

# Dynamic Analysis of FWD Data



9<sup>th</sup> European FWD User Group Meeting



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# Outline



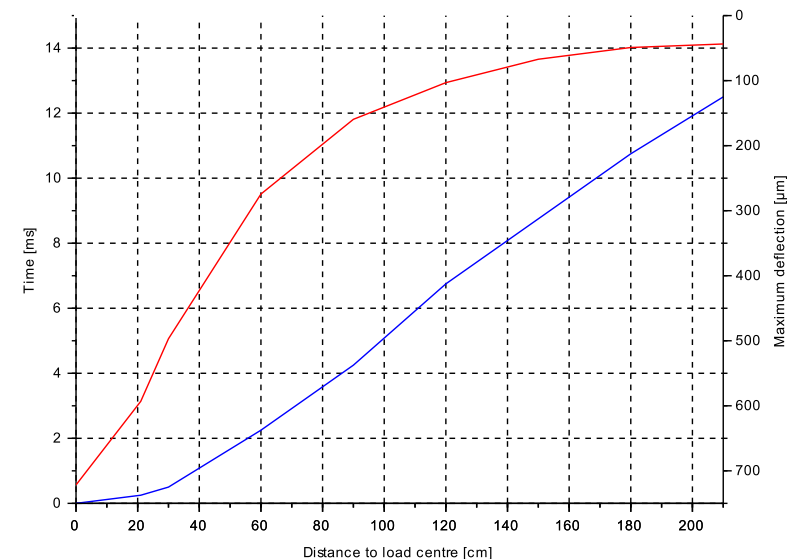
- 
- Introduction
  - Mechanical Fundamentals
  - Methods and Data
  - Results and Discussion

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# INTRODUCTION

# Time History

- FWD is capable of recording the evolution of a deflection for a time period of 60 ms with a resolution of 4 kHz
- problem with this procedure: peak deflections do not occur simultaneously
- static backcalculation methods are always flawed by the assumption of a static deflection bowl



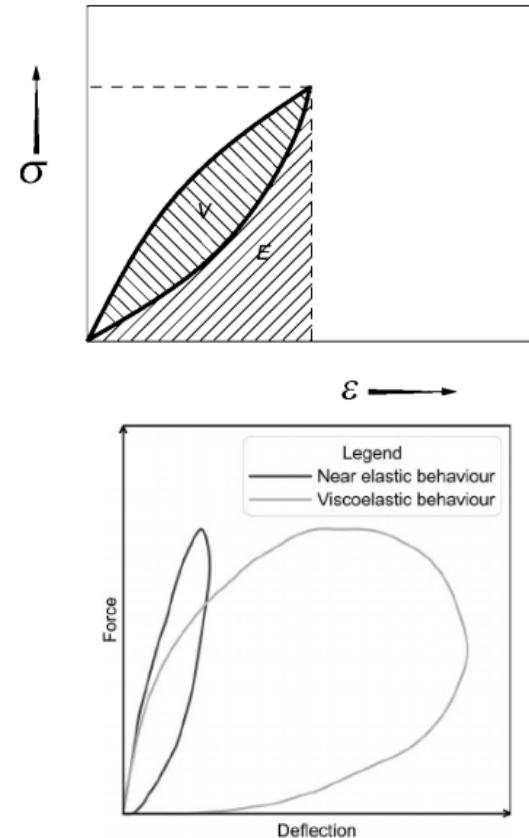
Measured deflection bowl (red curve) and time shift of deflection maxima (blue curve)

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# MECHANICAL FUNDAMENTALS

# Mechanical Fundamentals

- “hysteresis” loops: information about elastic and dissipated work
- concrete pavements react totally different to the impulse load of the FWD than asphalt pavements
- area within the loop is depending on the asphalt temperature and the structural substance

