Integration of Simulation and Testing in Power Train Engineering Based on the Example of the Dual Mass Flywheel

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Integration of Simulation and Testing in Power Train Engineering Based on the Example of the Dual Mass Flywheel

- Introduction and Methodology
- The Universal Power Train Test-Bench
- The Dual Mass Flywheel - Function and Design
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- Validation
- Summary and Conclusions

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Experiment

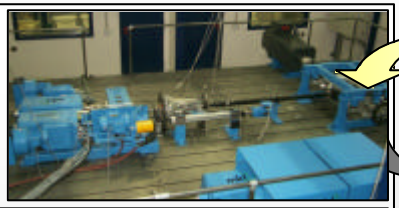
Drive Test

Customer requirements, comfort, life

Roller Test Stand (scheduled)

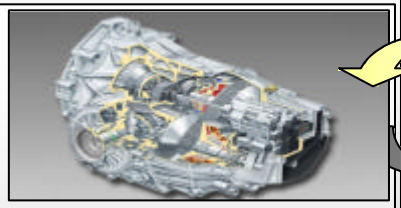
Power Train Test-Bench

Complete power trains, components



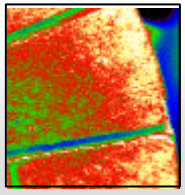
Sub-system

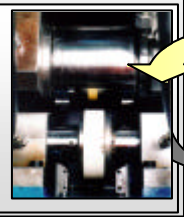
Transmissions, rolling- and sliding bearings



Element

Frictional function systems, EHD-systems





Simulation

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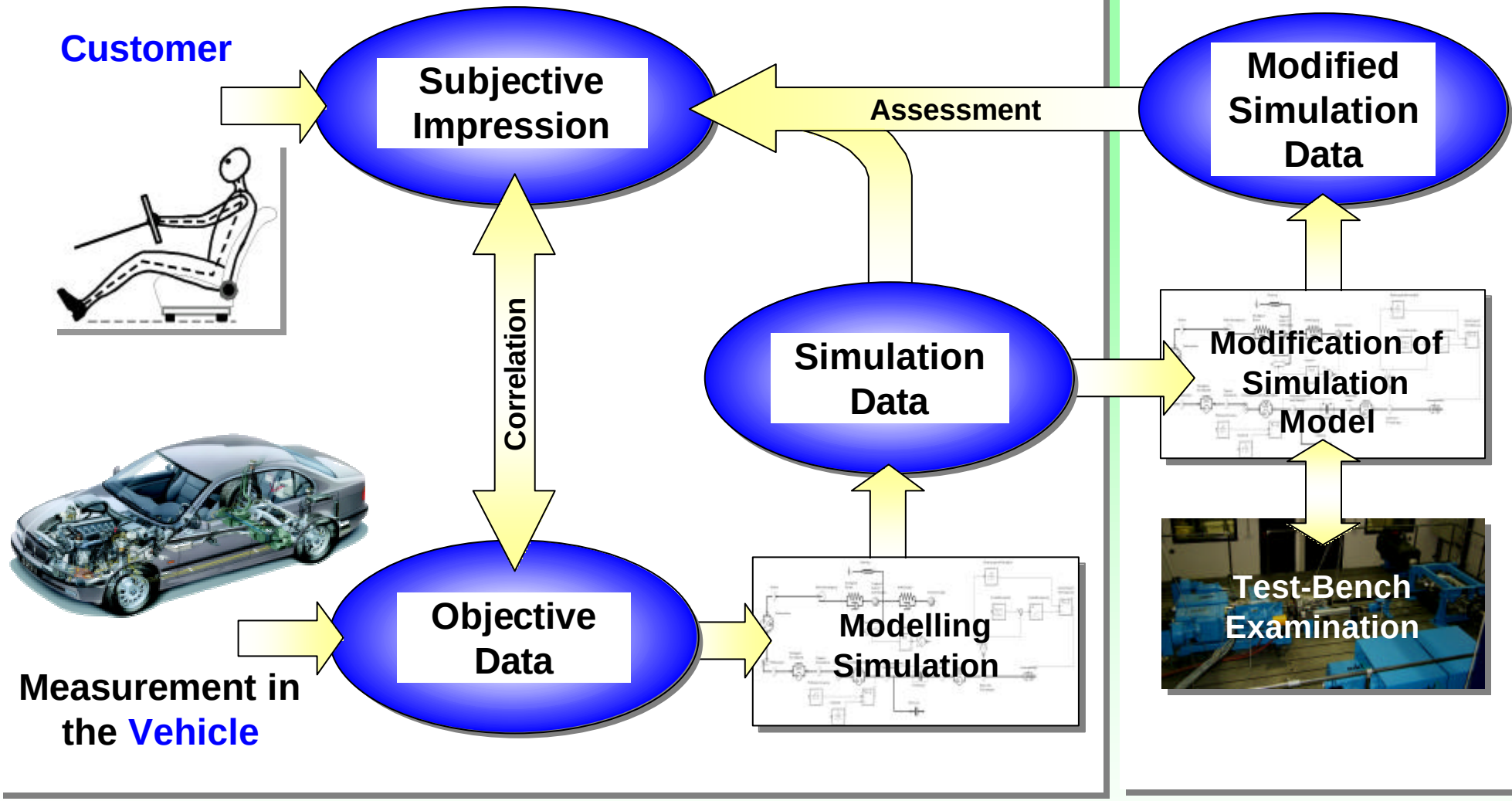
Customer
Subjective Impression
Assessment
Modified Simulation Data
Correlation
Simulation Data
Modification of Simulation Model
Test-Bench Examination
Objective Data
Modelling Simulation
Measurement in the Vehicle

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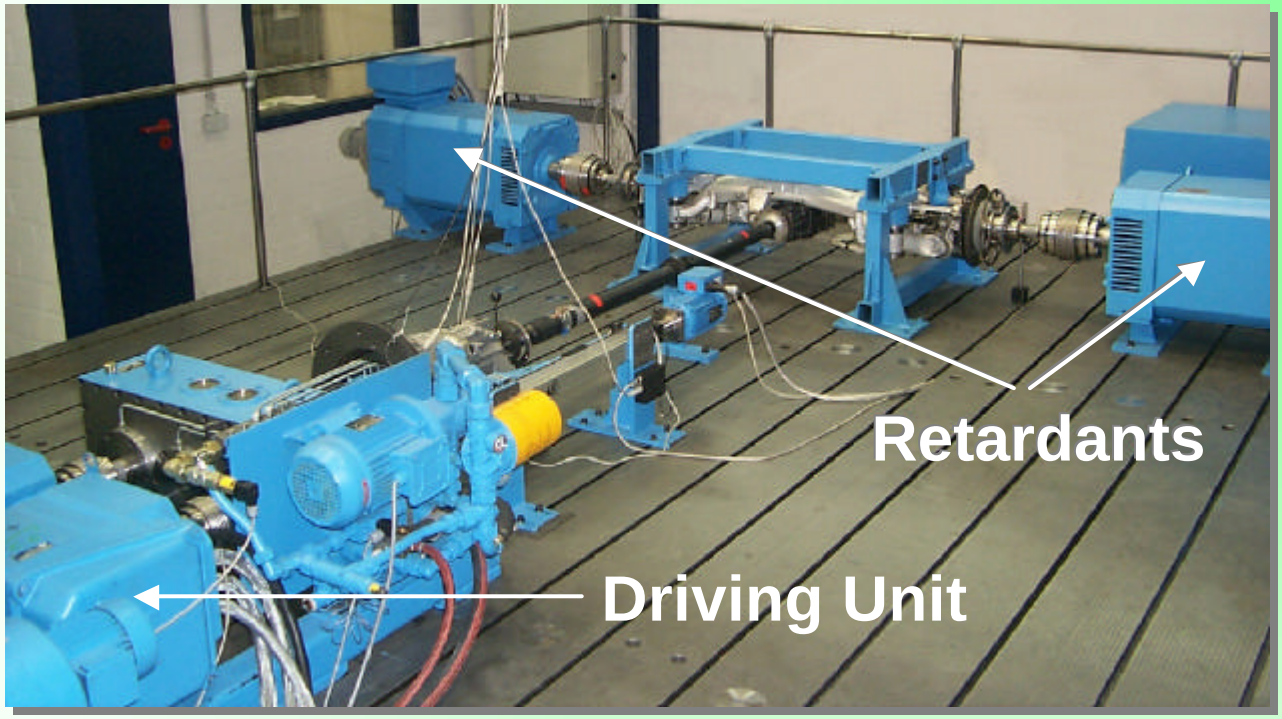

