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UNIVERSITY OF TECHNOLOGY

Design of a Test Rig for Squealing Noise

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Supervised by Wolfgang Kropp and Astrid Pieringer
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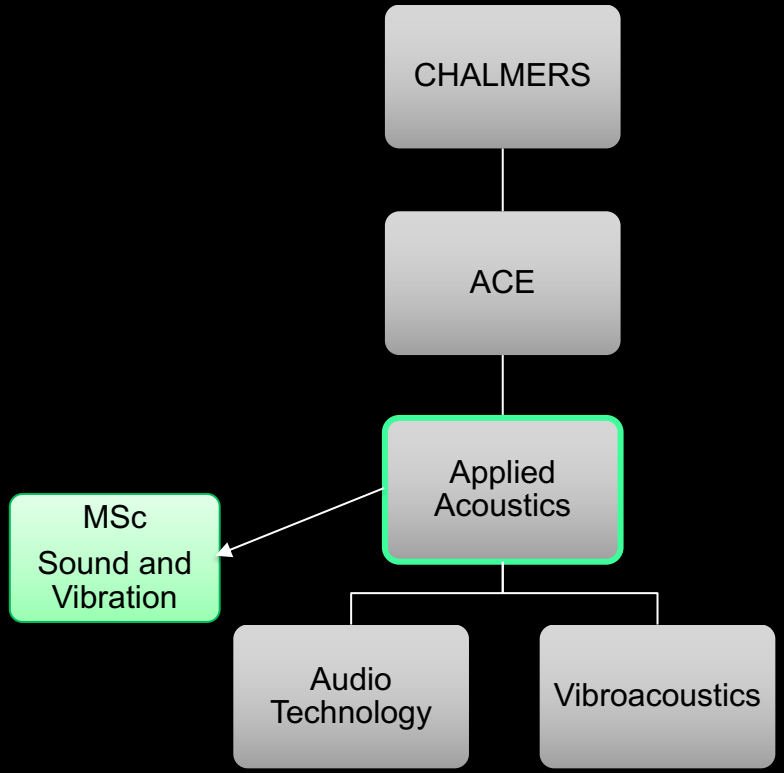
Swedtrain Examenstävling

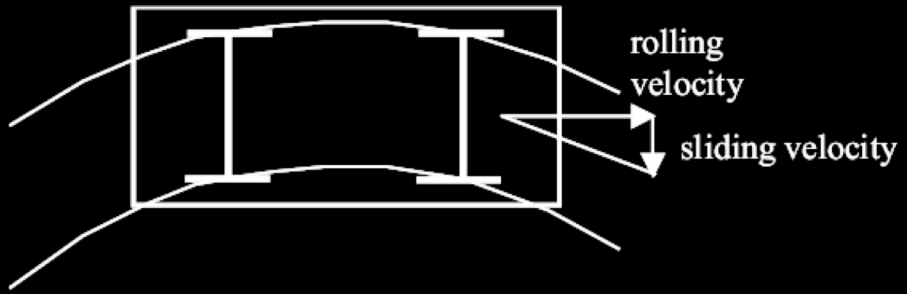
How to find us



- Vibroacoustics group is involved in CHARMEC projects
- Squealing project is one of the CHARMEC projects

Why research squealing?

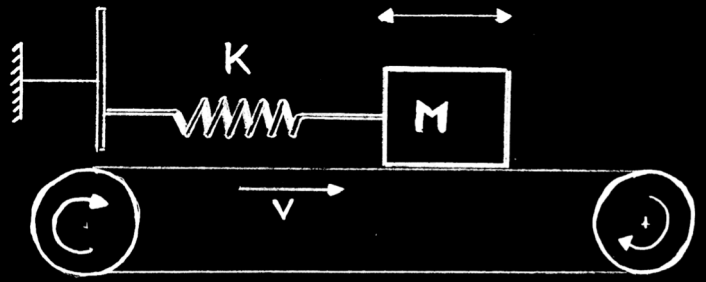
How does squealing occur?



