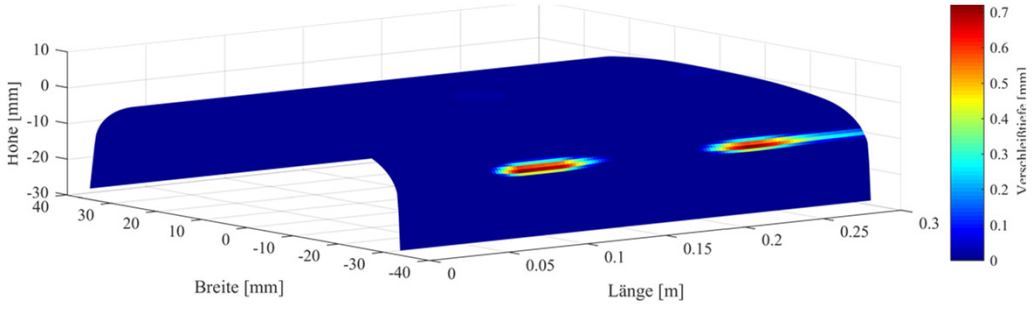


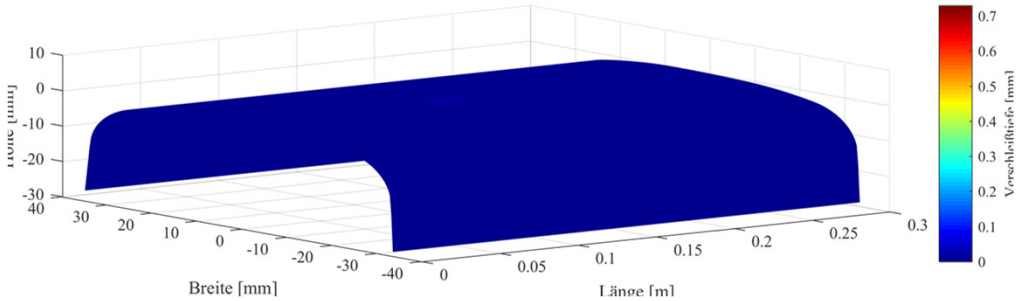
Wear Simulations with the Help of MBS Simulation

- Wear development of optimized wheel profile can be predicted in advance
- Origin of corrugation due to two-point contact (R=500m)

Initial wheel profile

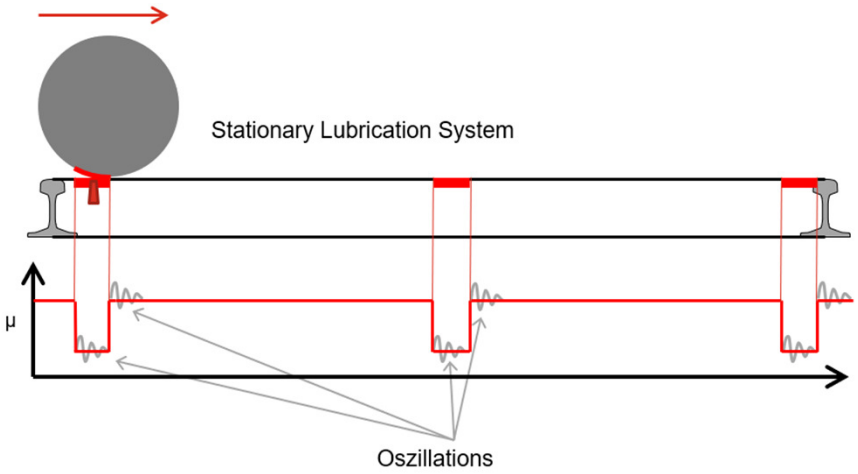


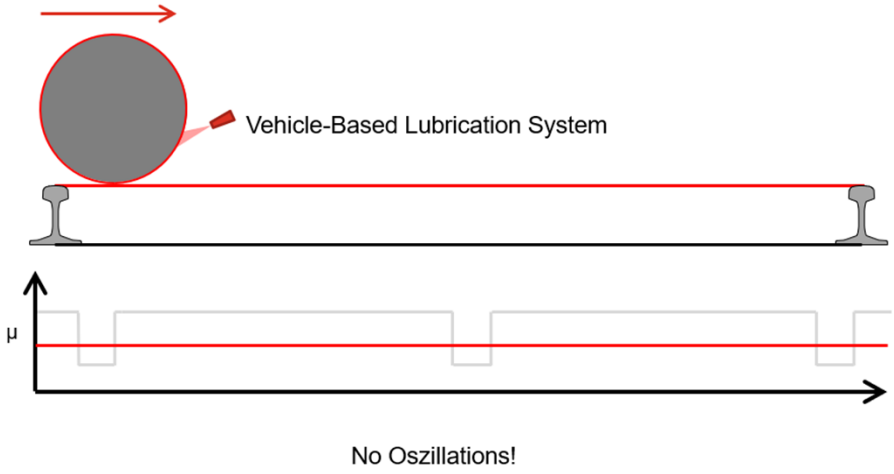
Optimized wheel profile



Analysis and Optimization

- Wheel reprofiling and rail grinding strategy
- Flange lubrication and/or top of rail friction modifier





Support

- Assistance in dealing with authorities
- Project support over a long period of time
  → Some projects have been successfully supported for more than 8 years

THE BENEFITS

Benefits - General

Performing the WRIS offers a lot of benefits like reducing (or even eliminating):

- Wear on wheels and rails
- Noise development
- Sinusoidal rail flange wear
- Corrugation on rails
- Polygonization of wheels
- The risk of rolling contact fatigue (RCF)

Benefits - Examples

Example 1 (LRV)

- Reduction of rail gauge face wear from 3mm to 0.2mm per year (factor 15!)
- Reduction of wheel flange wear from 0.4mm to 0.03mm per 1000km mileage (factor 13!)
- Increased wheel mileage from 25tkm to 220tkm (~factor 9!)

Example 2 (Metro)

- Avoid hollow wear and increase the reprofiling interval from 25-30tkm to more than 150tkm without any instability problems (factor 5)

Benefits - Examples

Example 3 (LRV)

- Wheel/Rail Profile developed by ALSTOM
- Tire mileage: more than 550tkm
- The identical vehicle at different customer only reaches a tire mileage of approx. 180tkm (two-point contact and flange back contact) (factor 3)

Example 4 (Mainline)

- Increased wheel reprofiling intervals from 60tkm to more than 240tkm (>factor 4)

Costs

- To exclude any financial risks for our customers, we have developed a „Shared Benefit Model”, where only the financial saving are shared amongst the stakeholders and each party shall bear its own costs
- Annual revision of actual wheel reprofiling data for the calculation of actual savings
- Savings are shared between customer and ALSTOM
  - Customer: portion of wheel savings + total savings in rail wear
  - ALSTOM: portion of wheel savings
- After contractual duration customer benefits from complete savings

Conclusion

An optimised wheel/rail-combination adapted to the customer's track network in combination with an appropriate lubrication and maintenance strategy is the key to success.

WRIS®

Thank you

References

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