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Wheel wear of a two axle freight vehicle

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Layout

- Project description
- Wear modelling
- Experimental results
- Validation and discussion
- Conclusions and further work

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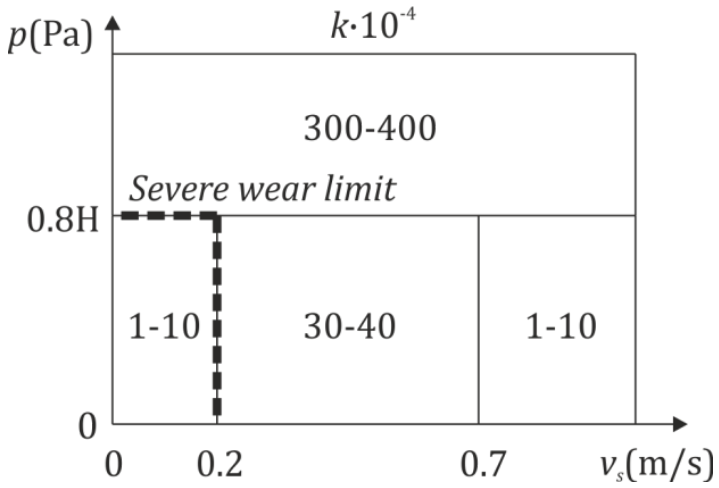
Objectives

- Design of a new wheel profile for freight wagons
  - Reduce maintenance costs caused by wear and fatigue
  - Reduce the effect of low frequency instability
- Analyse the influence of freight vehicle modelling on uniform wear and RCF
  - Increased axle loads
  - Energy dissipation elements

Wear Modelling

- Archard's wear law

$$V_w = k\frac{sN}{H}$$



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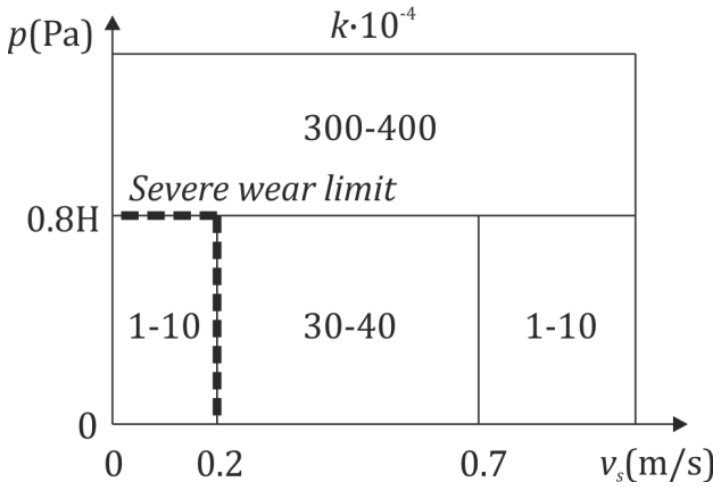
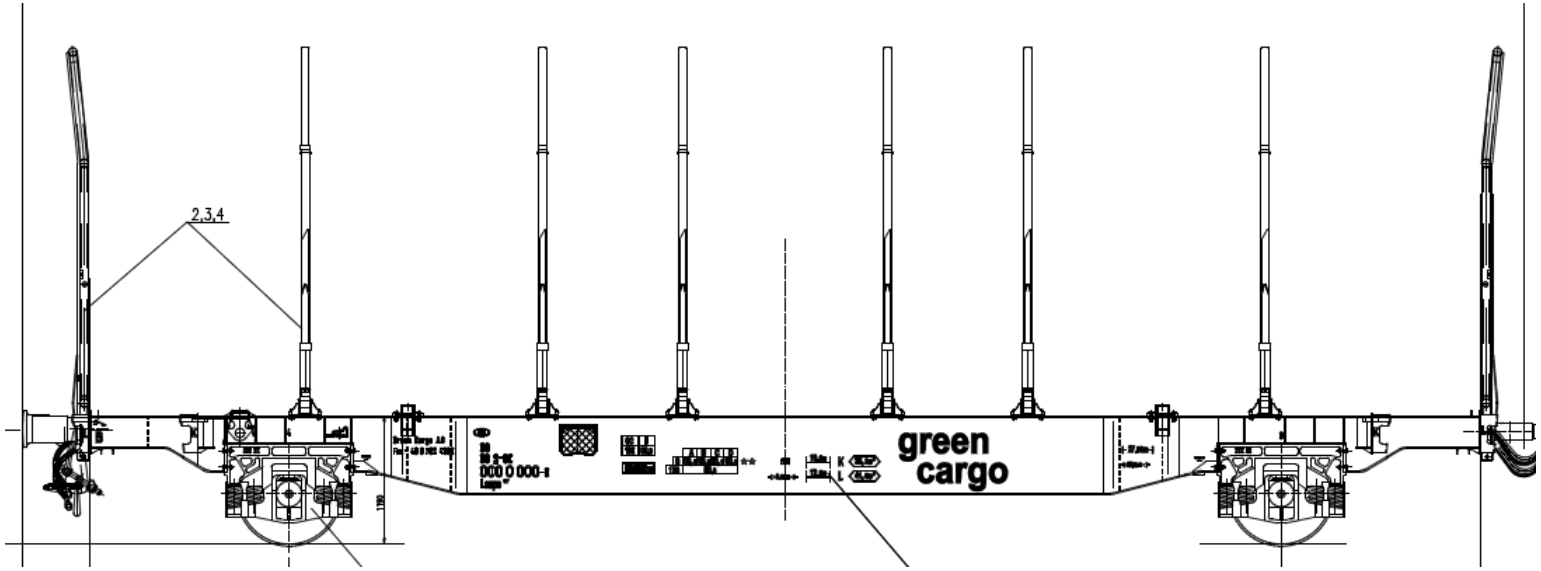


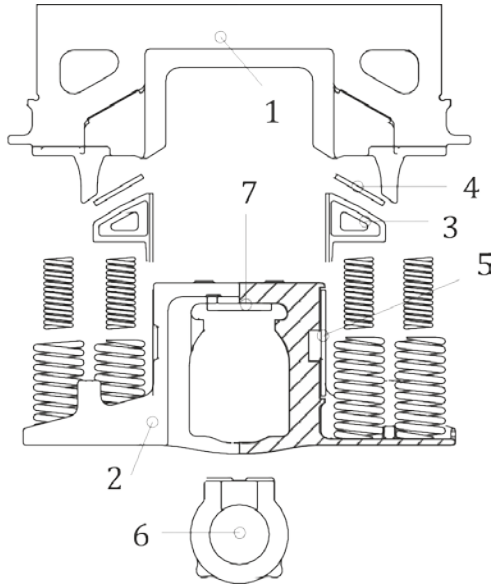
- Define Operational Case
- Perform dynamic simulations
- Calculate wheel wear
- Update wheel profile