- Excitation frequencies up to 250 Hz
- Torque of driving unit in continuous operation up to 260 Nm
- Speed of driving unit up to 6900 rpm
- Simulation of vehicle mass done electrically by retardants
- Torque of driven machines up to 1500 Nm

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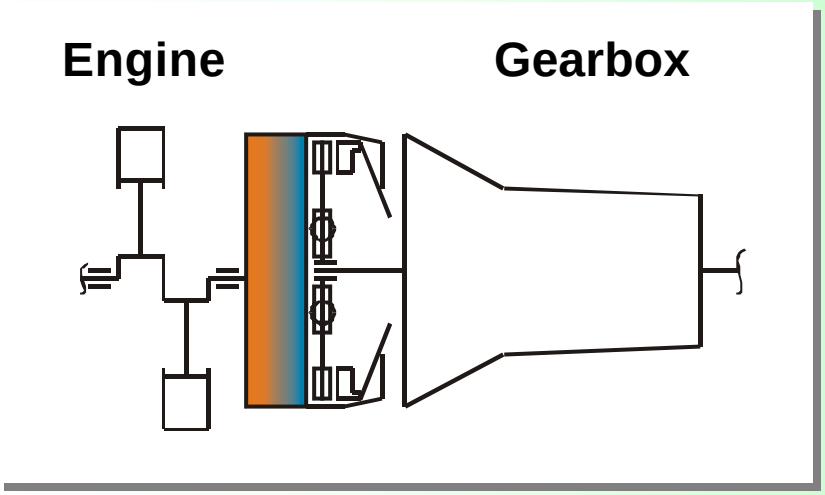
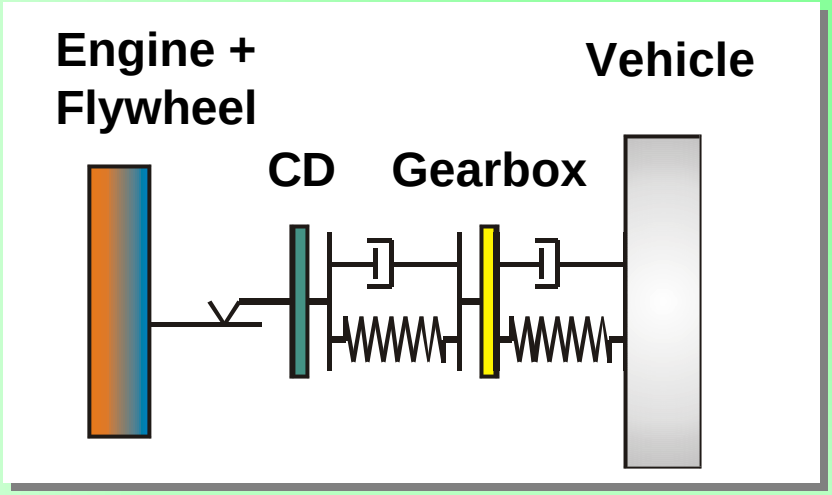
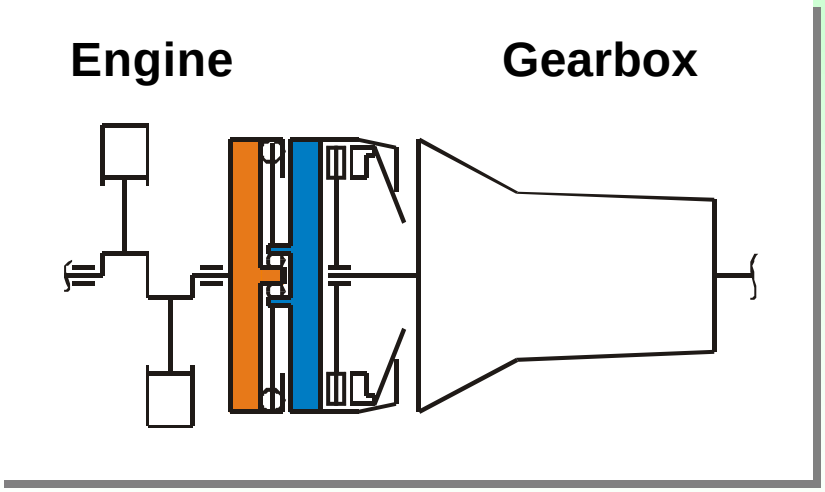
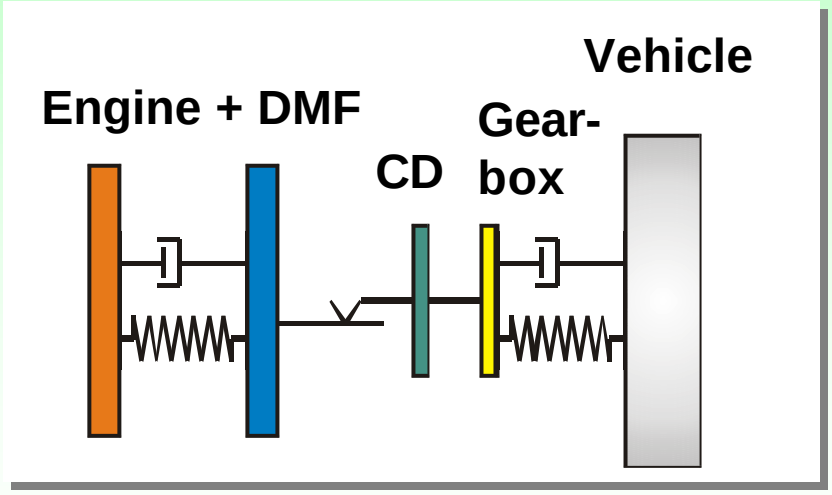
Powertrain with Conventional Clutch





