EFFECT OF MISALIGNED WHEELSETS ON SAFETY AND WEAR FOR FREIGHT RAIL VEHICLES WITH VAMPIRE

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Prof. Auteliano Antunes dos Santos Jr., Ph.D

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OUR GROUP

Lafer's (Railway Laboratory) main purpose is to develop research on freight and passenger railway vehicle dynamics, evaluation of braking performance, life of railway components (wheels, rails, wagons, couplings, locomotive components...). It has a team of specialists for the development of new vehicle projects, as well as training graduate and undergraduate students on topics related to the railway sector.

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Projects

Research projects developed by UNICAMP and VALE S. A.

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VALE

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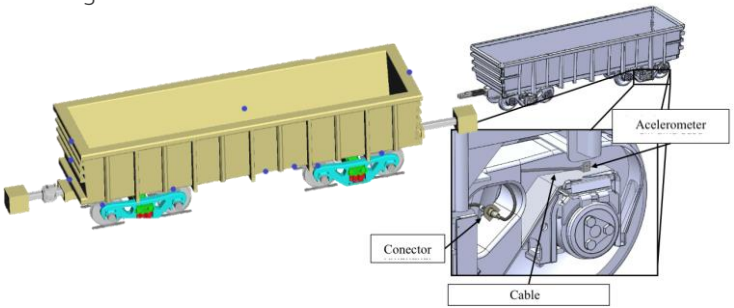
Modelling of passenger cars

Computer models development for dynamic simulation of passenger cars in vampire software

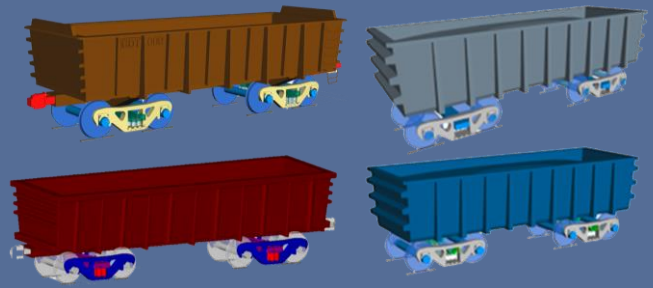
Instrumentation in freight cars

Track Parameters Measured by Instrumented Wagons



Modelling of freight cars

Development and analysis of the effect of braking with dynamic models in MBS software including Vampire



WHAT WE ARE WORKING ON

OUR STUDY LOCATIONS

Real case studies from these railroads are modeled and simulated by our research groups.

TABLE OF CONTENTS

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INTRODUCTION

01

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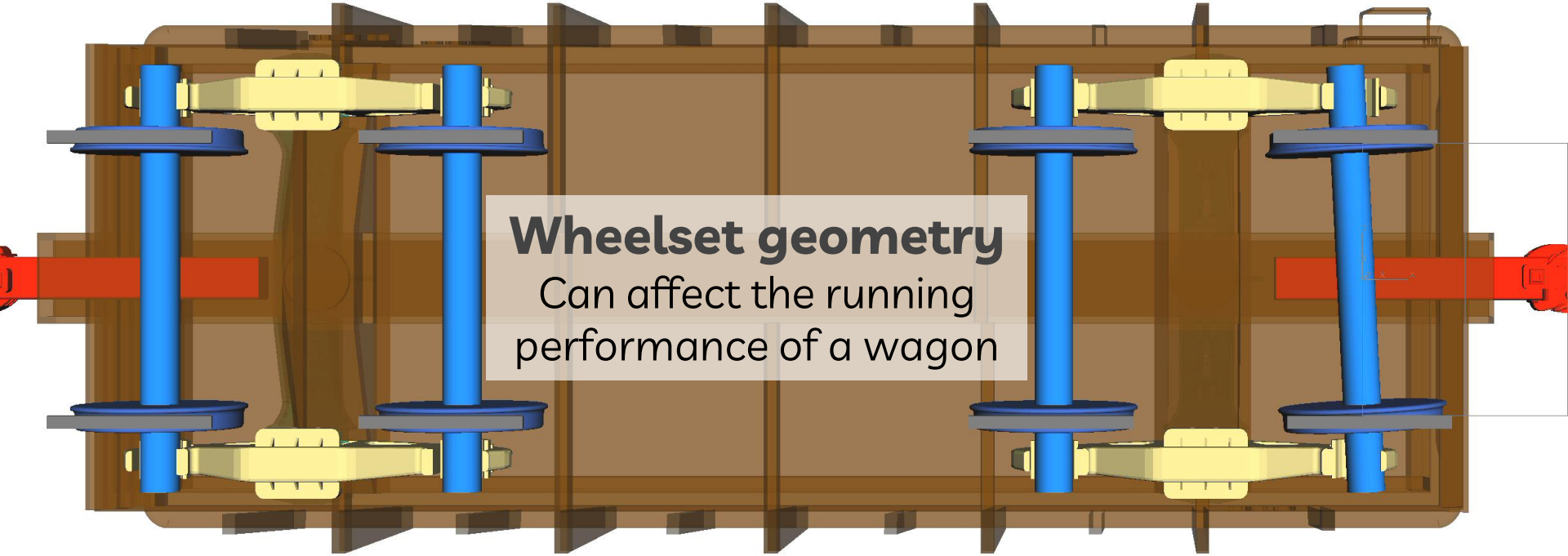
Introduction