Longitudinal stiffness of axle mounting prevents radial alignment with curvature of the track

→ Relative lateral velocity between wheel and rail

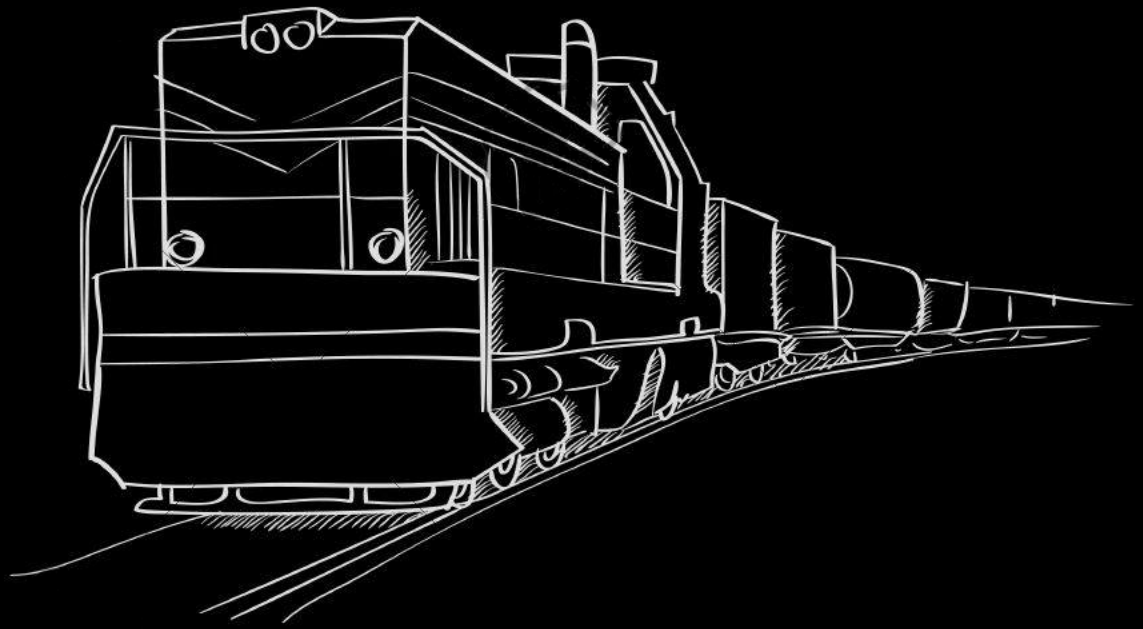
Stick-slip oscillations excite the wheel vibrations



What is the challenge in squealing research?

What is the individual influence of the…

Weight of the trains?



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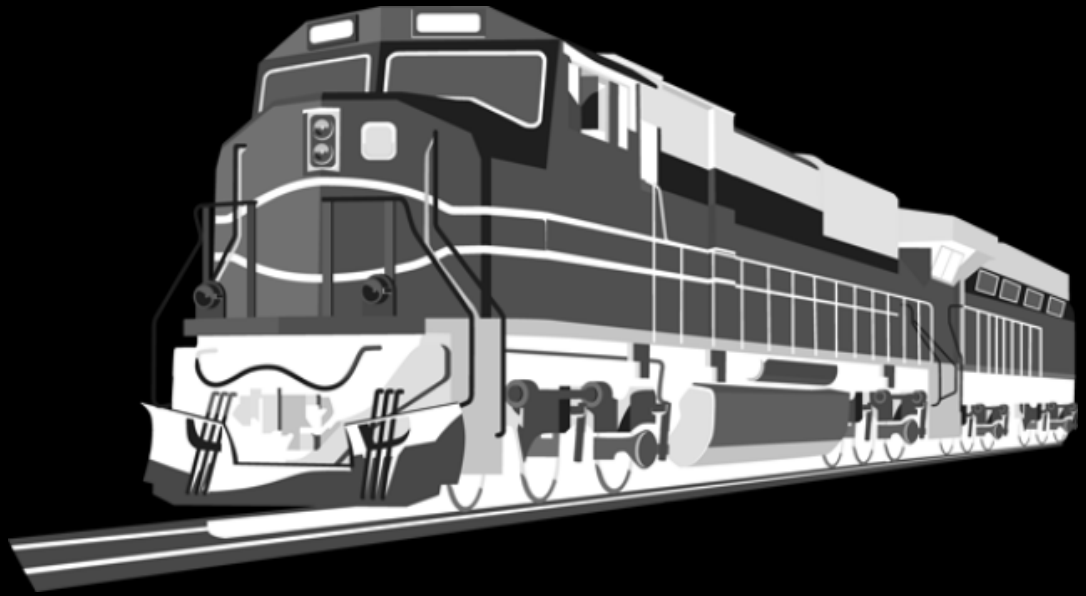
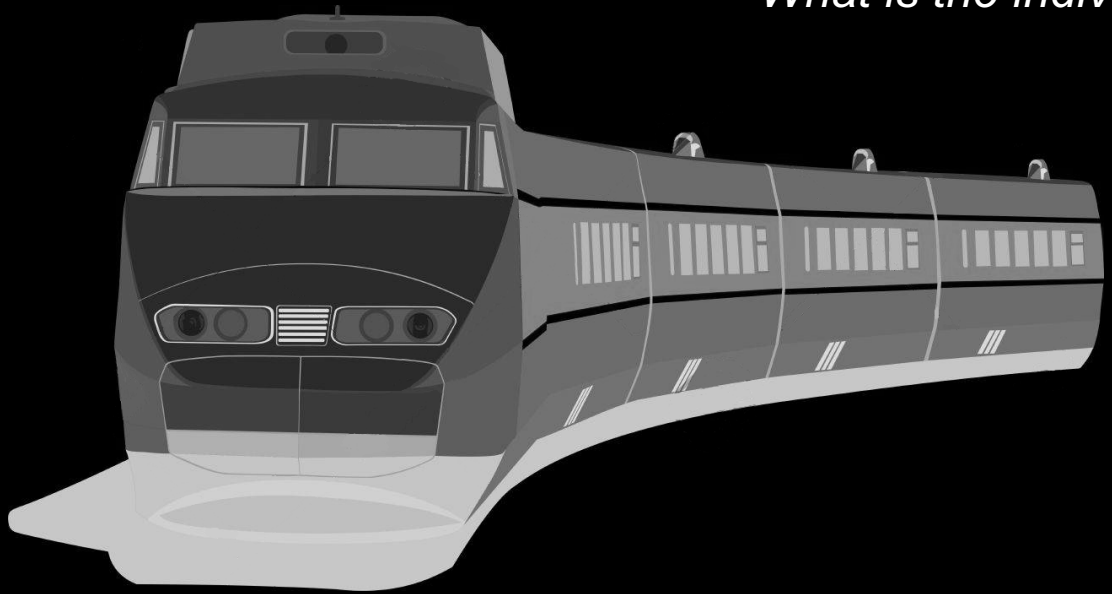