Powertrain with Dual Mass Flywheel





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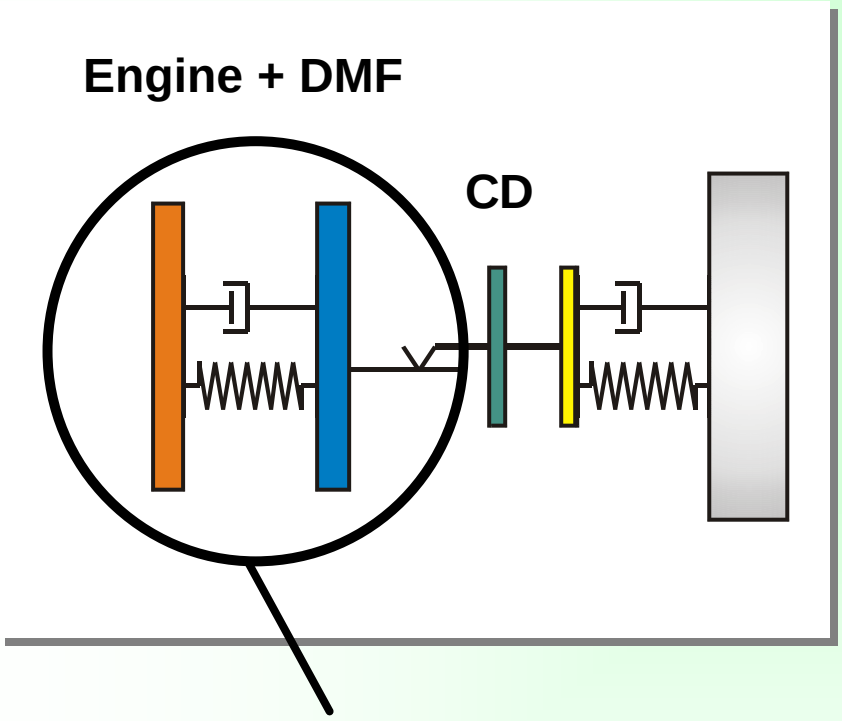
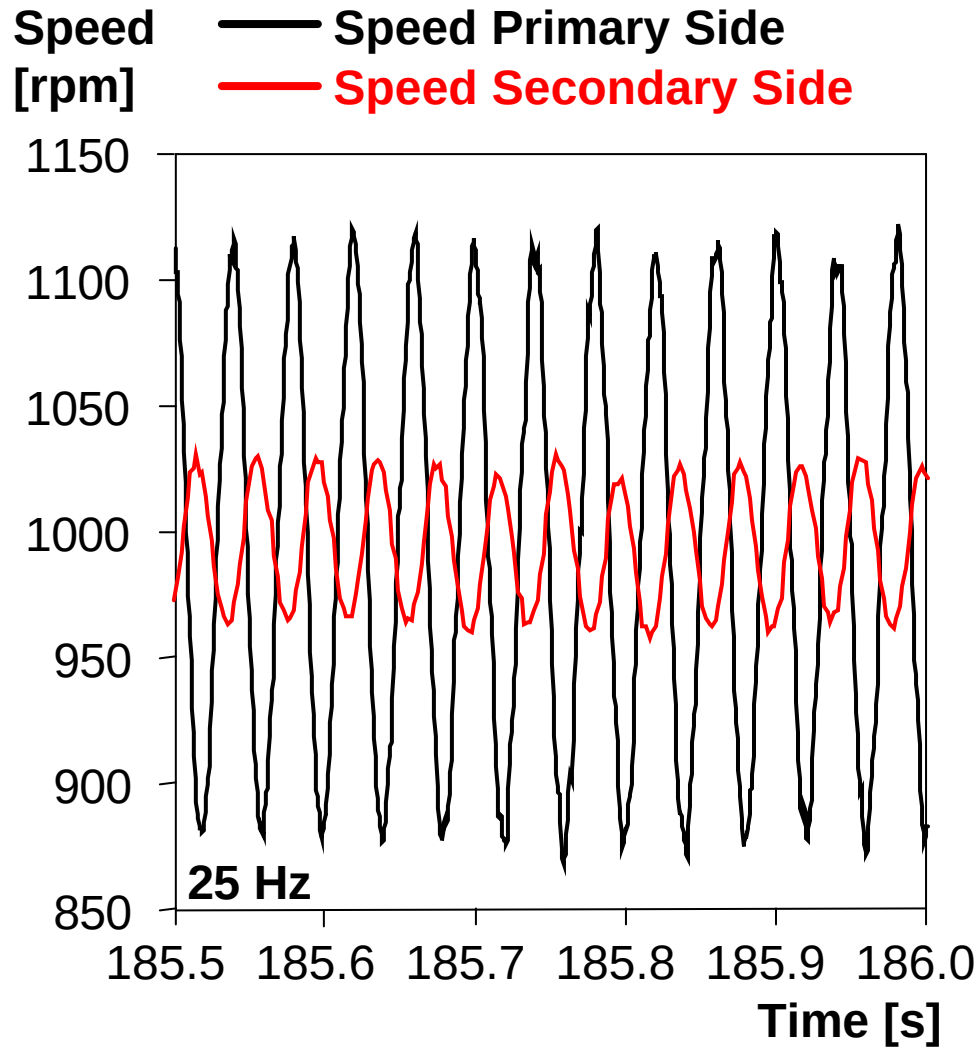