Wheelset geometry

Can affect the running performance of a wagon

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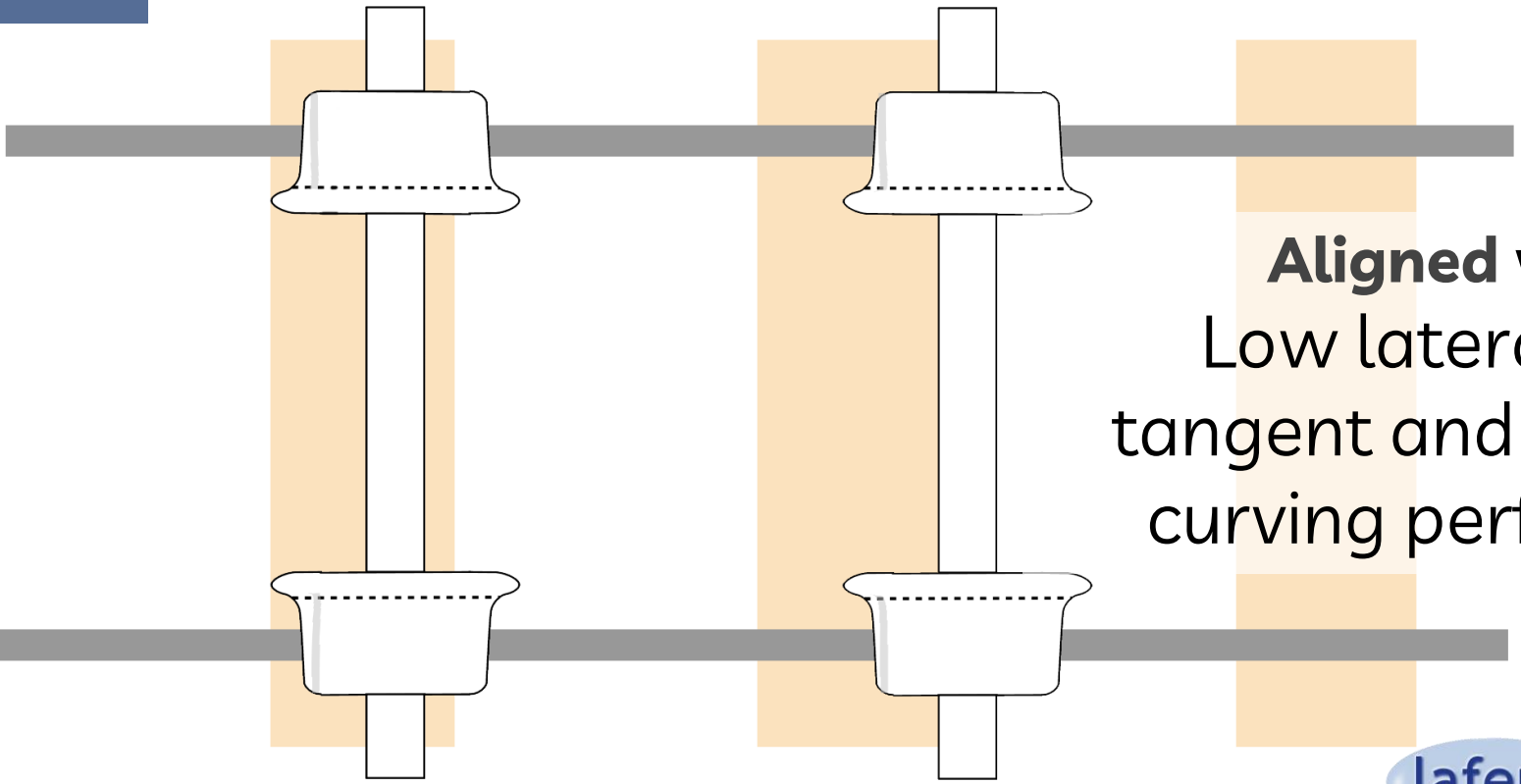

Aligned wheelsets:
Low lateral force in tangent and expected curving performance

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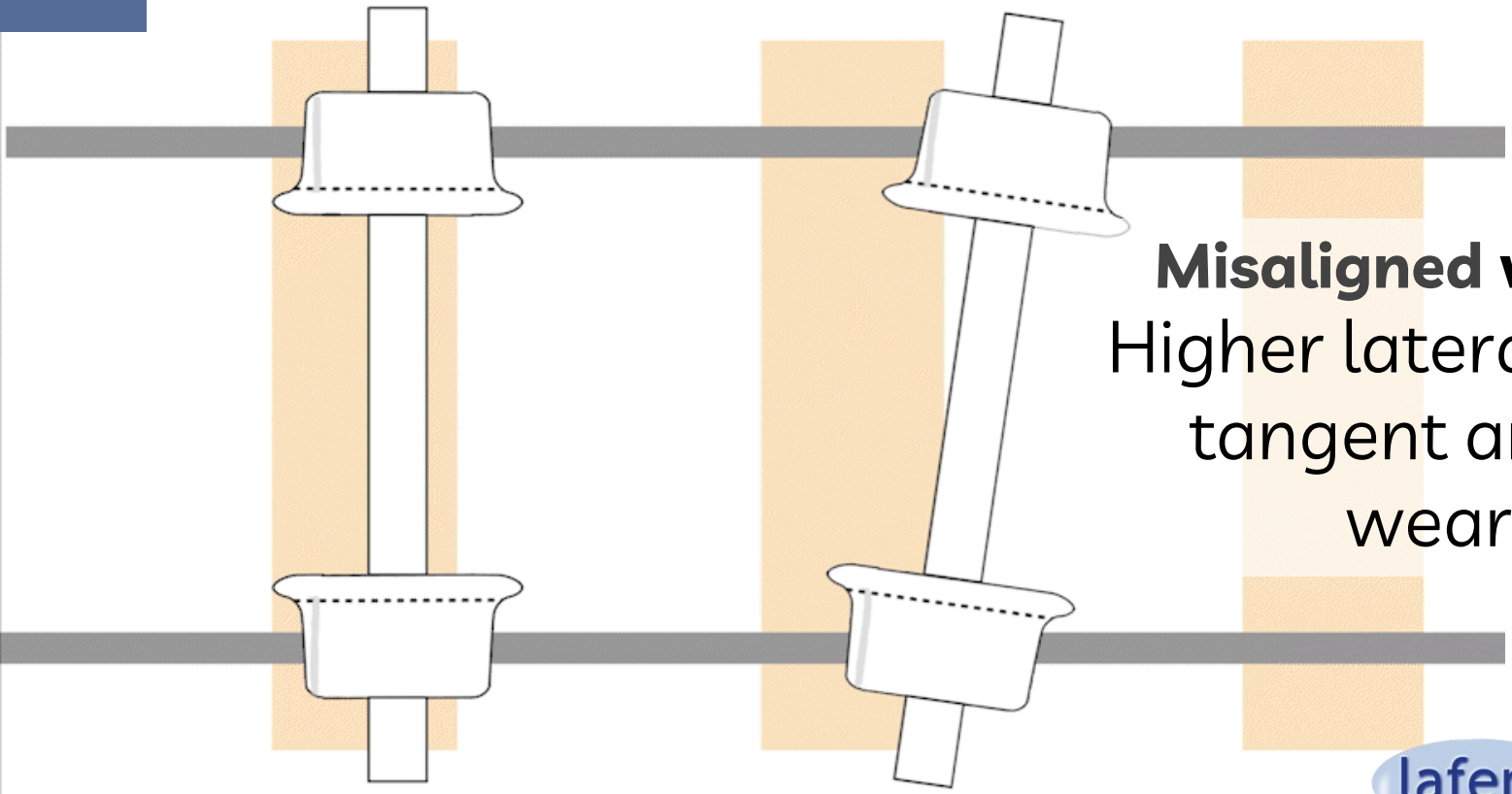