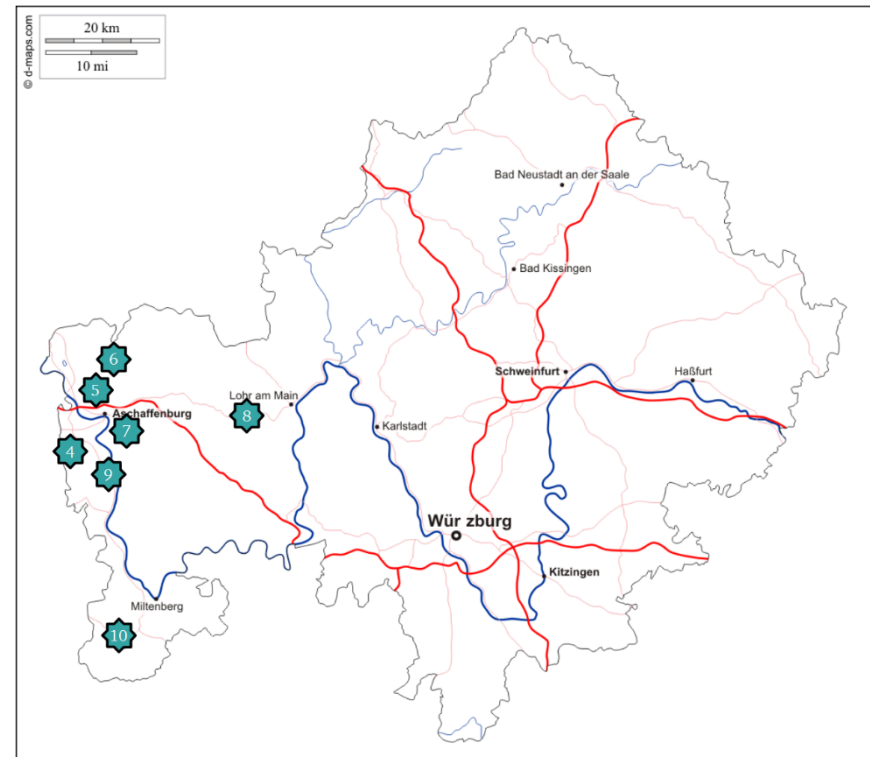
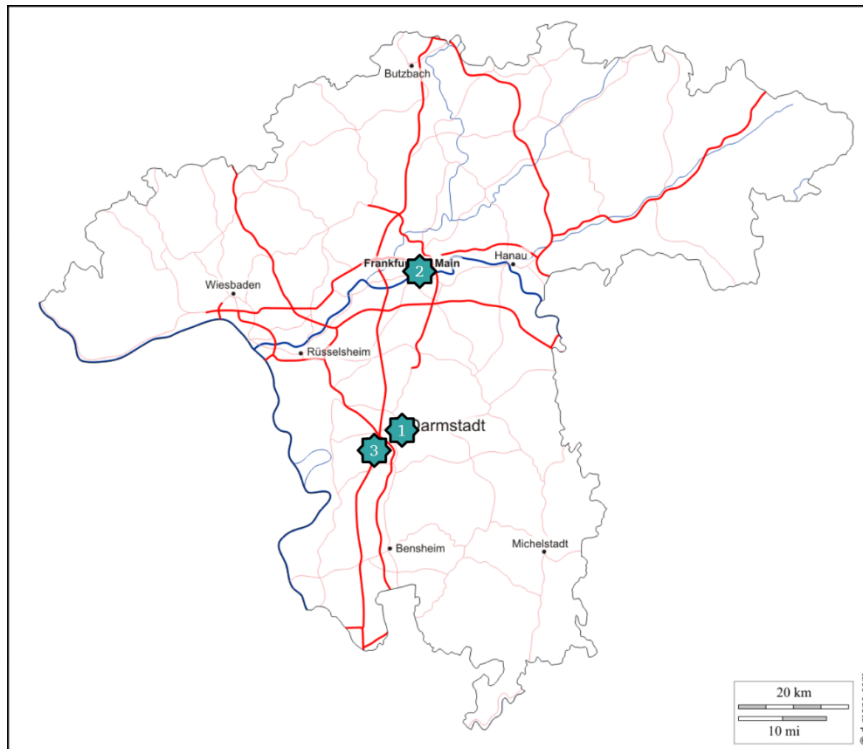


(a) Basic principle of dissipated and elastic work in hysteresis loops (Figura 2004); (b) Different load-displacement loops depending on the pavement type (Deblois et al. 2010)