Stop when desired mileage is reached

Reference Case: Trätåg Timber Wagons

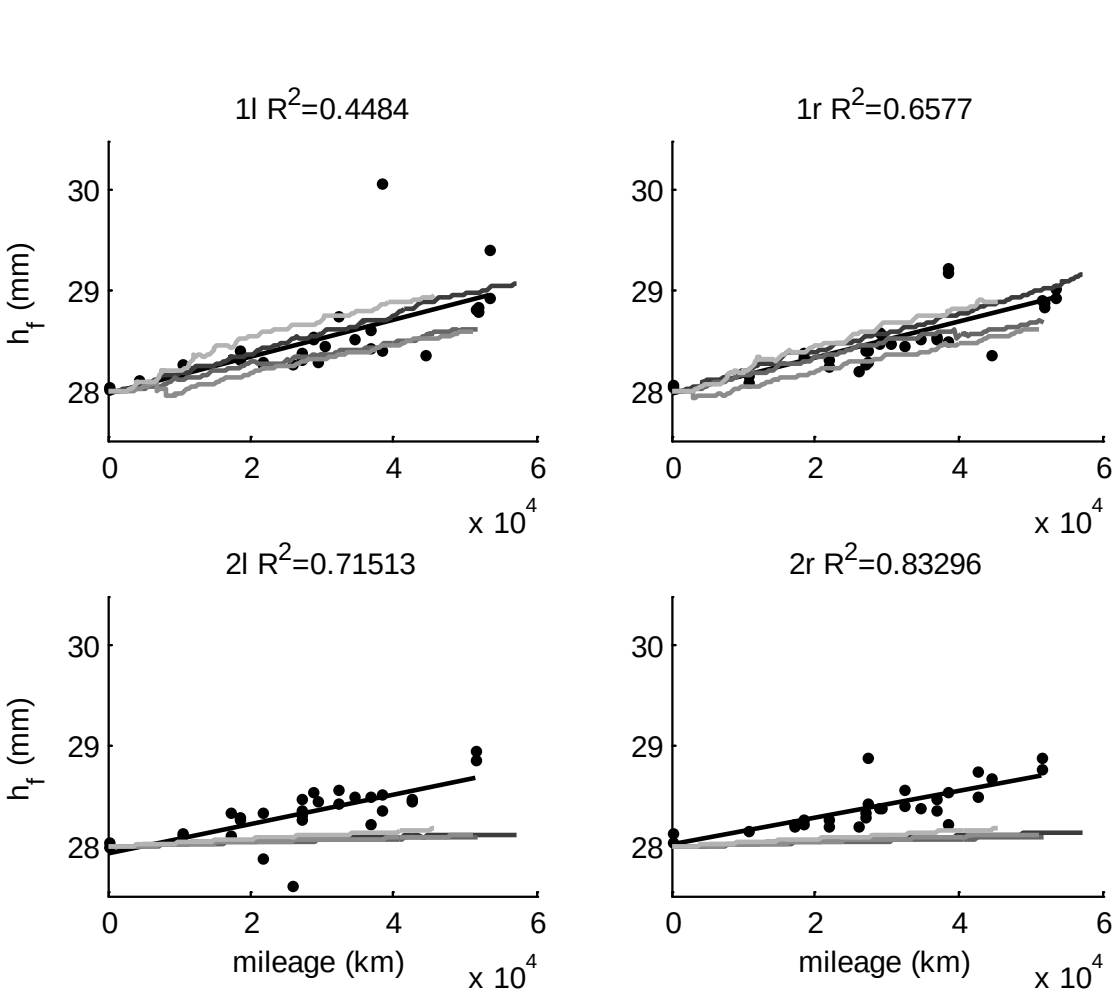
- *Laaps* wagons, *Unitruck* running gear