Misaligned wheelsets: Higher lateral force in tangent and higher wear in curves

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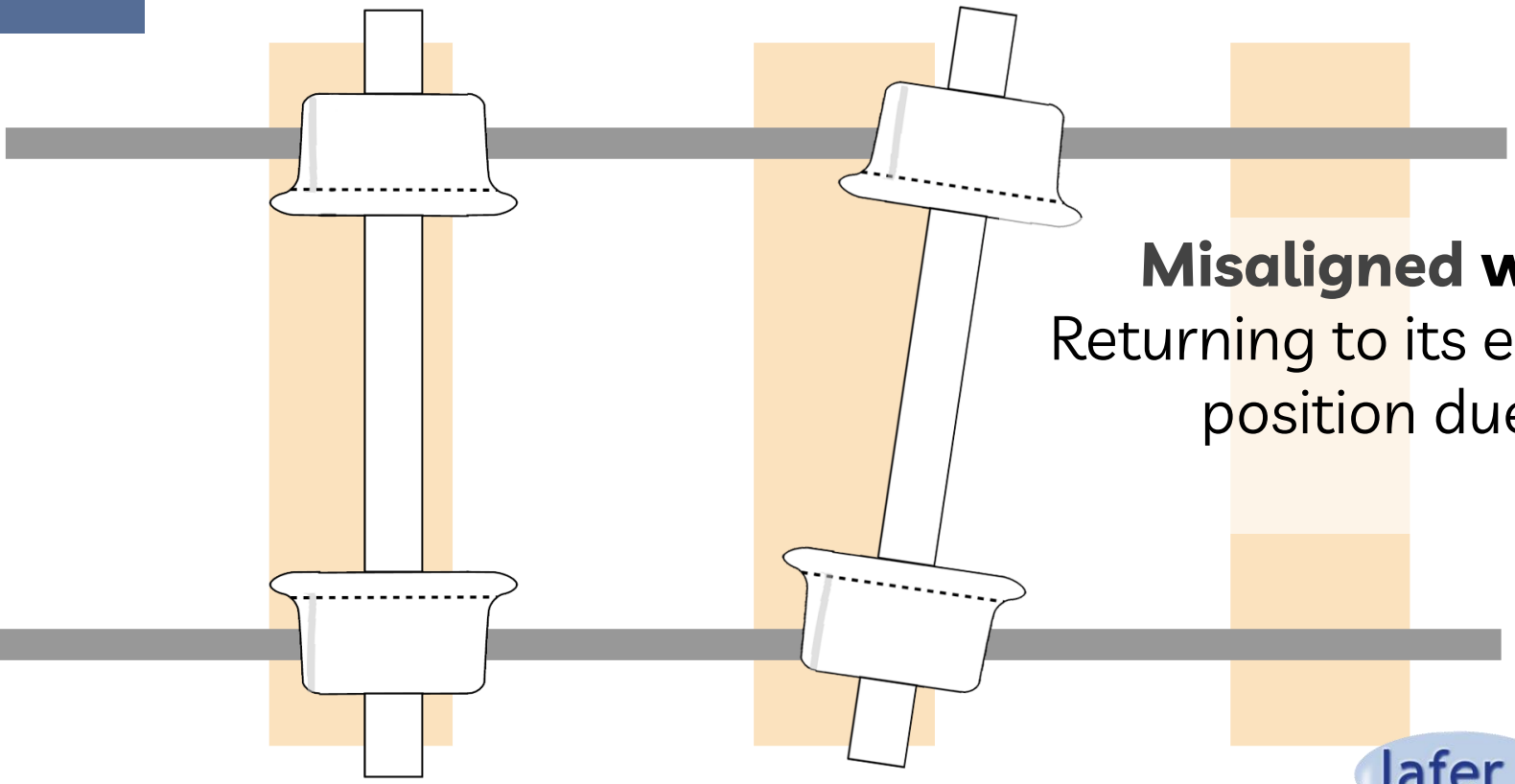

Misaligned wheelsets: Returning to its equilibrium position due to wheel gemotery

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MODELING

02

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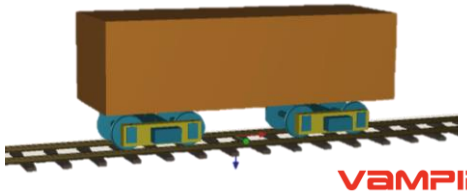
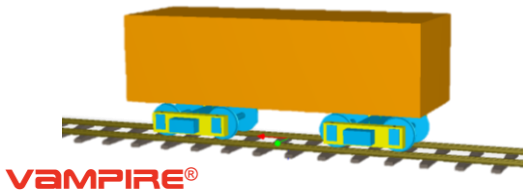
Modeling: The wagons