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# **METHODS AND DATA**

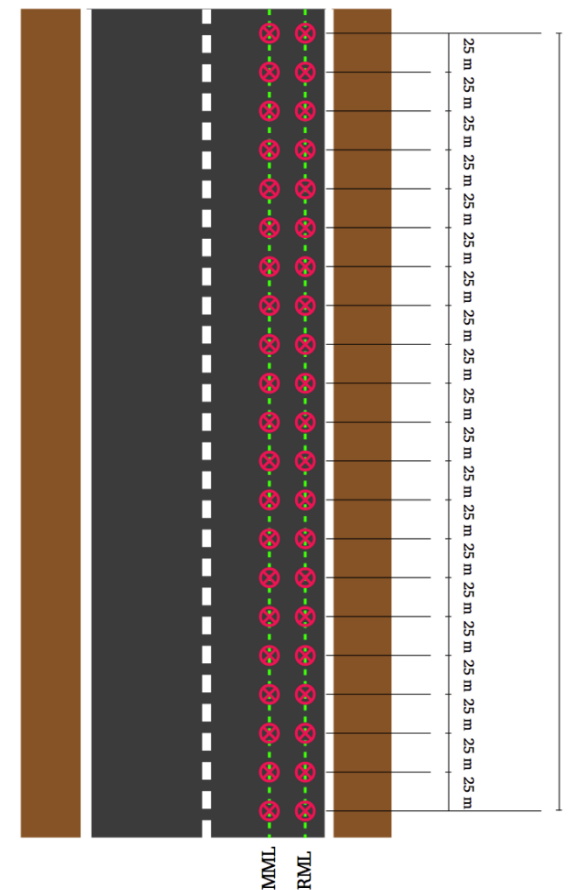
# Measuring Scheme





# Measuring Scheme

- measurement in the right wheel track and middle of the lane (if possible, depending on the overall width of the road)
- measuring grid of 25 m
- total measuring length of 500 m
- reference load of 50 kN



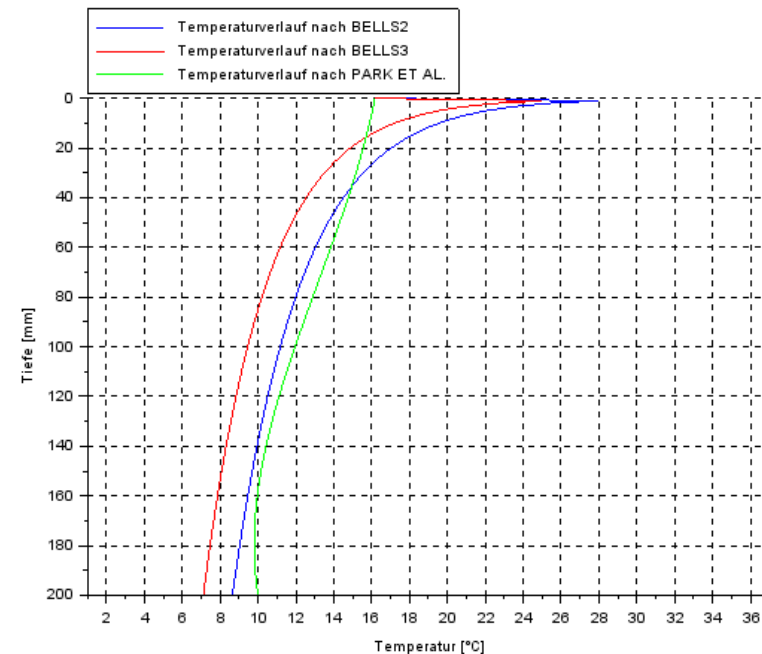
# Measuring Scheme

- ten measuring tracks
- different road categories (federal highways, rural roads, municipal roads)
- differing pavements (regarding overall thickness)
- one track made out of concrete