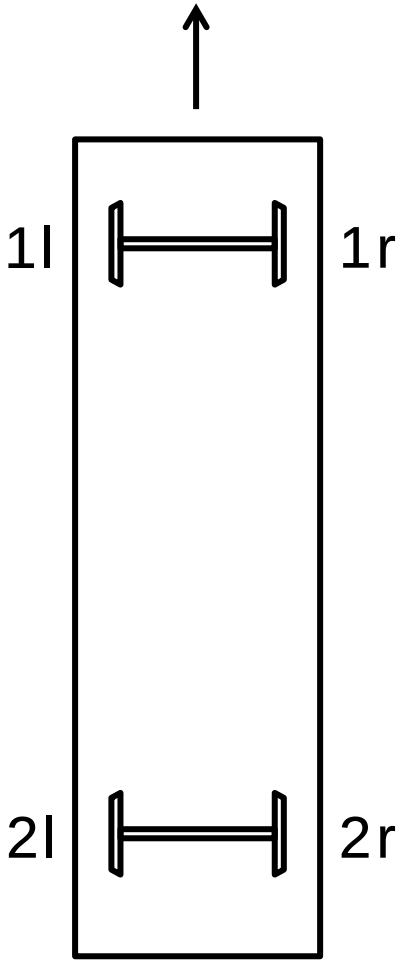




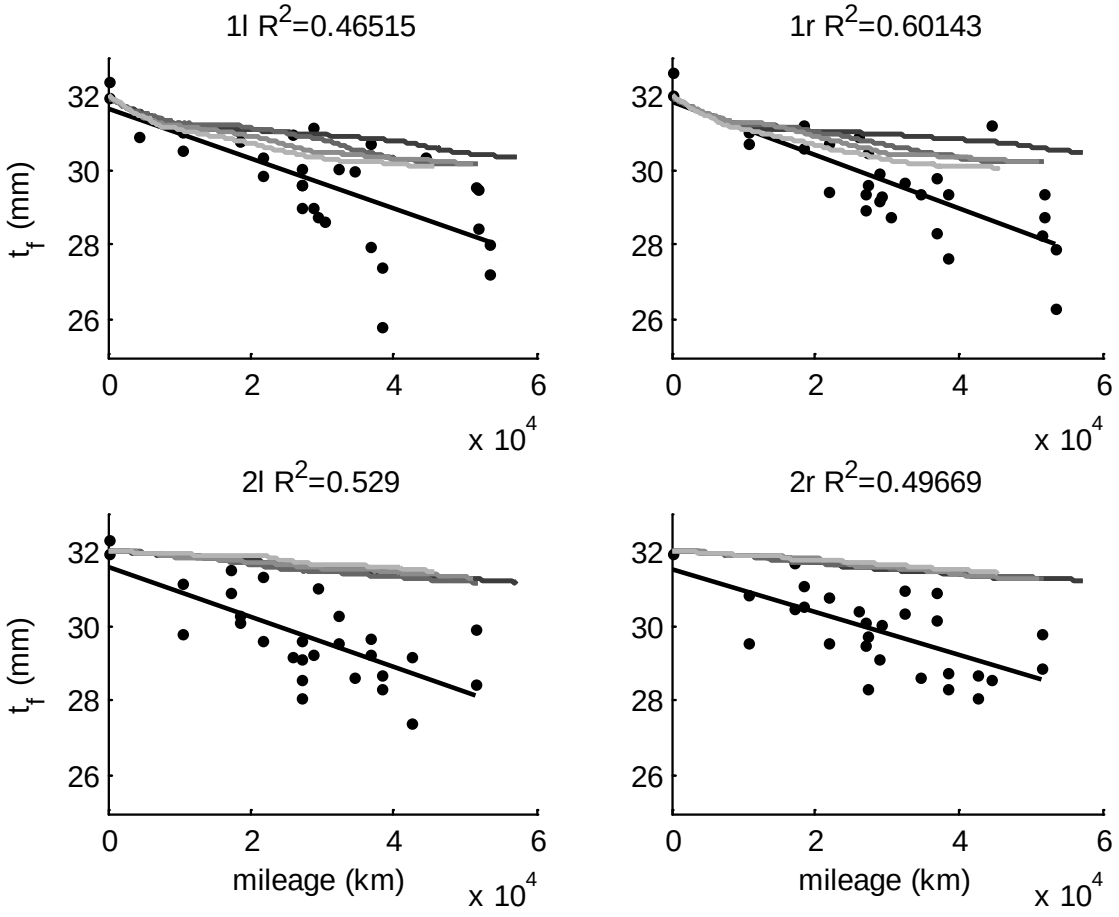
Reference Case: Trätåg Timber Wagons

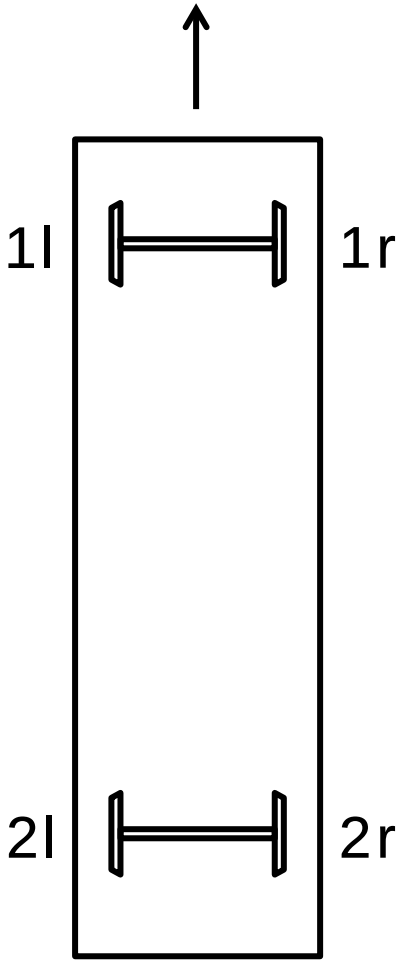
Experimental results: flange height h_f



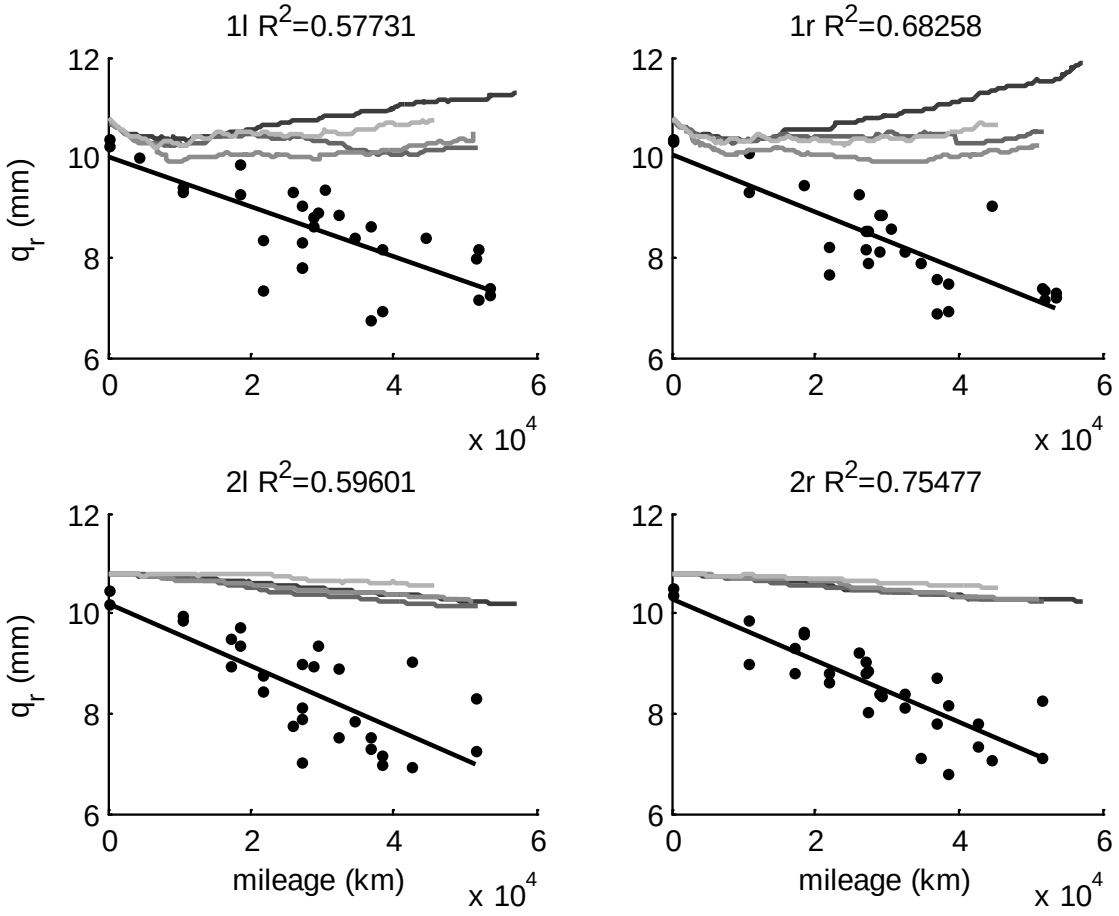


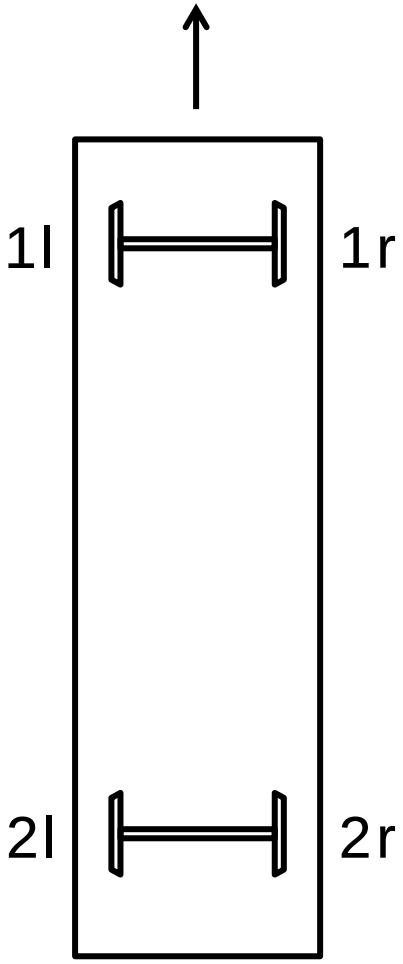
Experimental results: flange thickness t_f