GDE – Ride Control

Load	110 T
Running speed	65 km/h
Wheel Profile	Design 2
Rail Profile	EFVM measured rails
Gauge	Metre (1 m)

Vitoria-Minas railroad



GDT – Ride Control

Load	130 T
Running speed	70 km/h
Wheel Profile	Design 3
Rail Profile	EFC High Sharp / TR68
Gauge	Broad (1.6 m)

Carajás railroad

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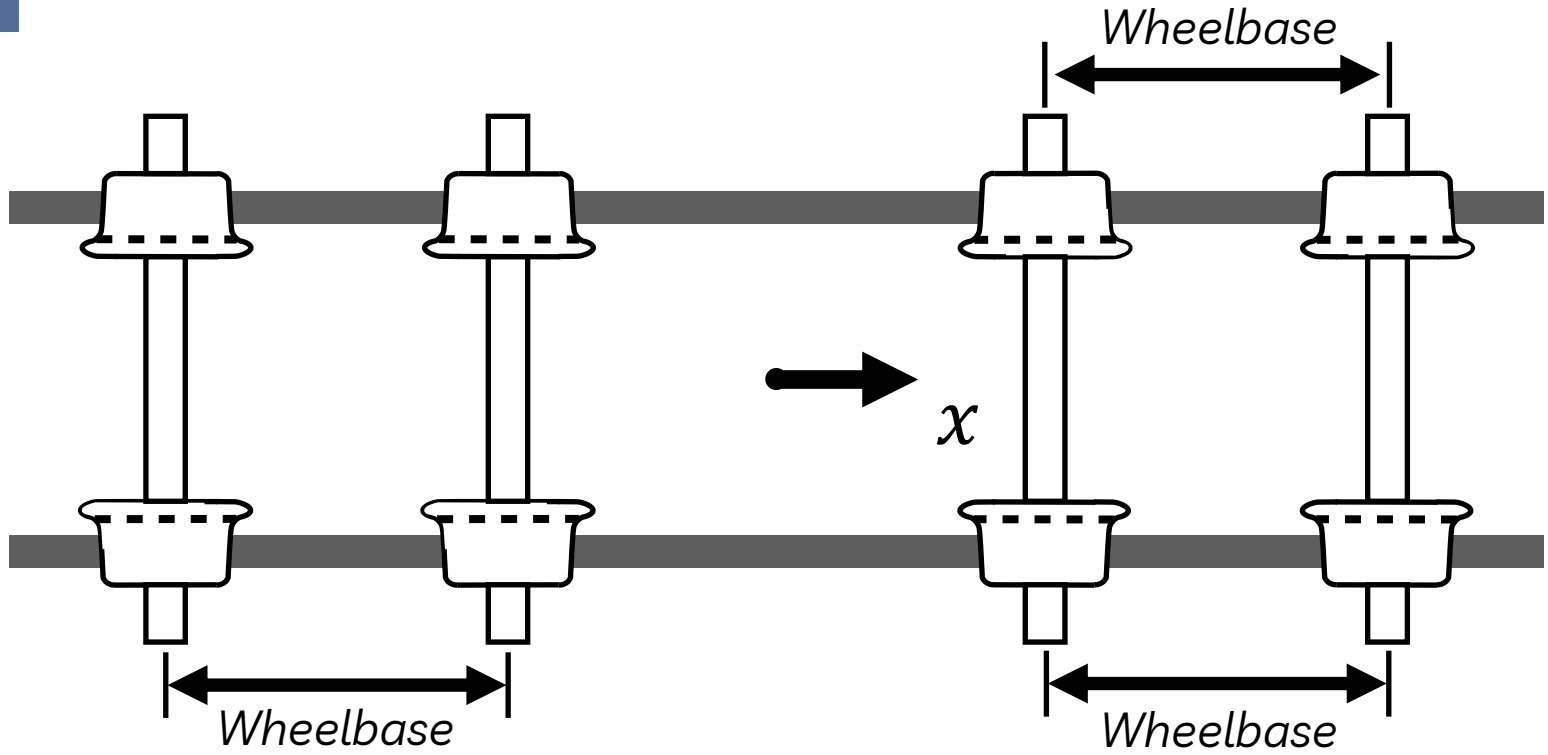
Modeling: MISALIGNED WHEELSETS