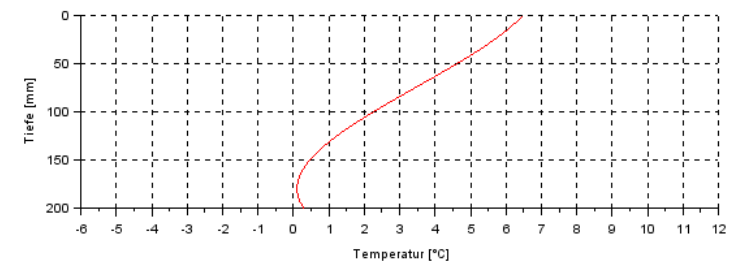
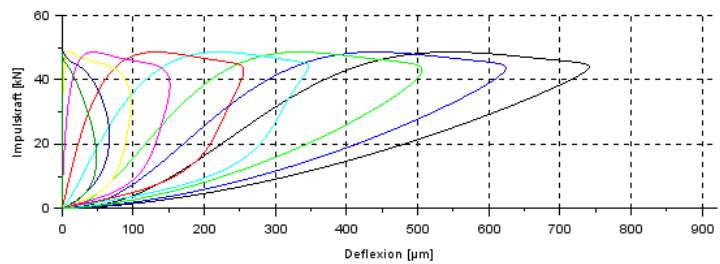
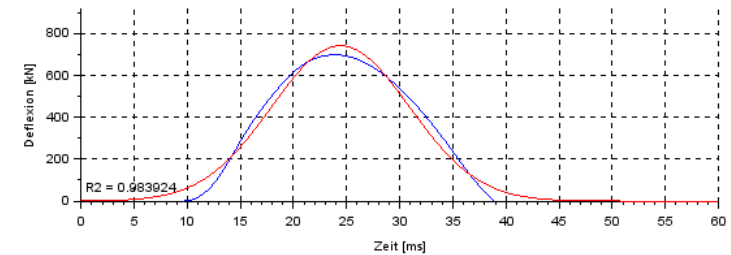
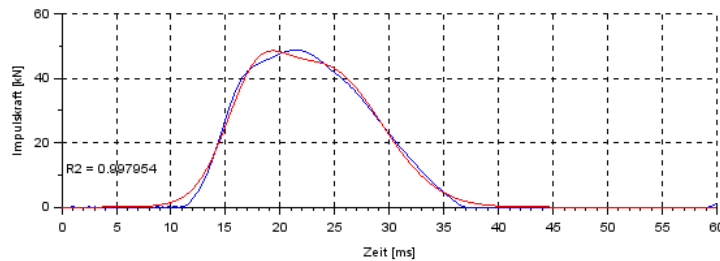
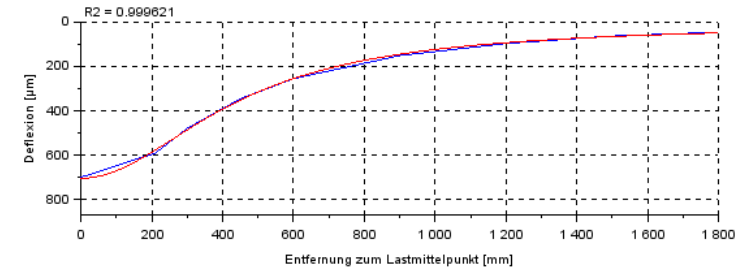
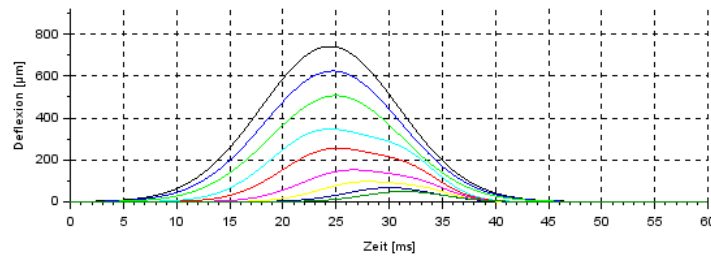
	MK 1	MK 2	MK 3	MK 4	MK 5	MK 6
MS 1	10.01.2017	07.03.2017	03.04.2017	31.05.2017	18.07.2017	16.11.2017
MS 2	03.04.2017	31.05.2017	23.11.2017	-	-	-
MS 3	07.03.2017	03.04.2017	31.05.2017	18.07.2017	23.11.2017	-
MS 4	11.01.2017	08.03.2017	04.04.2017	01.06.2017	19.07.2017	16.11.2017
MS 5	11.01.2017	08.03.2017	04.04.2017	01.06.2017	19.07.2017	16.11.2017
MS 6	11.01.2017	08.03.2017	04.04.2017	01.06.2017	19.07.2017	16.11.2017
MS 7	11.01.2017	08.03.2017	04.04.2017	01.06.2017	19.07.2017	16.11.2017
MS 8	11.01.2017	08.03.2017	04.04.2017	01.06.2017	19.07.2017	16.11.2017
MS 9	10.01.2017	07.03.2017	03.04.2017	31.05.2017	18.07.2017	23.11.2017
MS 10	10.01.2017	07.03.2017	03.04.2017	31.05.2017	18.07.2017	23.11.2017