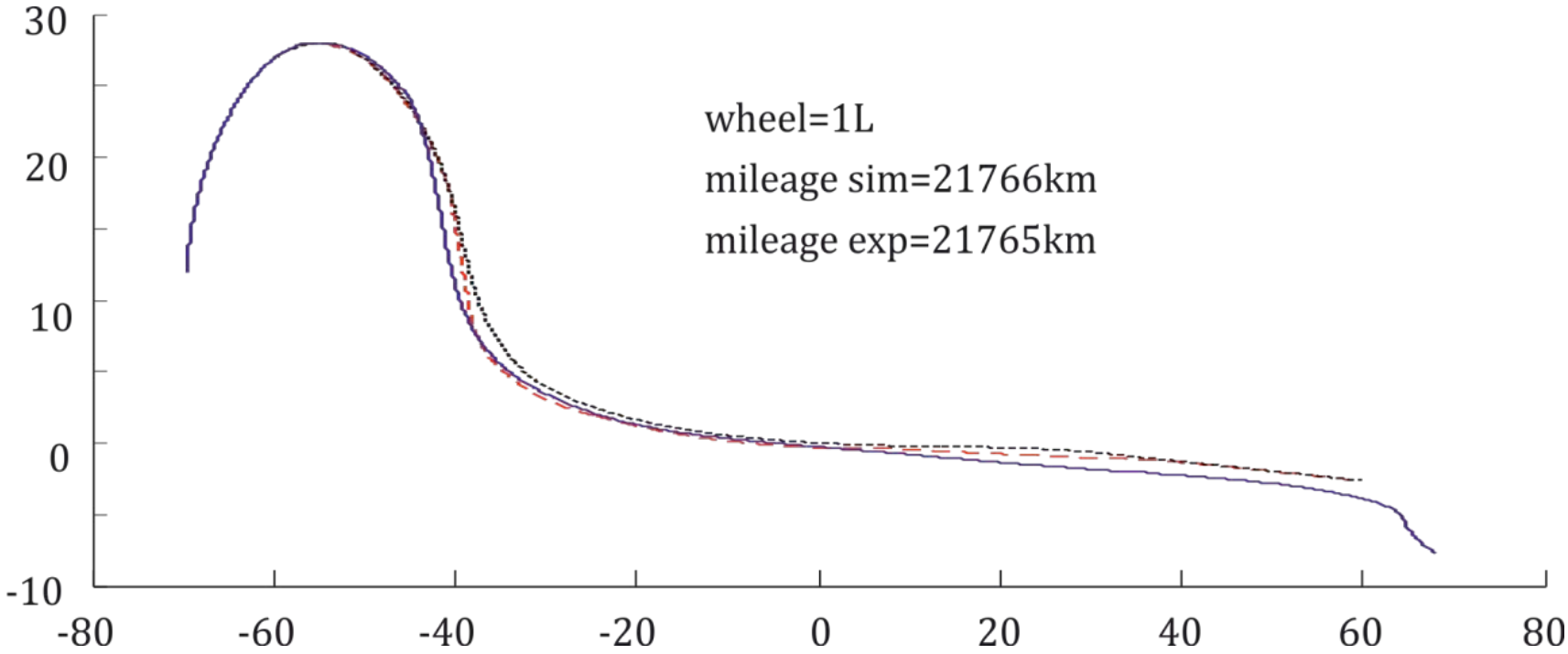


Experimental results: flange inclin. q_r





Experimental validation



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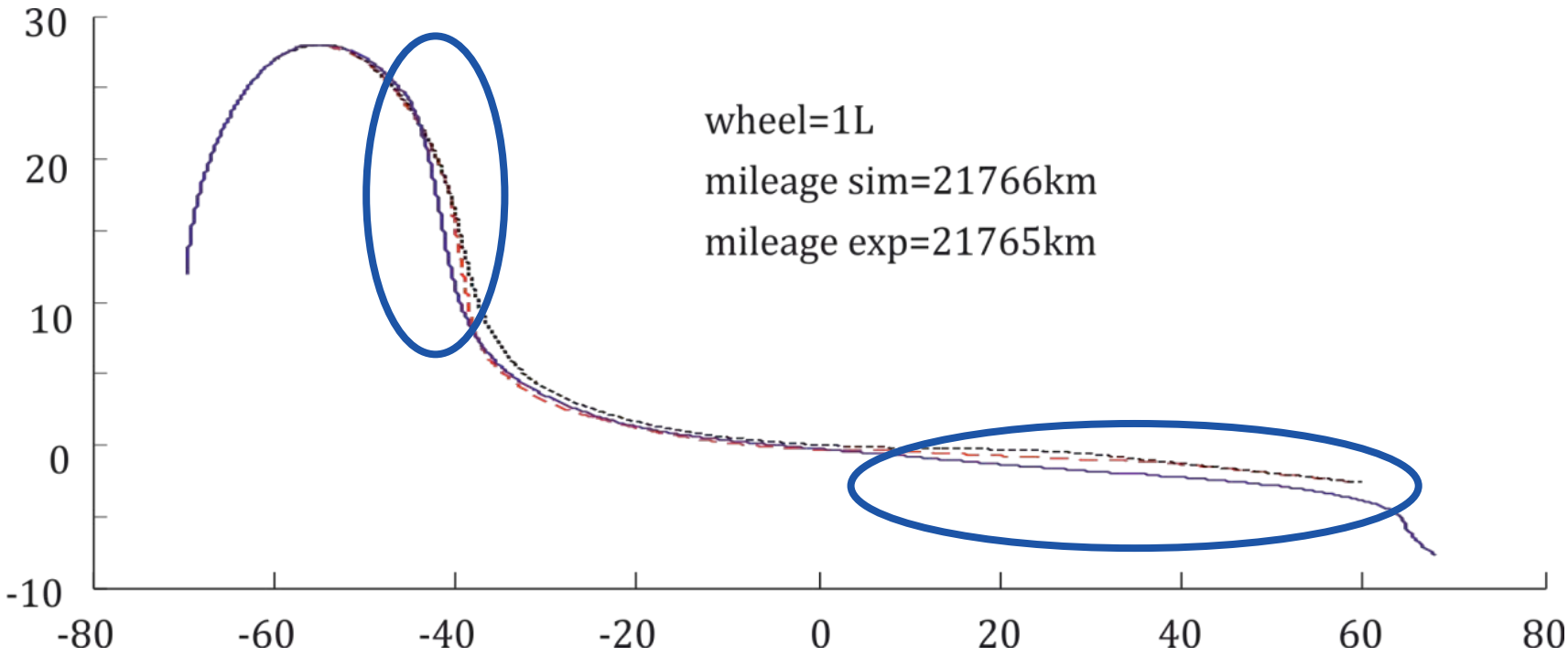