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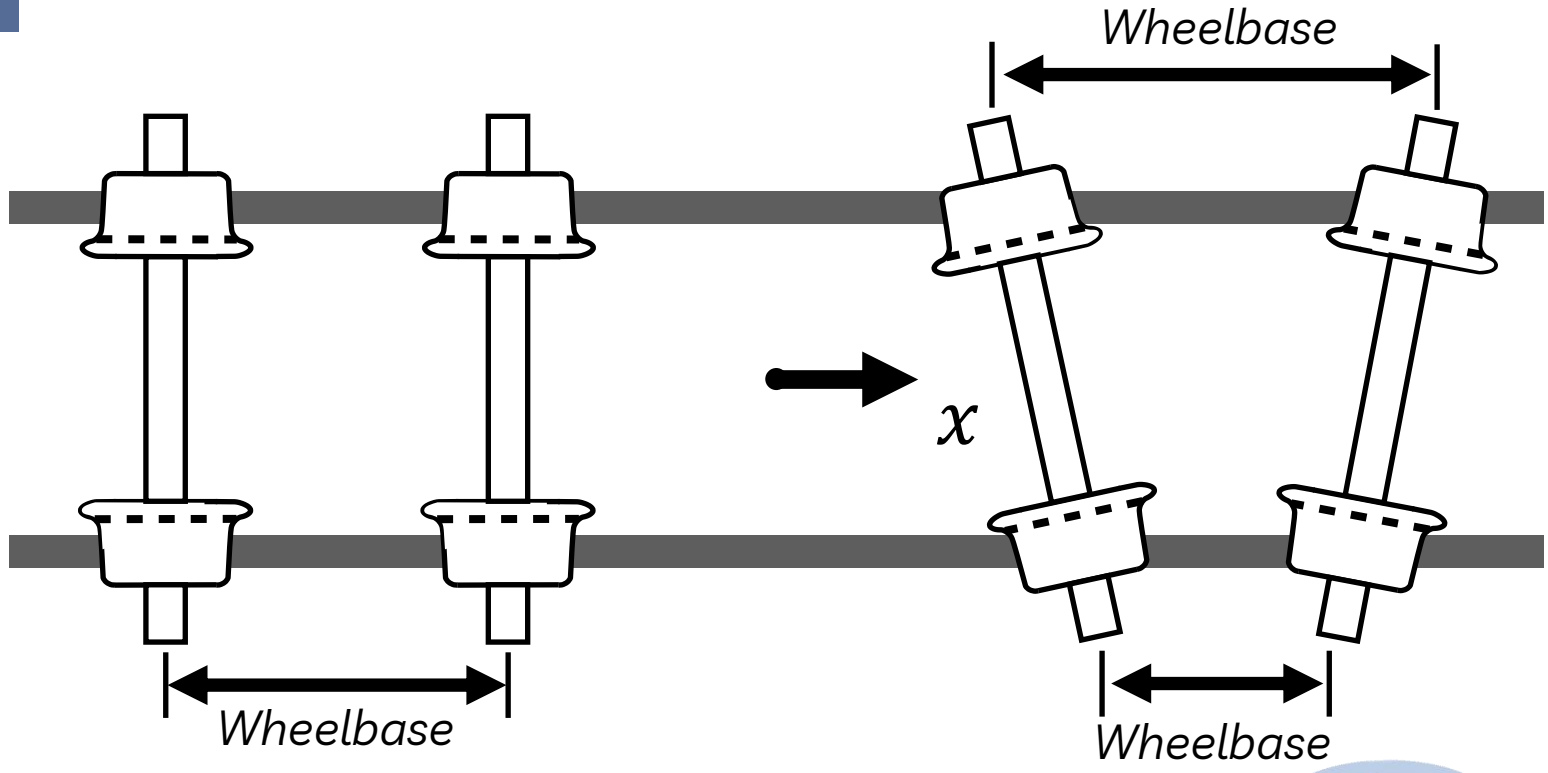
Modeling: MISALIGNED WHEELSETS



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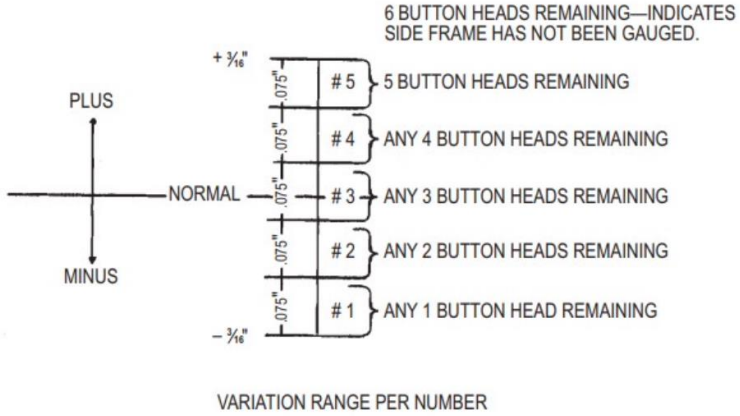
Modeling: AAR Section D - S-378



NOTE:S

1. SIX BUTTON HEADS OF 1/4 IN. MINIMUM DIAMETER AND 1/8 IN. MINIMUM HEIGHT SHALL BE CAST ON THE LEFTHAND JOURNAL BOX OR THE LEFTHAND PEDESTAL IN THE AREA SHOWN. THE MANUFACTURER WILL CHIP OFF THE BUTTONS AS FOLLOWS TO INDICATE WHEELBASE VARIATIONS.
2. FRAMES OF LIKE NUMBER SHALL BE ASSEMBLED IN THE SAME TRUCK. HOWEVER, FRAMES CONSECUTIVELY NUMBERED MAY BE MATED. THAT IS, 1 AND 2, OR 3 AND 4, ETC., MAY BE PAIRED, BUT 1 AND 3, OR 3 AND 5, ETC., MUST NOT BE ASSEMBLED IN THE SAME TRUCK.
3. SIDE FRAMES REMOVED FOR REPAIRS MUST BE GAUGED FOR WHEELBASE (DISTANCE BETWEEN PEDESTAL CENTERLINES), AND THE PROPER NUMBER OF BUTTONS MUST APPEAR ON THE FRAME. BUTTONS MAY BE ADDED TO THE FRAME BY WELDING, WHERE NECESSARY. WHEELBASE DIMENSIONS MUST ALSO BE MEASURED AND THE DIMENSION IN INCHES (TO THE NEAREST WHOLE INCH) STAMPED IN 3/8 IN. OR LARGER NUMERALS ADJACENT TO THE MATCHING BUTTONS UNLESS A NUMBER IS ALREADY CAST ON.