# Post-Processing

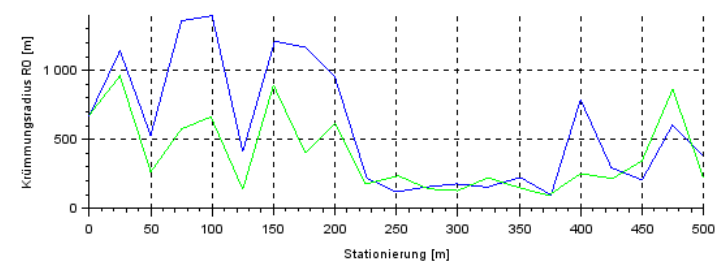
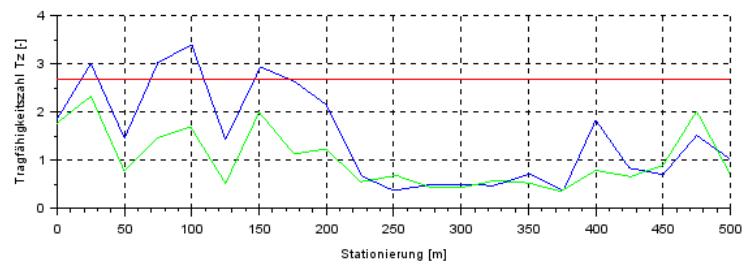
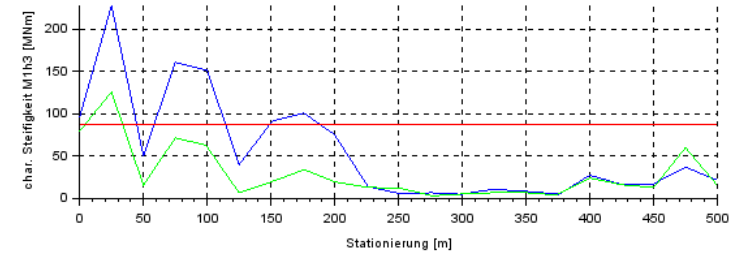
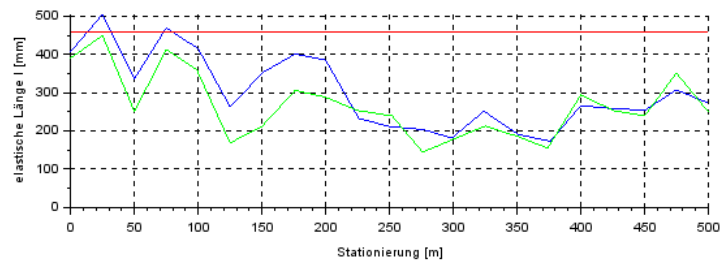
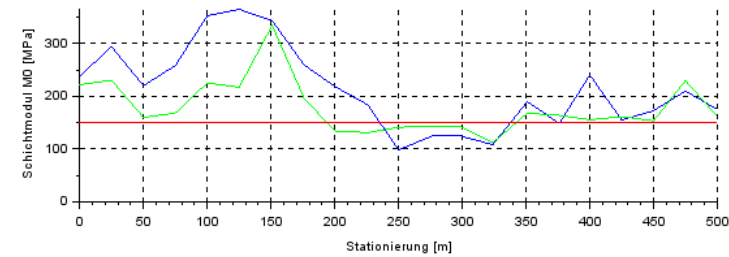
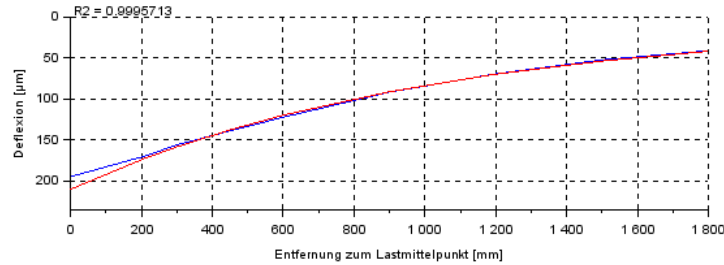
- data processing in SciLab
- linear adjustment to reference load of 50 kN
- no temperature correction
- curve fitting of load and deflection time histories seemed inadequate
- modelling of temperature profile (cross section) with thermal model of PARK ET AL.