“Mechanical low-pass filter“



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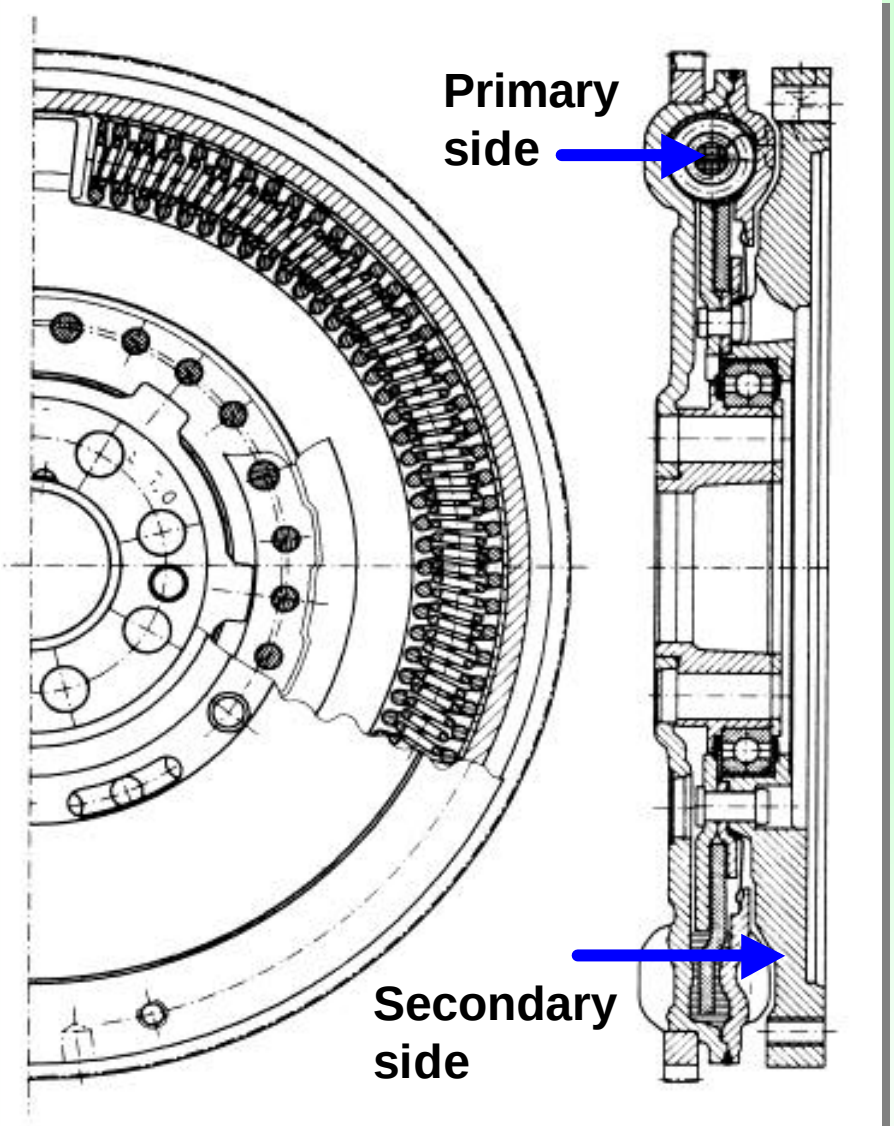
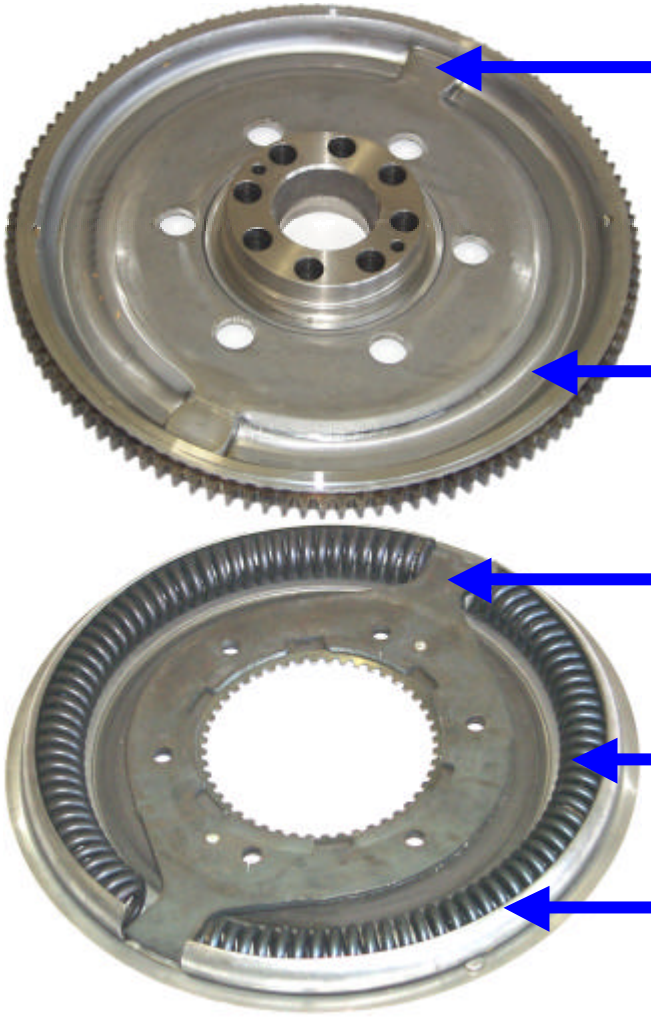


Primary side of a DMF:



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Design of the Dual Mass Flywheel

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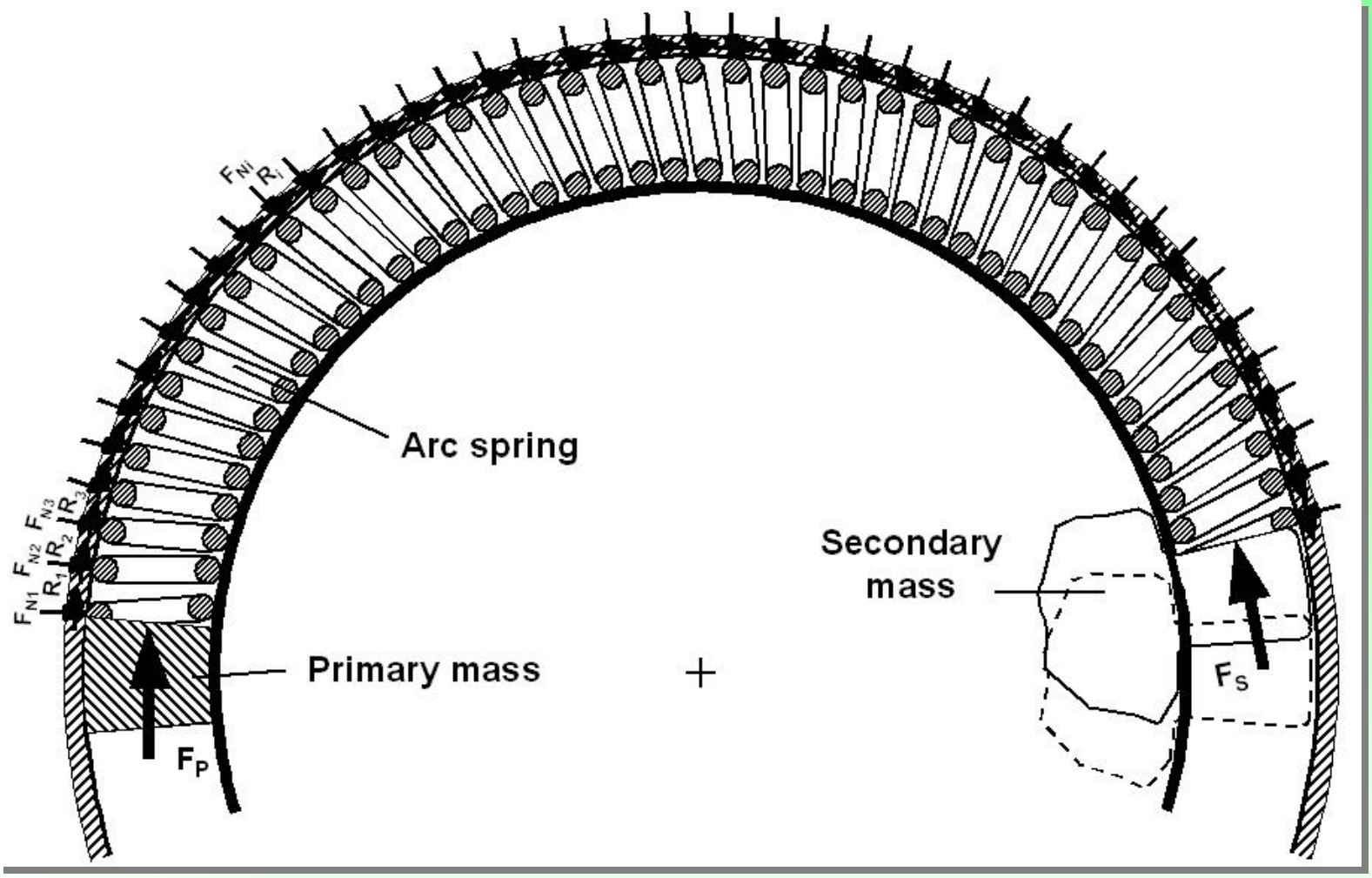

Forces between arc spring and support channel depend on angle of distorsion and rotary speed.