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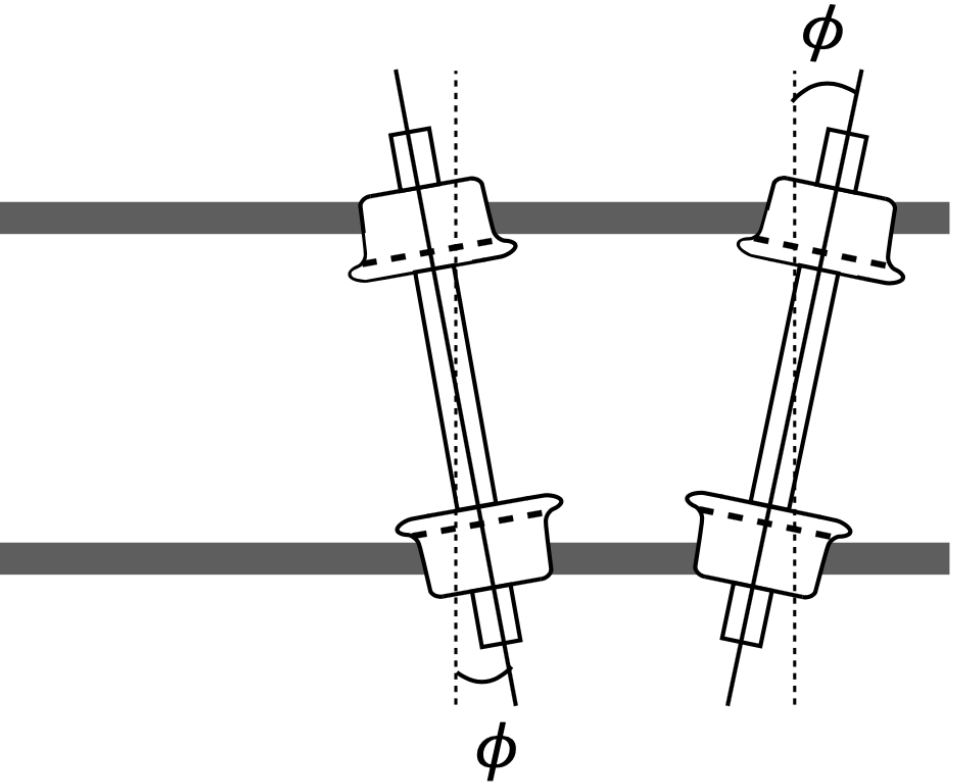
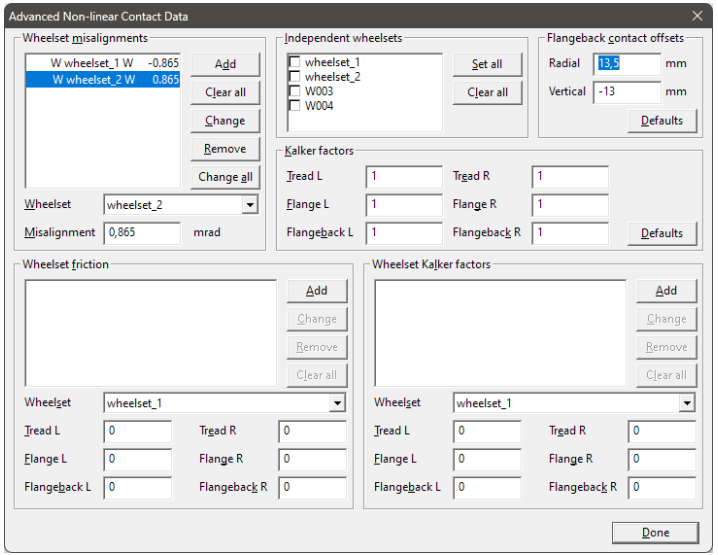
Modelling: MISALIGNED WHEELSETS





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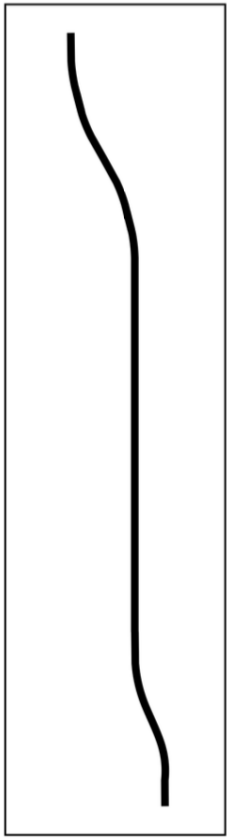
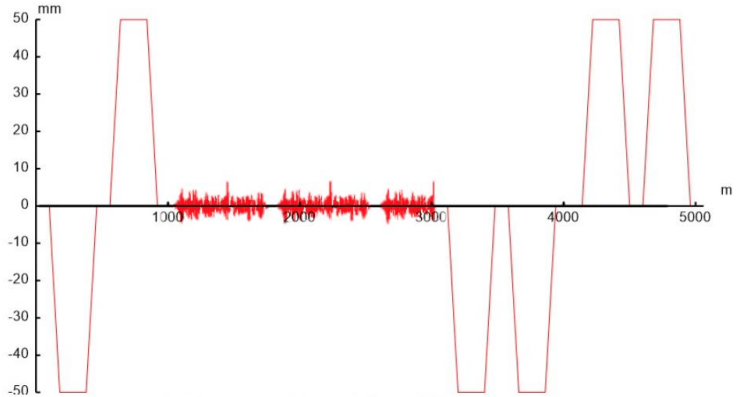
Modeling: Track



Total railroad length: 5 km
Two curves (Left - Right)
Section with lateral and vertical irregularities (measured on each rail and converted to Space Curve).
2 curves to Left and 2 curves to Right.
Carajas railroad: 860 m radius, 80 m transient, 50 mm superelevation, 200 m length.
Vitoria-Minas railroad: 371 m radius, 80 m transient, 57.2 mm superelevation, 200 m length.