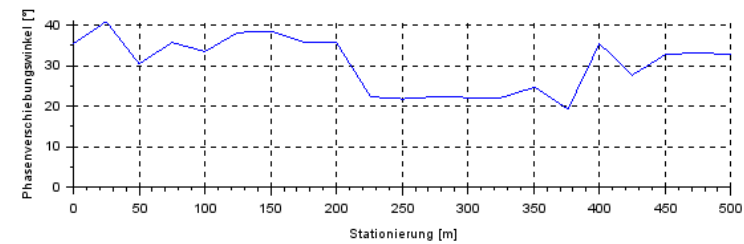
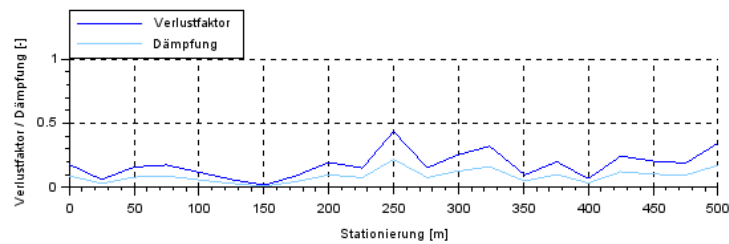
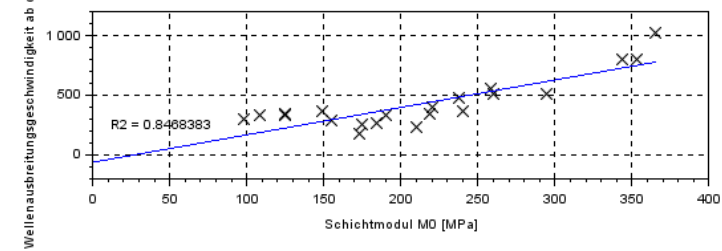
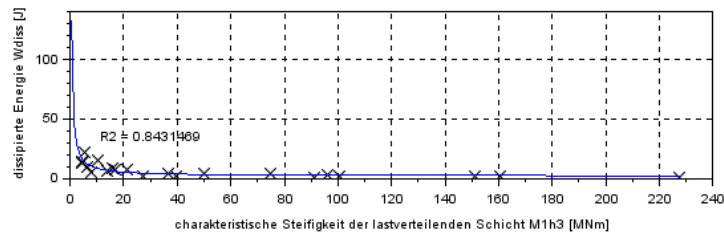
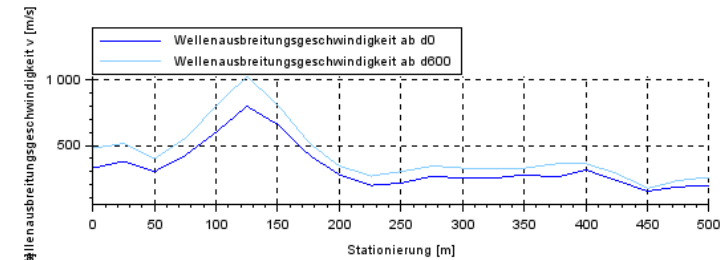
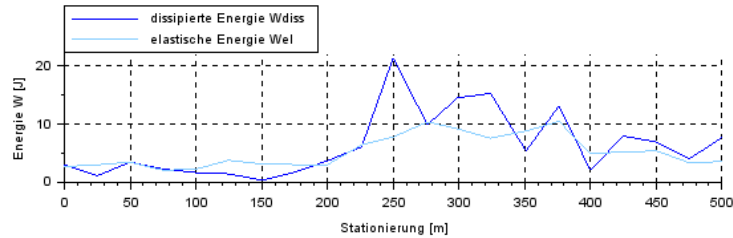
# Visualisation of Data