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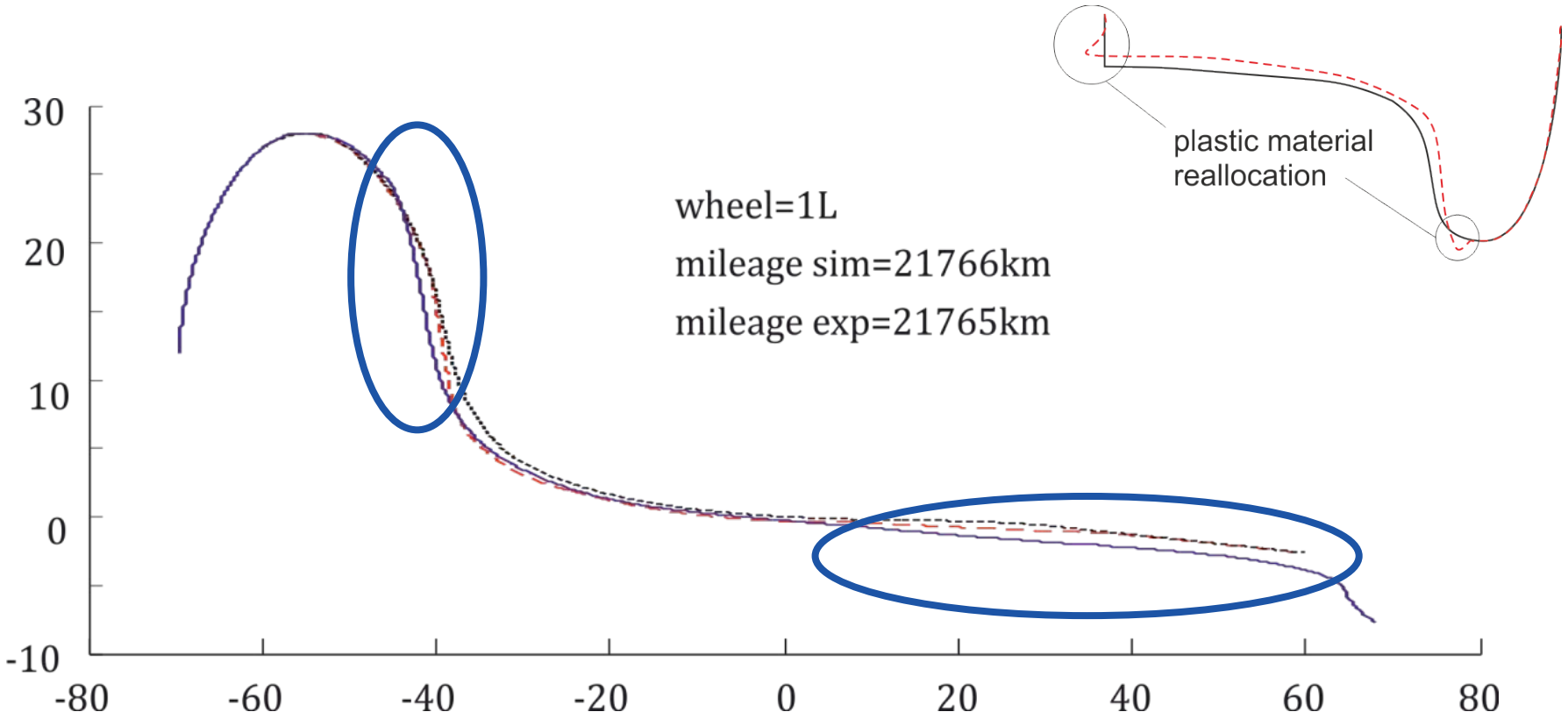

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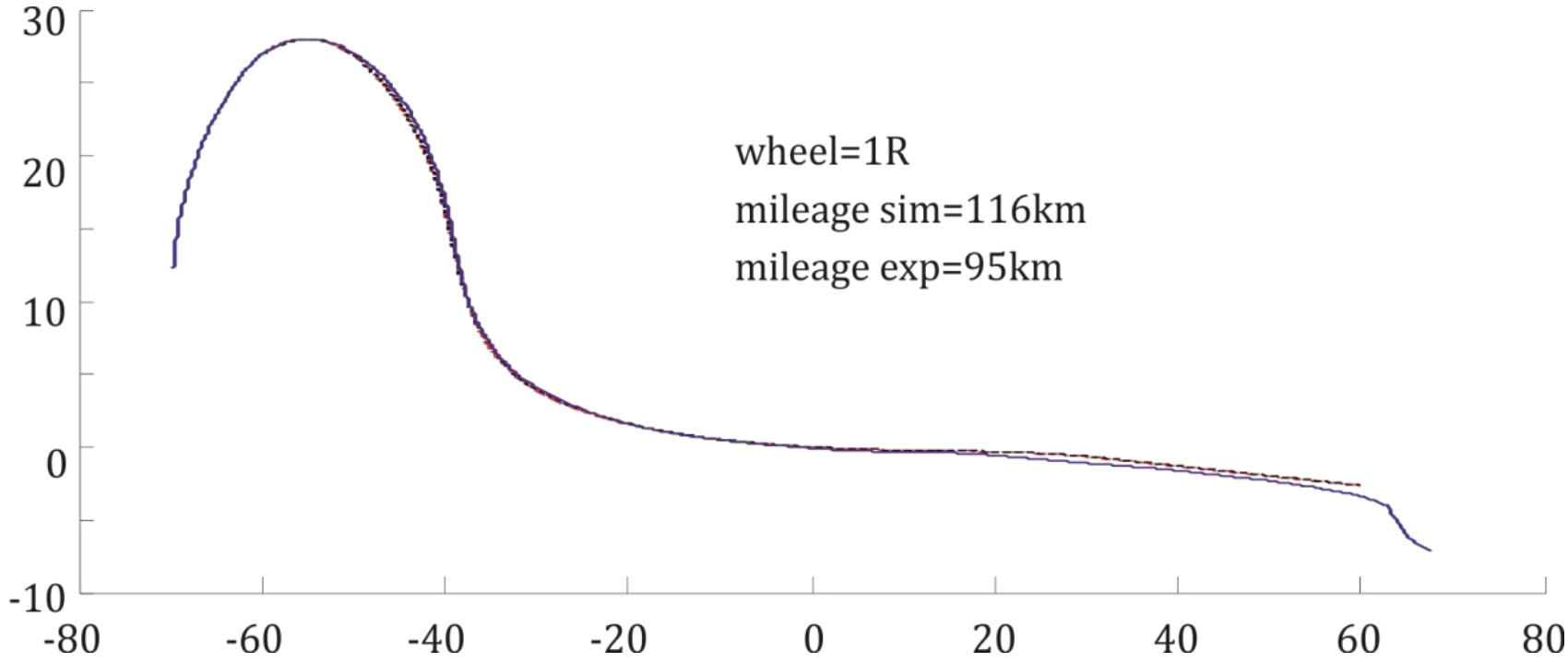