Superelevation

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RESULTS

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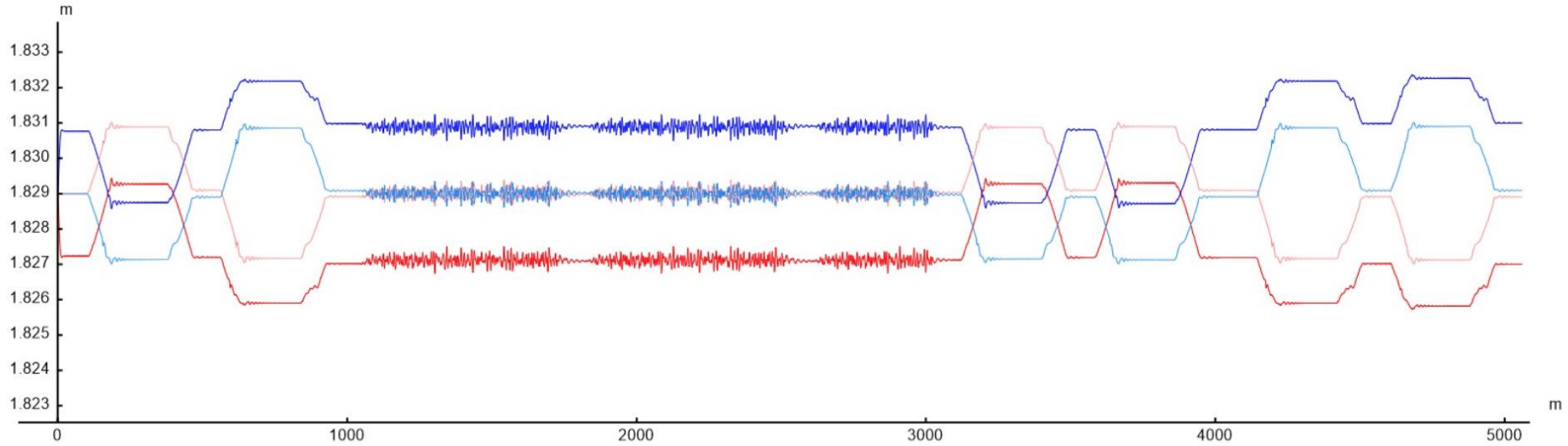
Results: Misalignment wheelset 1 in the GDT-Ride Control wagon



Misalignment: Right wheel.

Misalignment: Left Wheel.

Benchmark: Right wheel.

Benchmark: Left Wheel.

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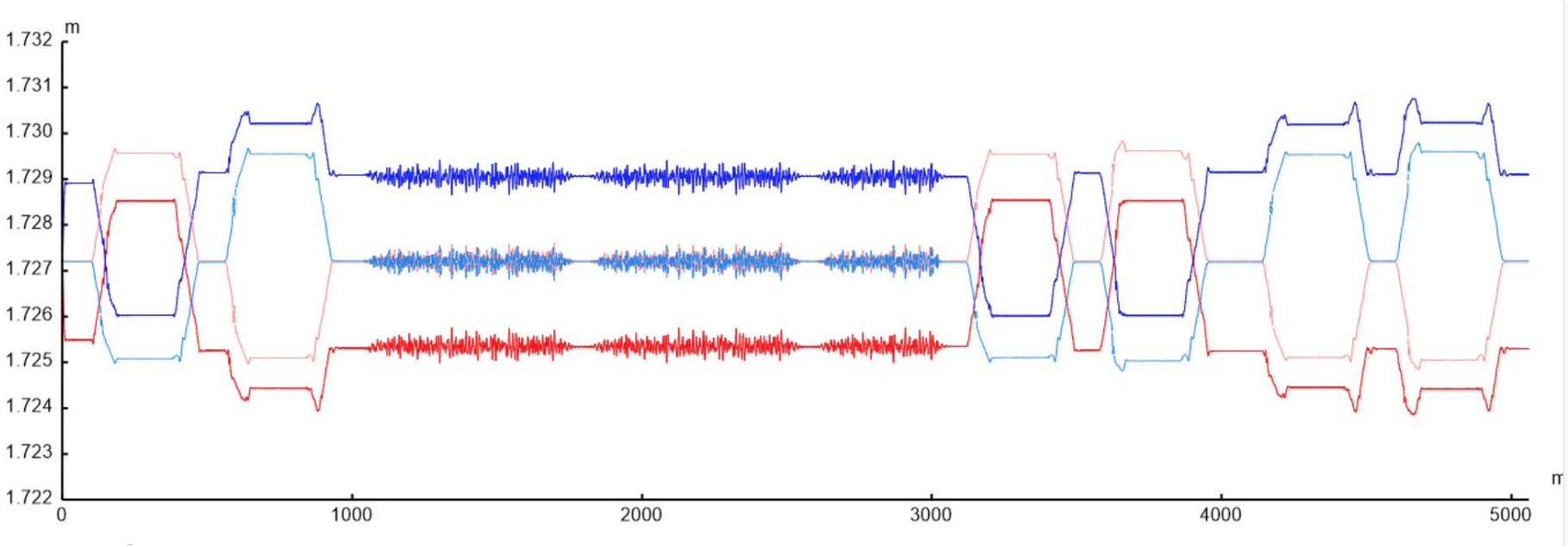
Results: Misalignment wheelset 1 in the GDE-Ride Control wagon



Misalignment: Right wheel.

Misalignment: Left Wheel.

Benchmark: Right wheel.

Benchmark: Left Wheel.