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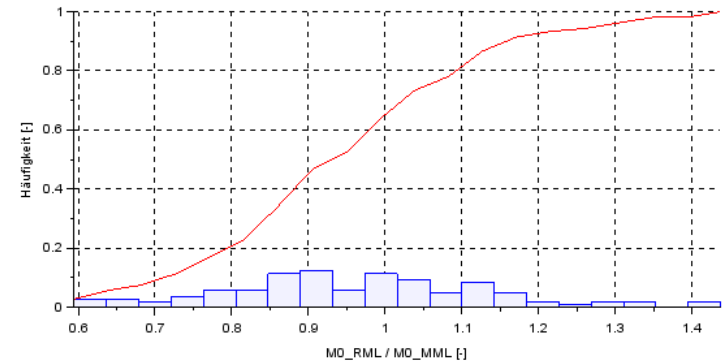
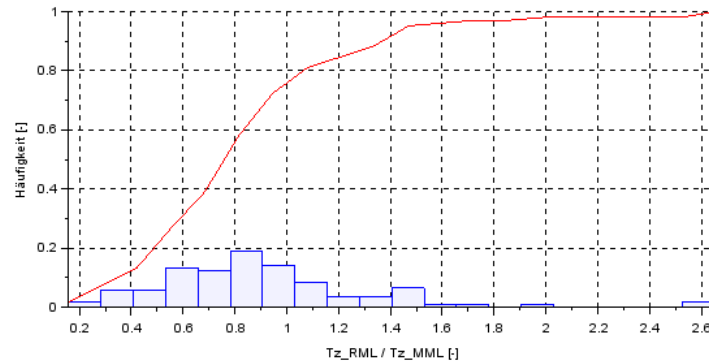
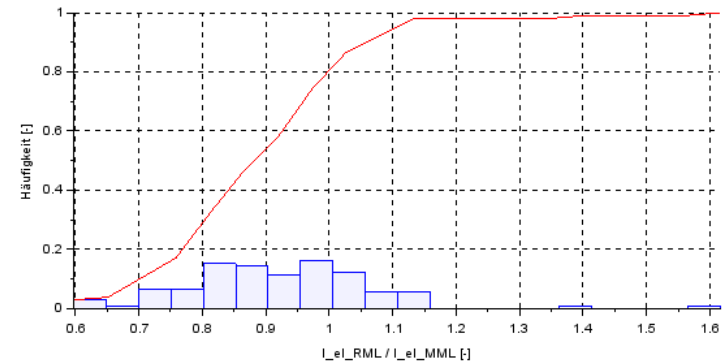
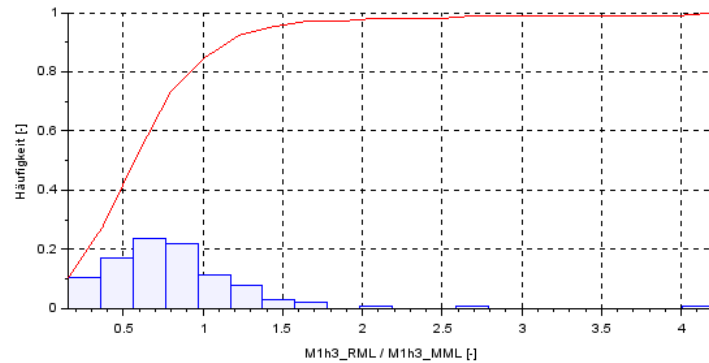
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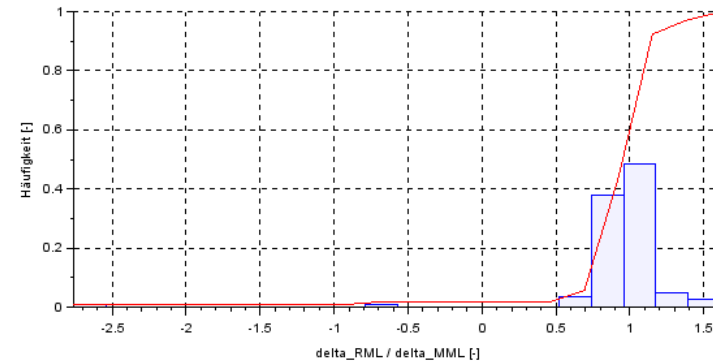
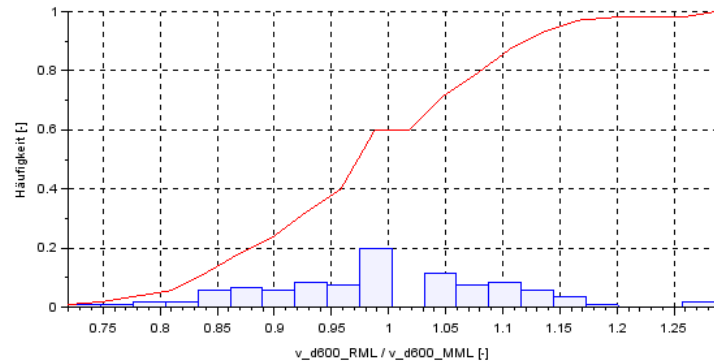
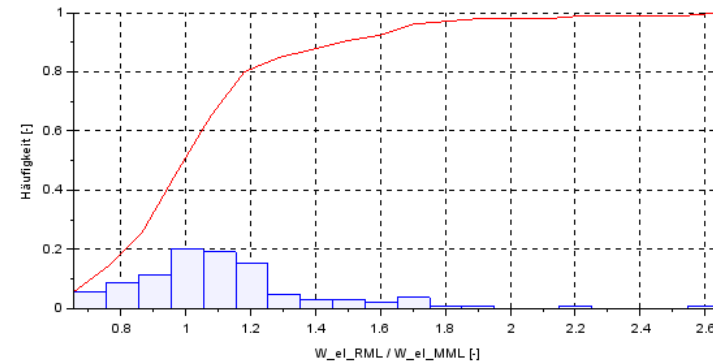
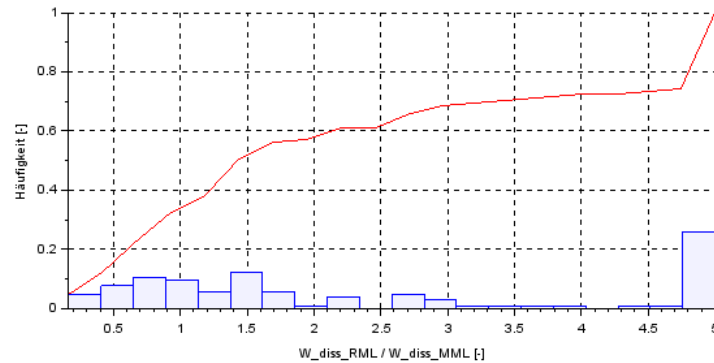
# RESULTS AND DISCUSSION