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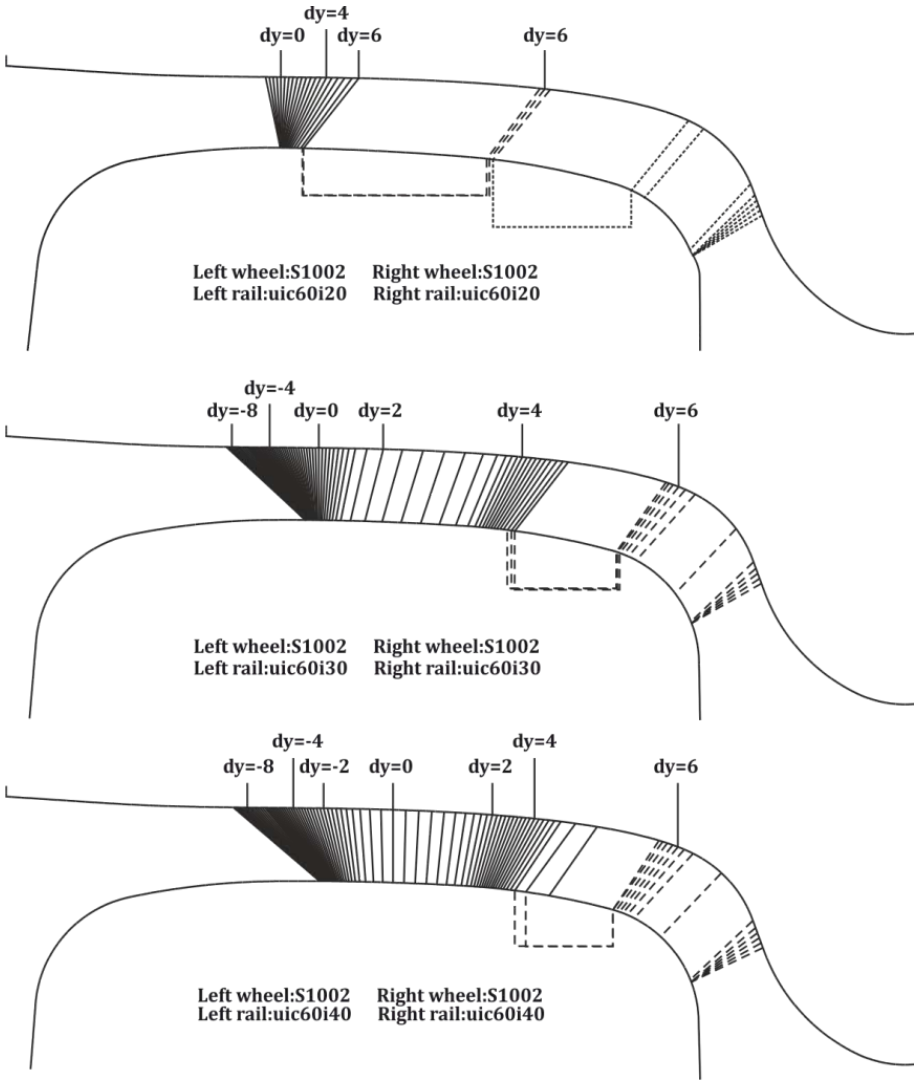
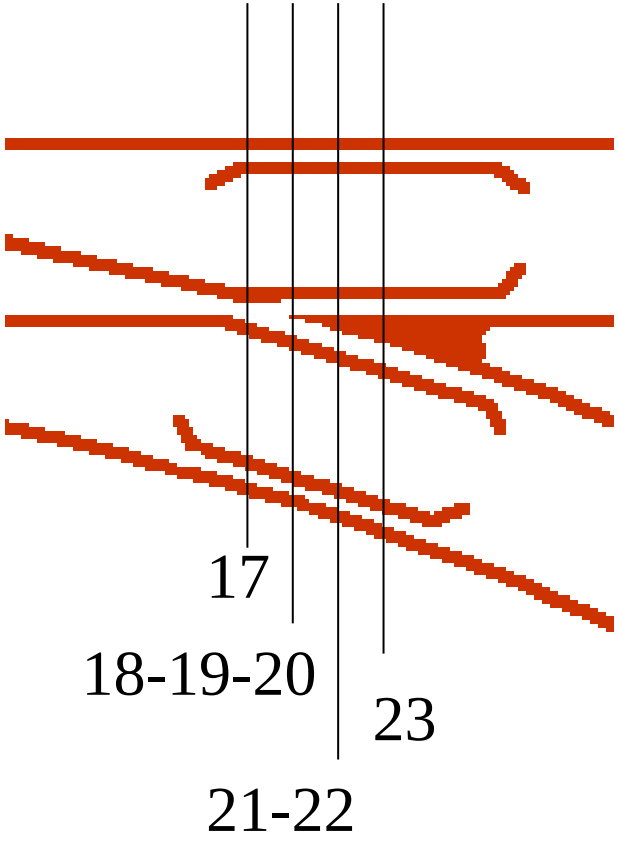
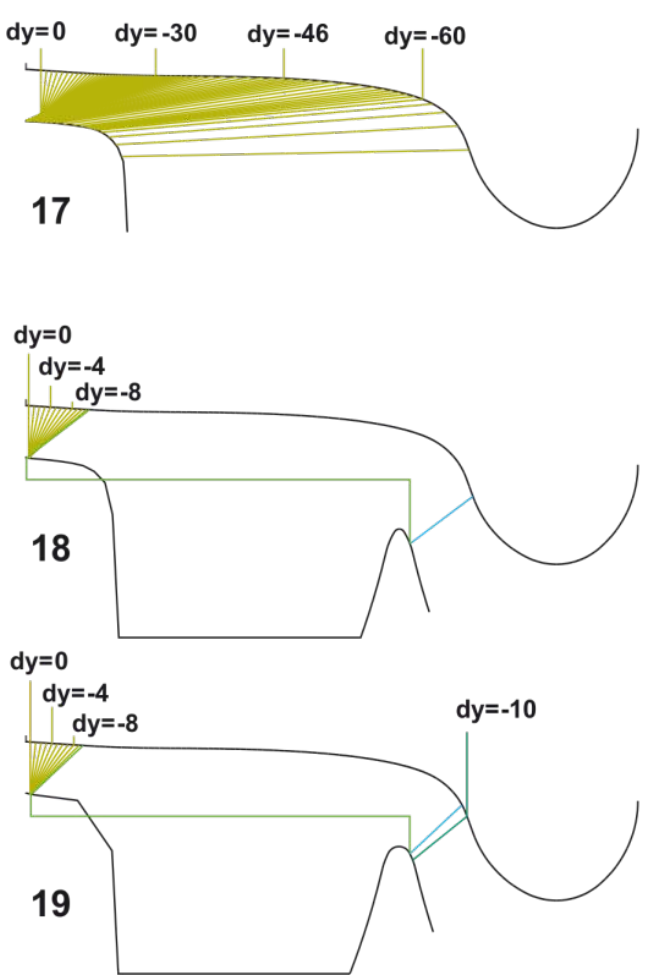
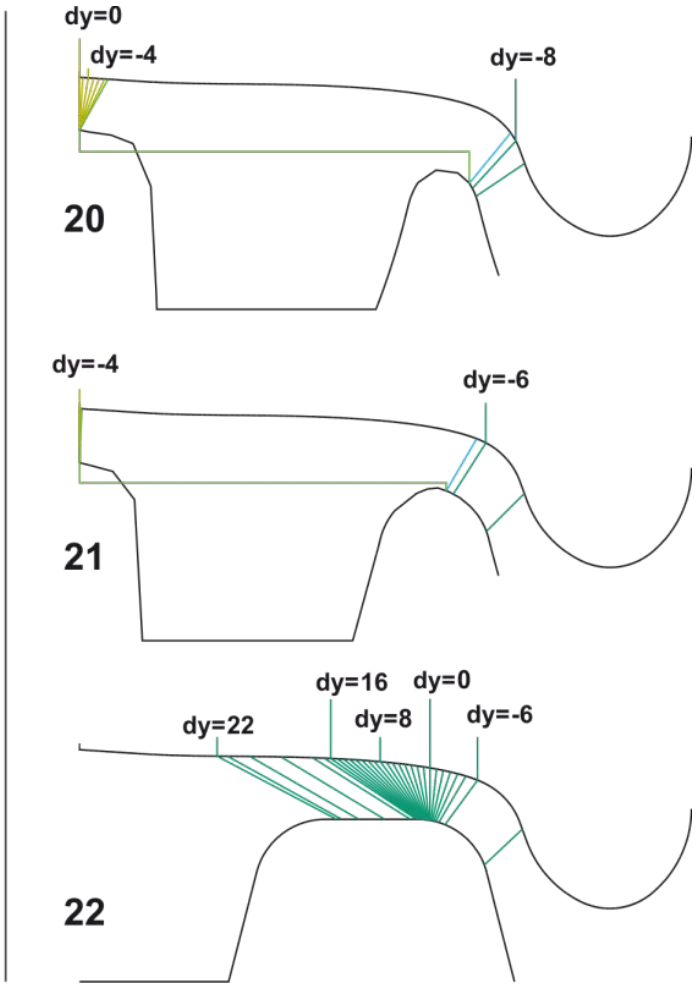