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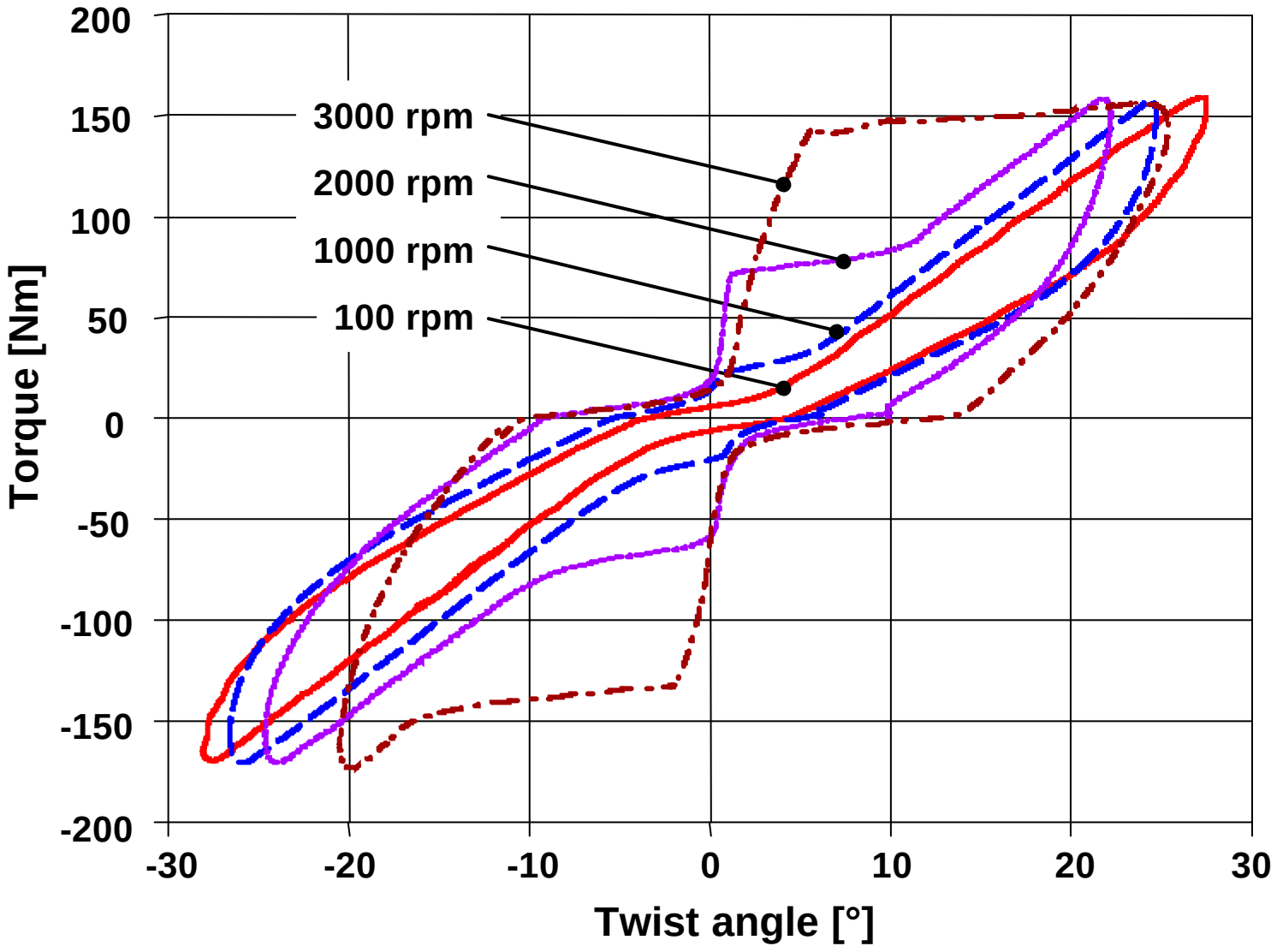

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Load Cycle Hysteresis Curves

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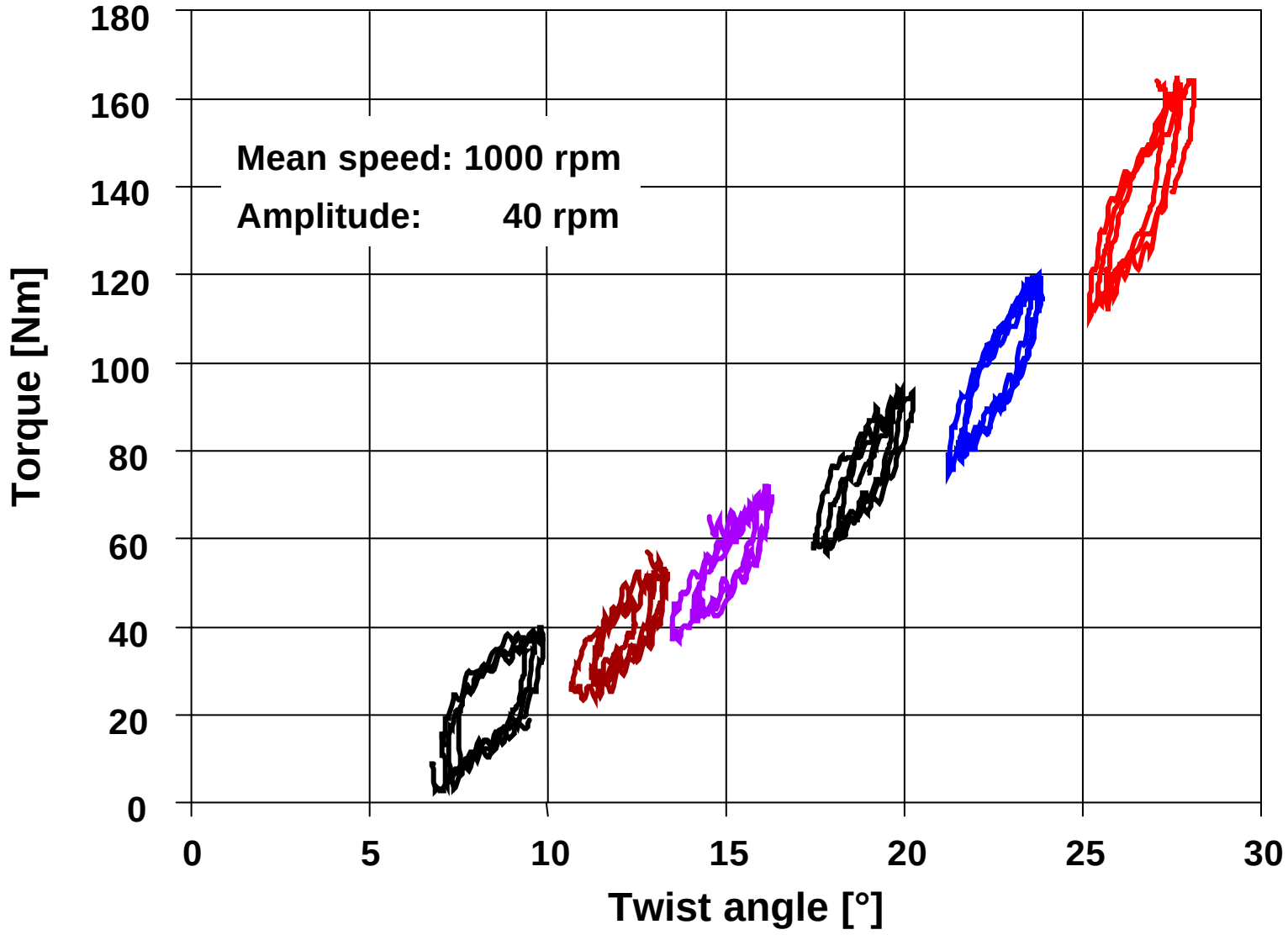