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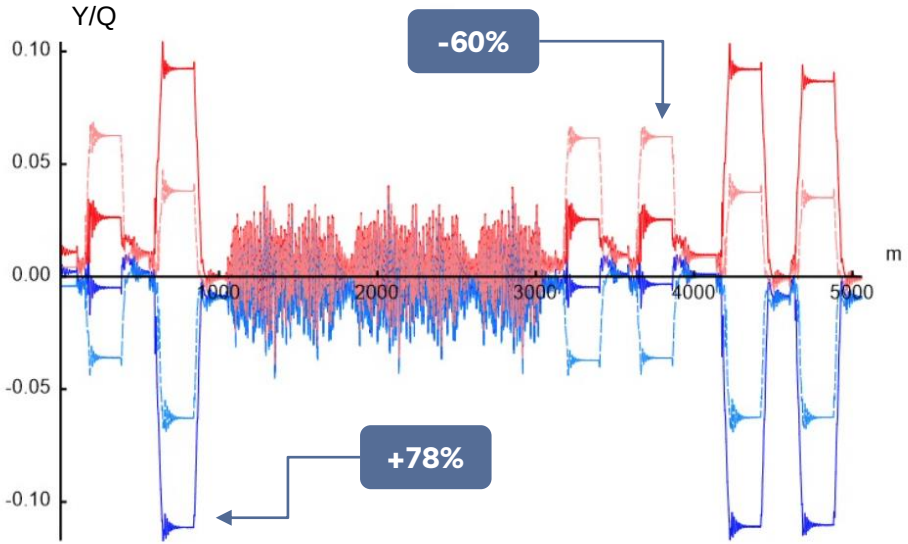
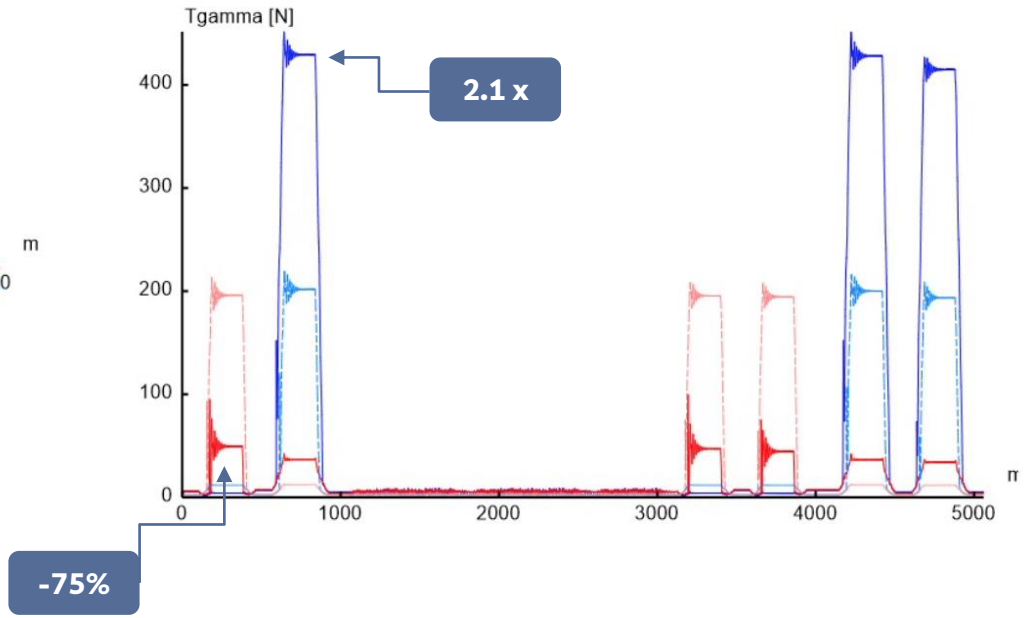
Results: Y/Q and wear on wheel - wheelset 1 of the GDT-Ride Control wagon





Misalignment: Right wheel.

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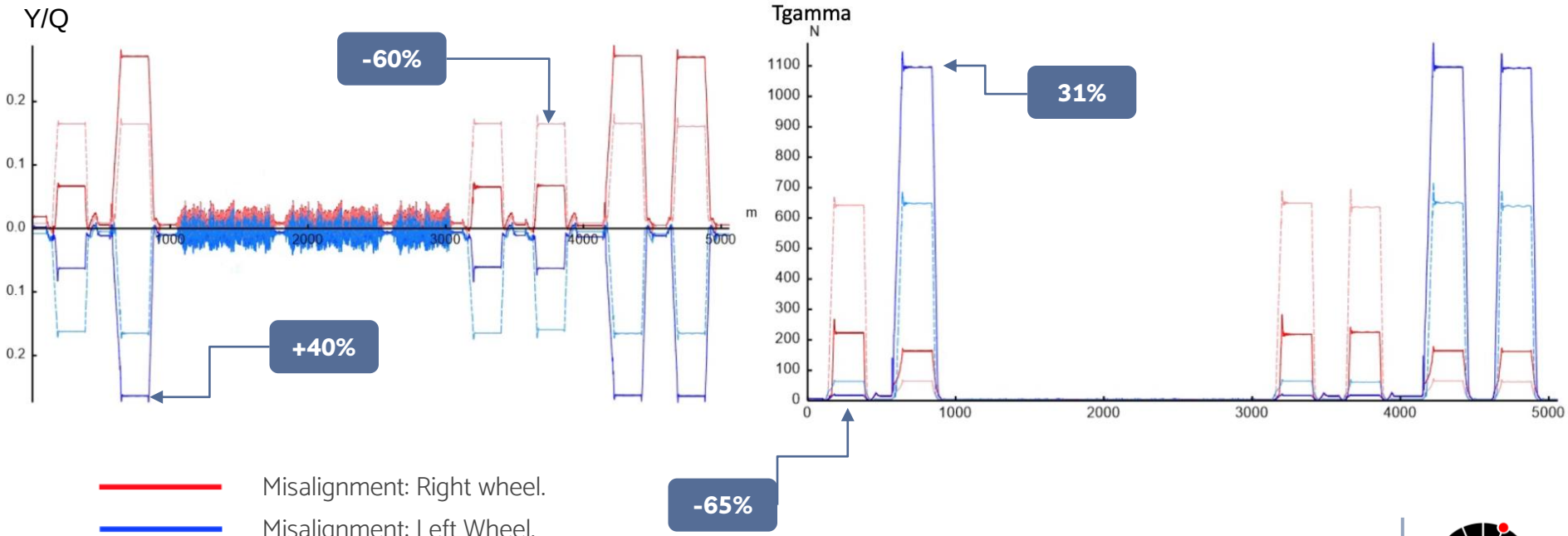

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FUTURE STUDIES

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FUTURE STUDIES

Triple cars

Run this simulation with three coupled cars to evaluate the consequence including longitudinal coupling efforts

Combined effects

Combining the effects of misaligned wheelsets with other parameters

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CONCLUSIONS

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CONCLUSIONS

1. The use of MBS software facilitates the process of evaluating certain dynamic behaviors that would be costly, or even impossible to intentionally impose in the real world. Thus, it is a valuable tool to predict risks and wear;

2. This modeling allows the analysis of misaligned wheelsets with fixed off-position and its consequence on derailment coefficient and wheel wear;

3. The misaligned models increase Y/Q and wear depending on the curve direction and decrease in the opposite direction due to wheelset steering and curving negotiation;

4. Although the models operate within safety parameters with misaligned wheelsets, the wear increase represents uneven wheel wear that can lead to premature maintenance and an increase in wheel replacement cost.

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THANKS

Does anyone have any question?
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