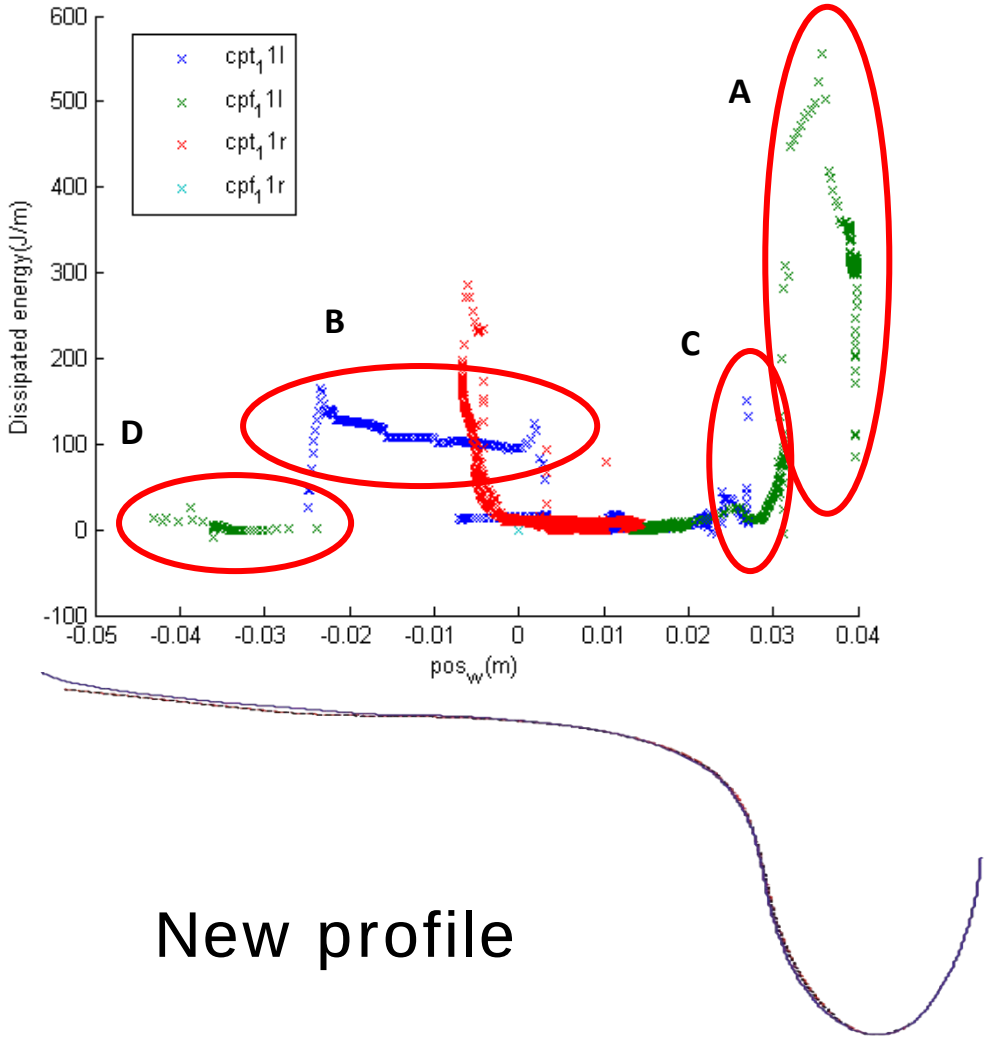
Contact geometry at the switch



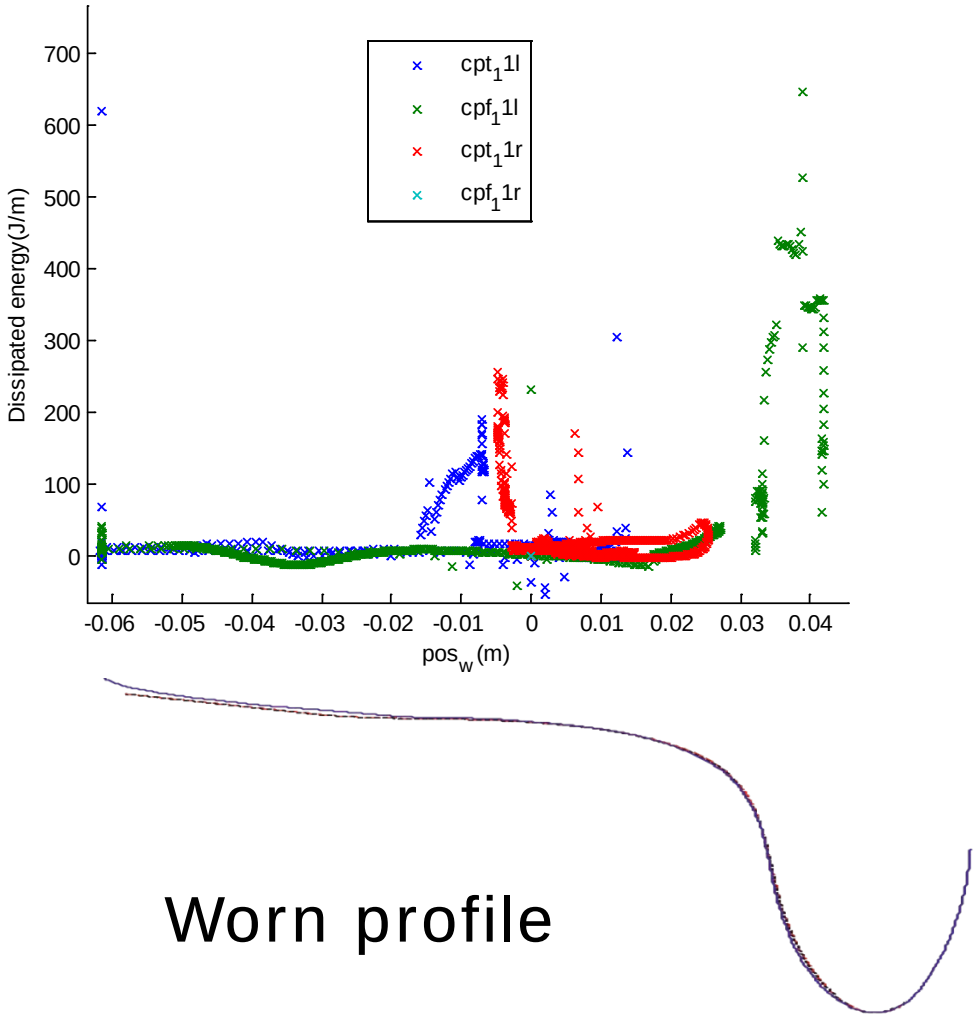




Switch simulation



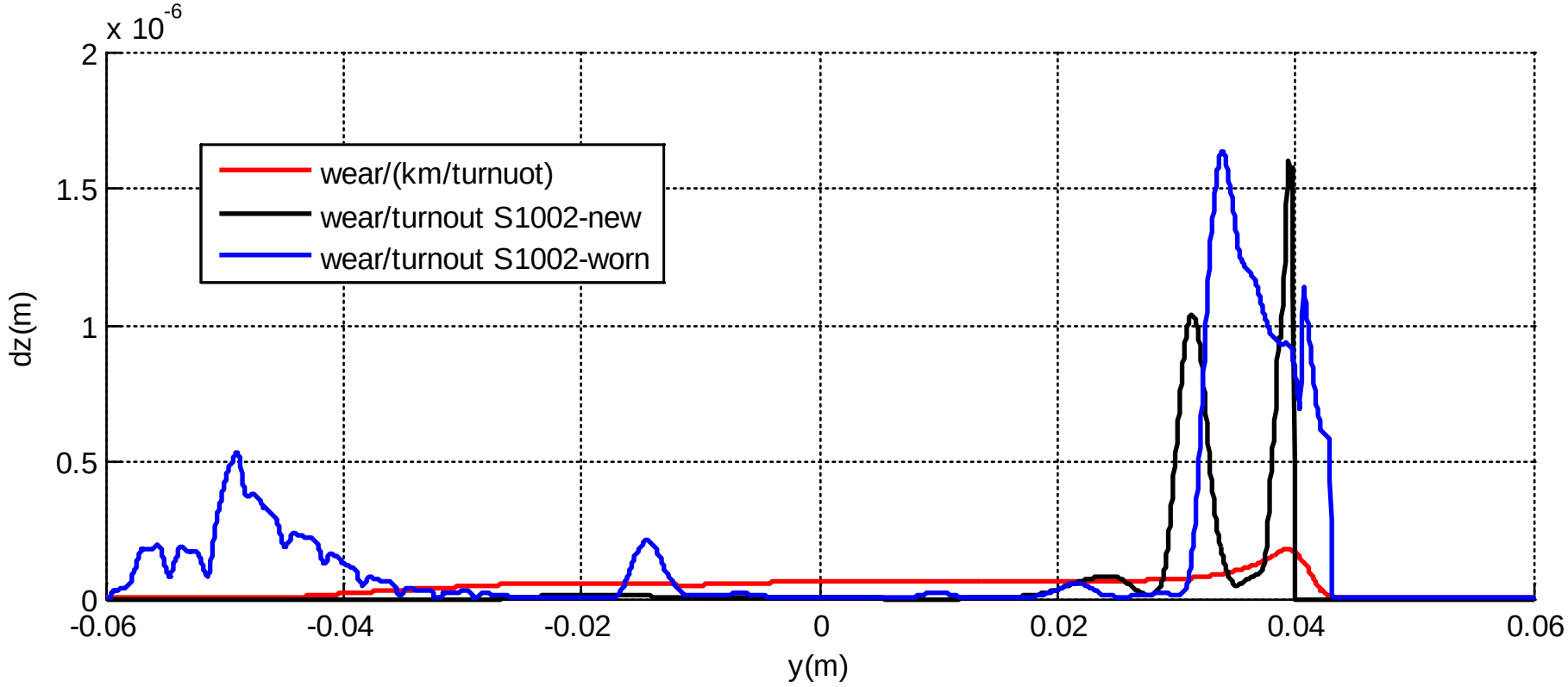
New profile



Worn profile

Switch simulation – wear

- Average: 3.14km per switch



Full simulation

- Laden
  - 3.14km simulation
  - Switch simulation
  - Repeat until laden run is ended
- Unladen
  - 3.14km simulation
  - Switch simulation
  - Repeat until unladen run is ended
- Laden
  - …

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Full simulation

- No way, simulations are:
  - *c.a.* 100km per wear step
  - *c.a.* 500 wear steps
  - *c.a.* 15 days computation.
- Switch simulation - *c.a.* 45 min. ~*c.a.* 22.5 days.
  - Non-smooth wheel profile will increase simulation time

Conclussion

- Wheel wear on freight vehicles cannot be studied considering only track geometry
  - Heavy wear at the tread end and flange top is caused by switch geometry
  - Block brakes will cause additional wear at the tread
- Wear pattern at the tread end could be detected with Archard's wear model but not with $T\gamma$ model
- Promising preliminary results

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Further work

- Switch simulation
  - Straight run
  - Unladen run
  - Worn switch geometry
- New vehicle – Y25 bogies
- Block brake influence

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Thank you for your attention
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