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Partial Hysteresis Loops

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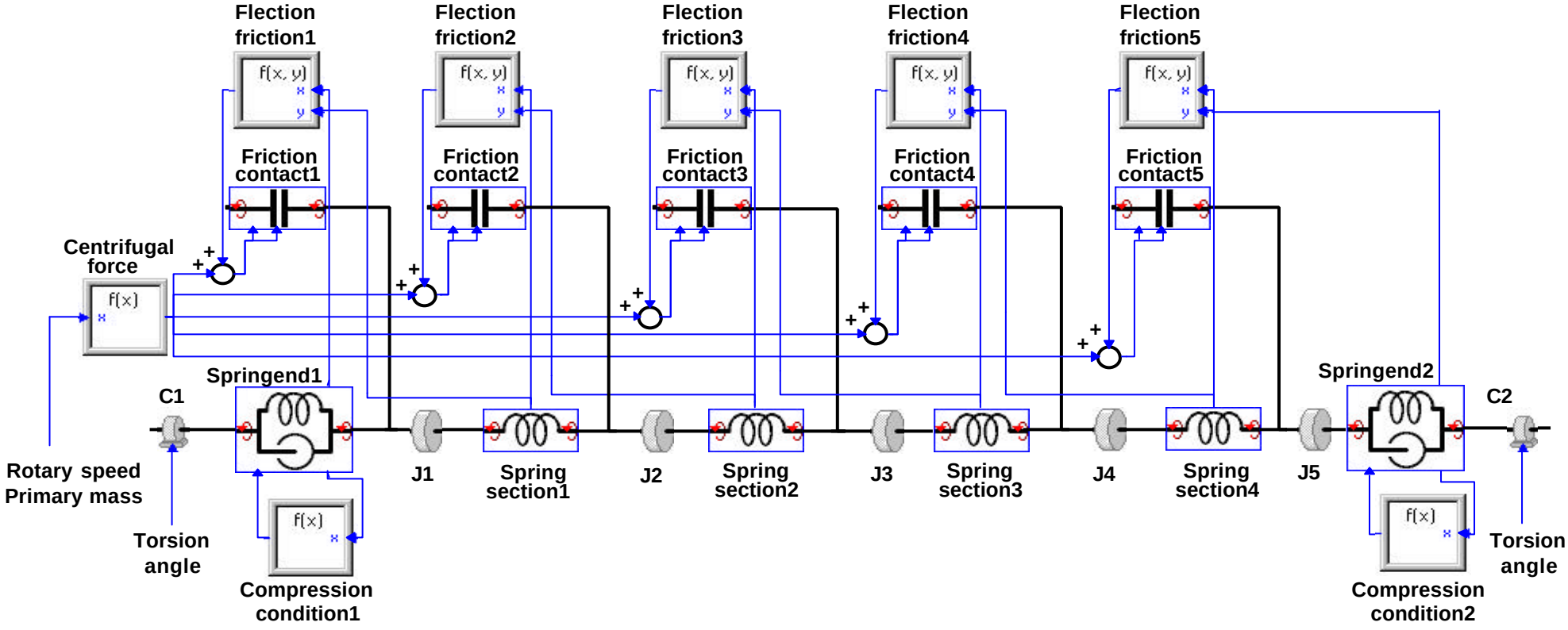
Multi-body Simulation Model of one Arc Spring



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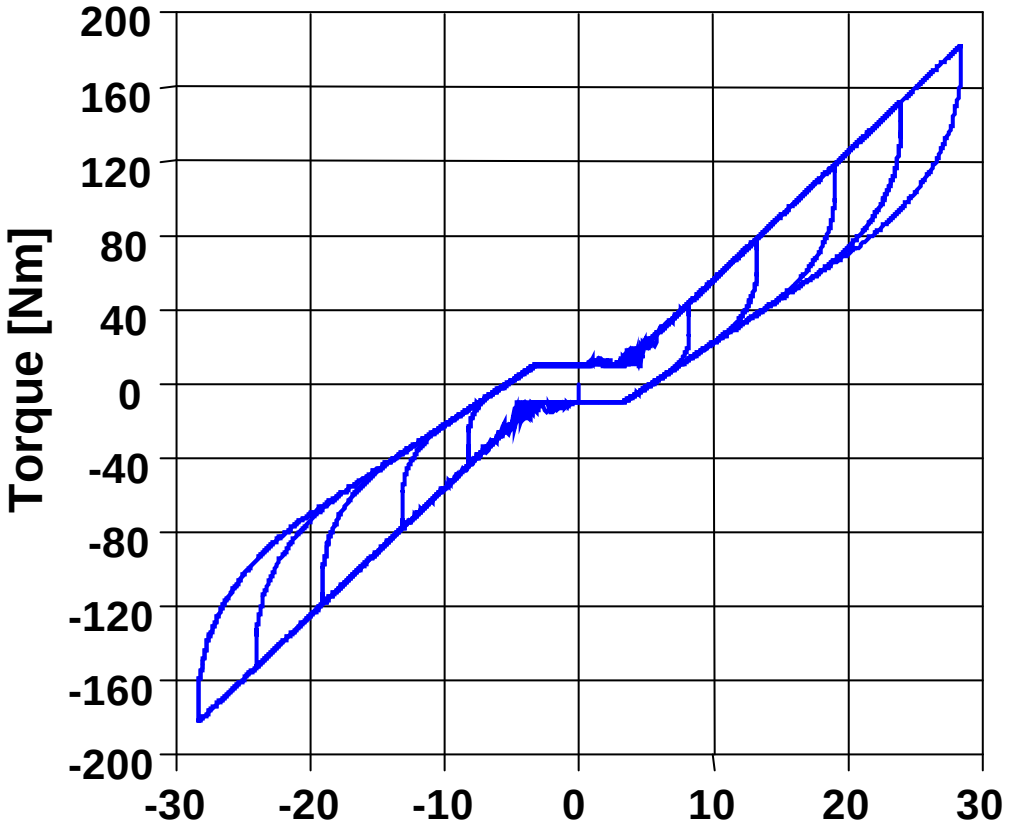
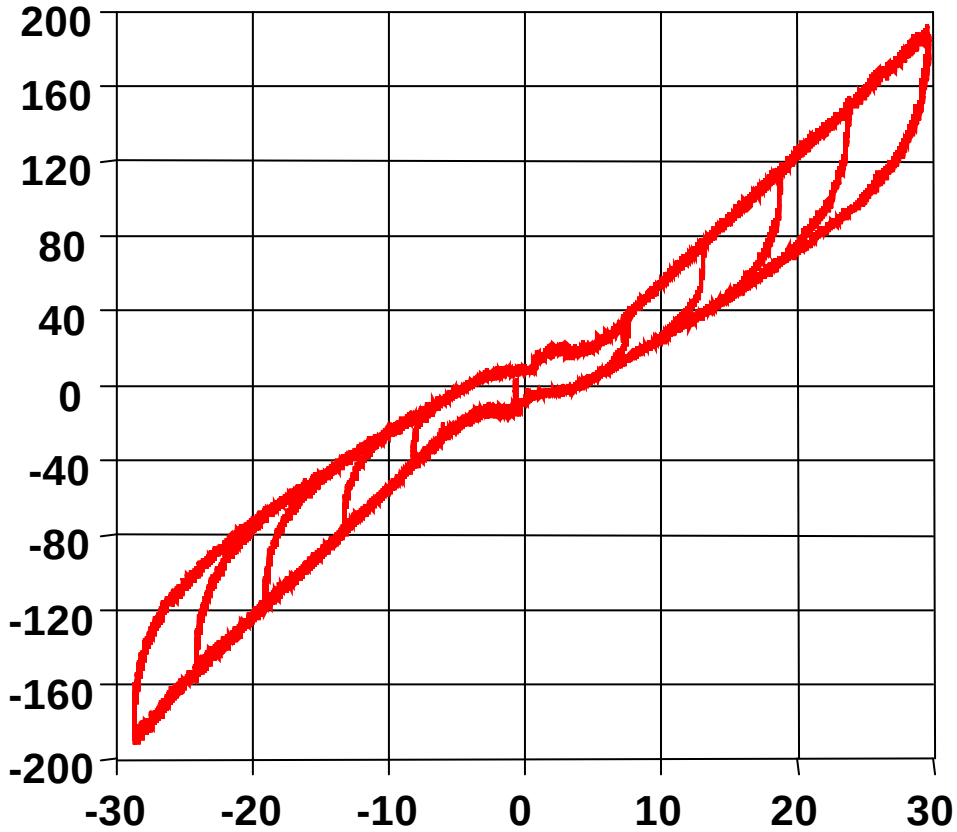
Load Cycle Hysteresis Curves at 200 rpm:





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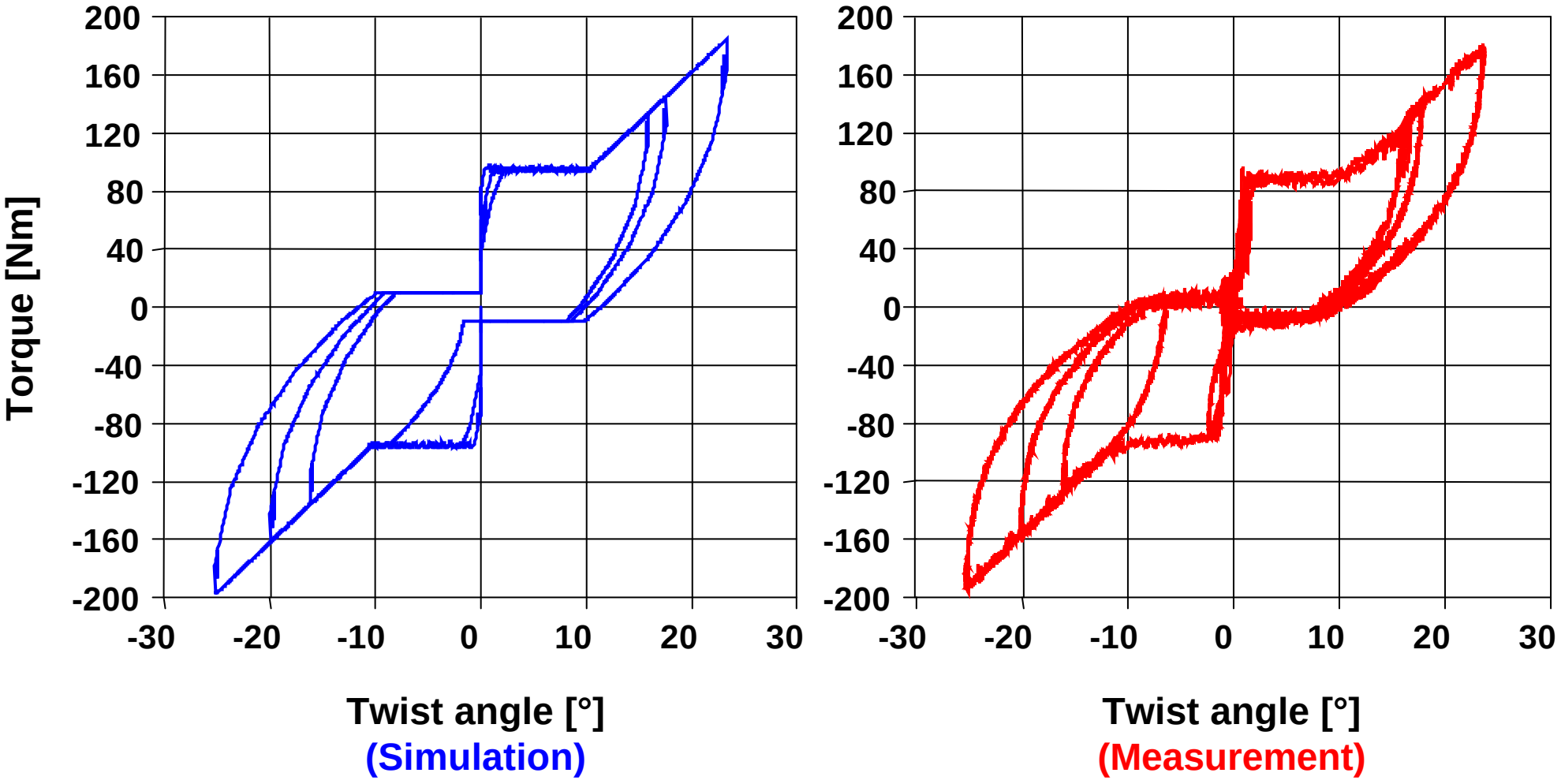
Load Cycle Hysteresis Curves at 2200 rpm:



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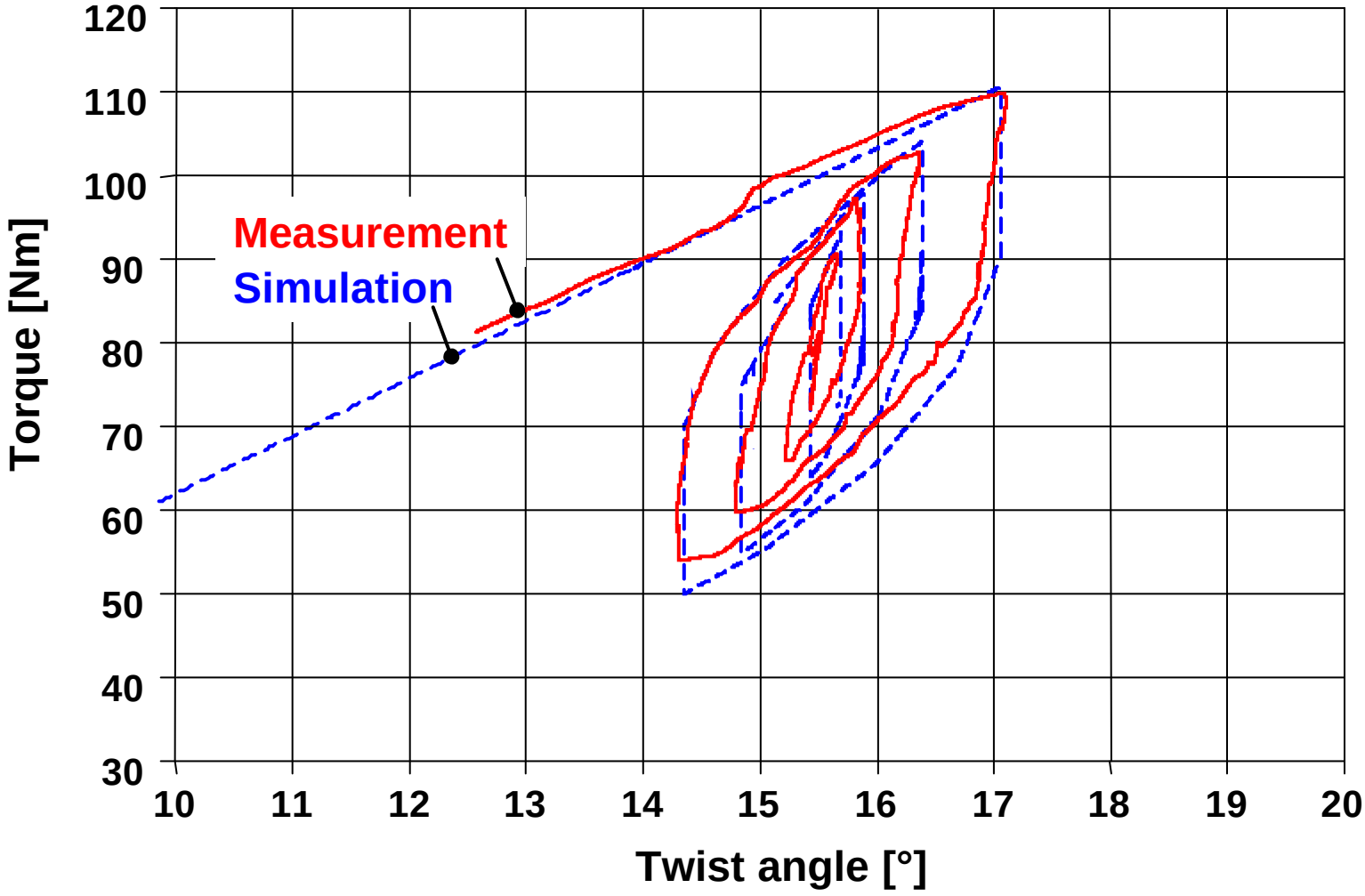
Partial Hysteresis Loops at 200 rpm and 80 Nm:



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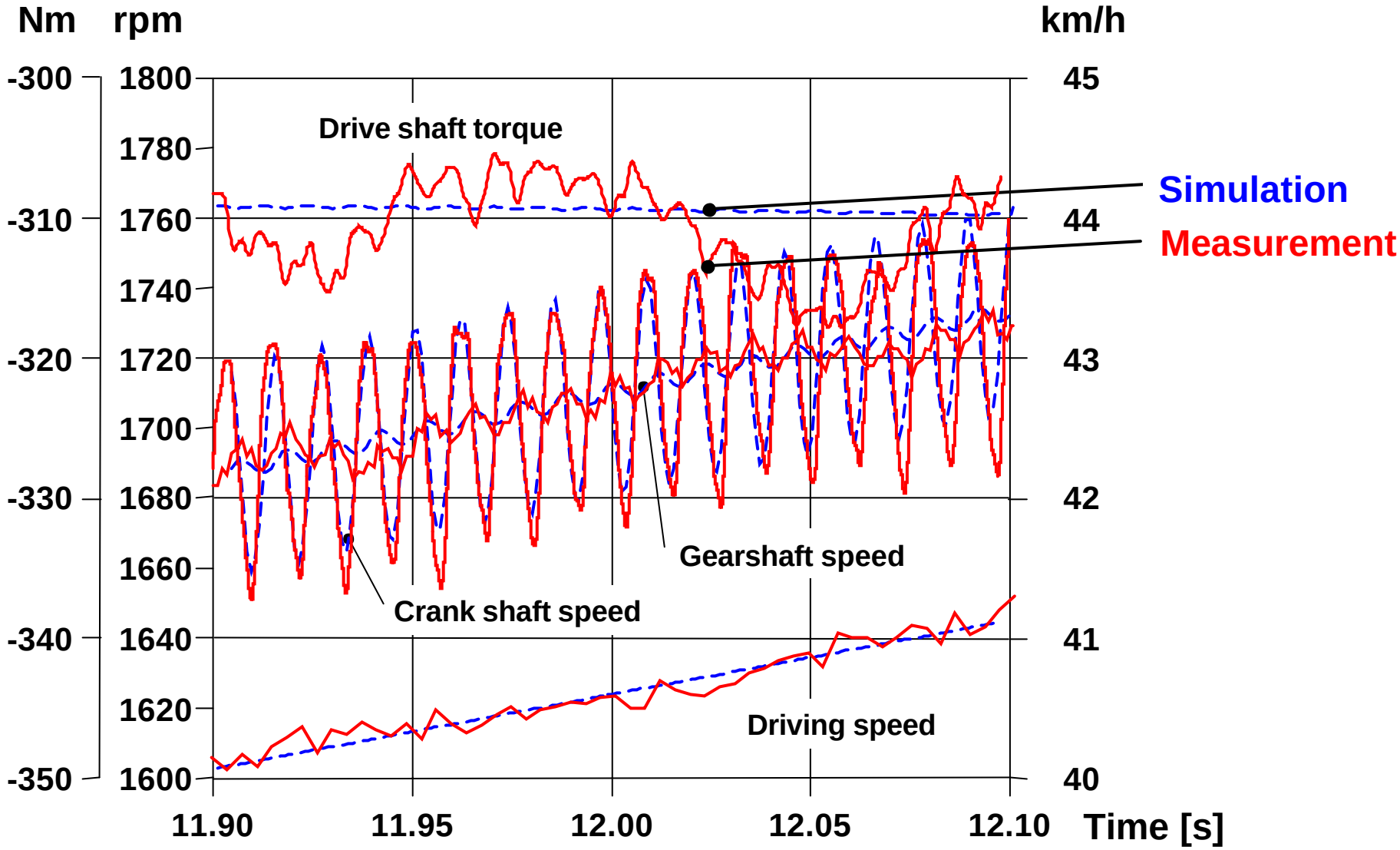
Nm
rpm
km/h
-300
-310
-320
-330
-340
-350
1800
1780
1760
1740
1720
1700
1680
1660
1640
1620
1600
45
44
43
42
41
40
Drive shaft torque
Simulation
Measurement
Gearshaft speed
Crank shaft speed
Driving speed
11.90
11.95
12.00
12.05
12.10
Time [s]

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- Intergral development environment for power trains
- Integral action shown exemplarily with the DMF
- Practicality proven by corresponding results of
  - measurement on the car,
  - measurement on the test-bench,
  - numerical simulation

= Increase of system comprehension

= Improved design of power train components and entire power trains

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