# Comparison: Right Wheel Track vs. Middle of the Lane (Static Parameters)

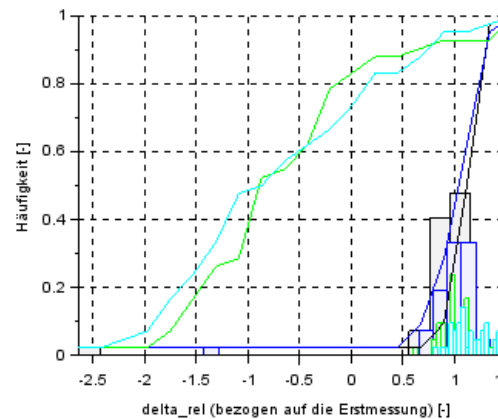
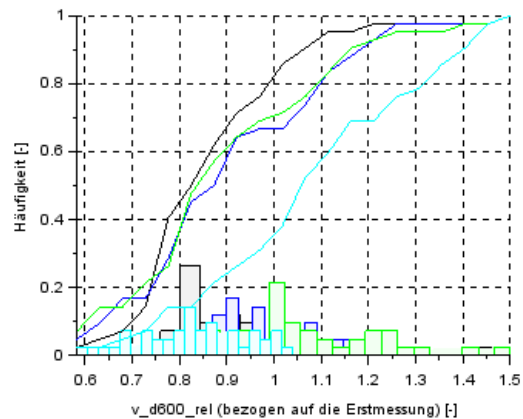
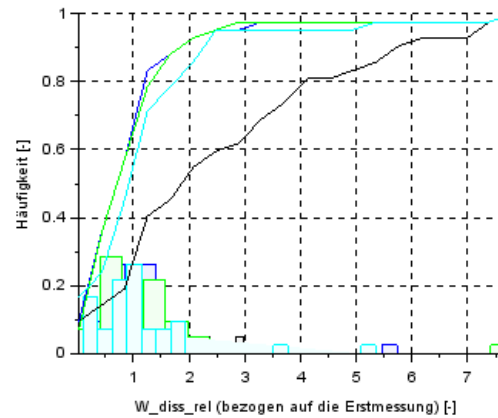
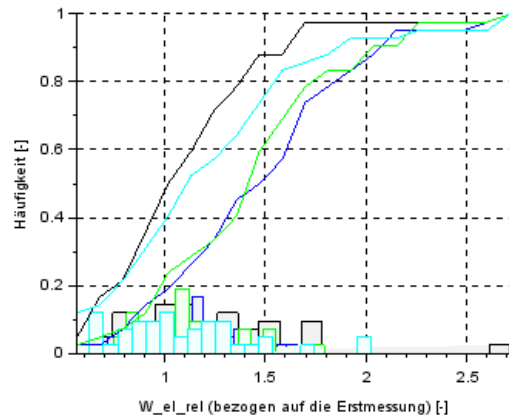




# Comparison: Right Wheel Track vs. Middle of the Lane (Dynamic Parameters)



# Evolution of Dynamic Parameters



Comparison of measurements and dynamic backcalculations between: reference measurement made in January 2017. March 2017 (black curve), April 2017 (blue curve), June 2017 (light green curve), November 2017 (turquoise curve)

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# Discussion



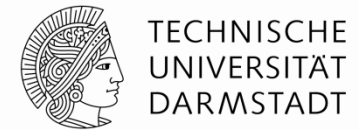
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- statistical evaluation of data / backcalculated parameters still ongoing
  - first results seem to be quite interesting
  - FE modelling as a means of validation still to be done

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# REFERENCES

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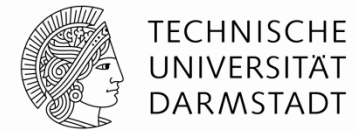
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