What is the individual influence of the…

Weight of the trains?
Speed of the trains?

What is the challenge in squealing research?



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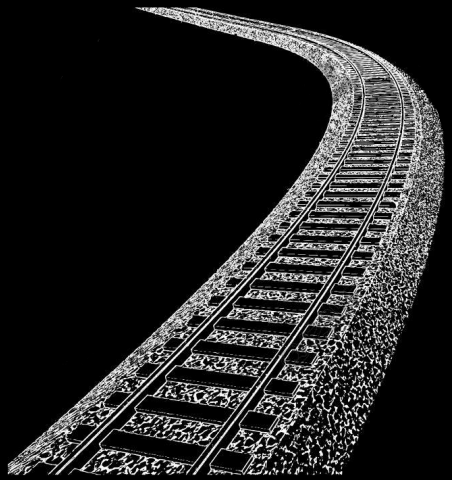
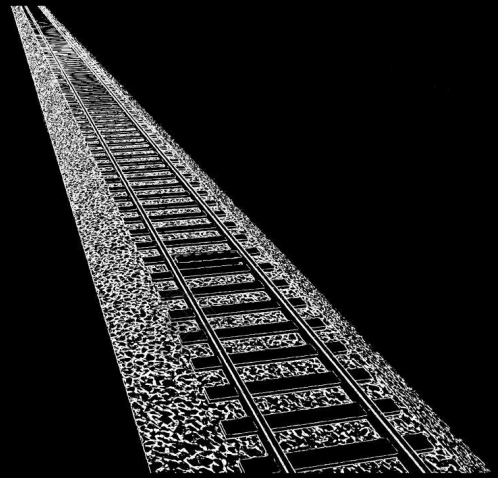
Weight of the trains?
Speed of the trains?
Size of the wheels?

What is the challenge in squealing research?





What is the individual influence of the…

Weight of the trains?
Speed of the trains?
Size of the wheels?
Curvature of the track?

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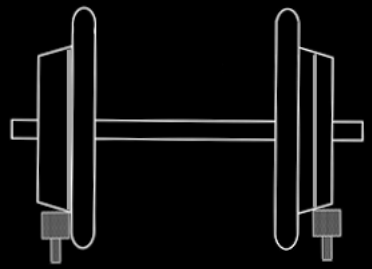
What is the individual influence of the…

Weight of the trains?
Speed of the trains?
Size of the wheels?
Curvature of the track?
Weather?

What is the challenge in squealing research?



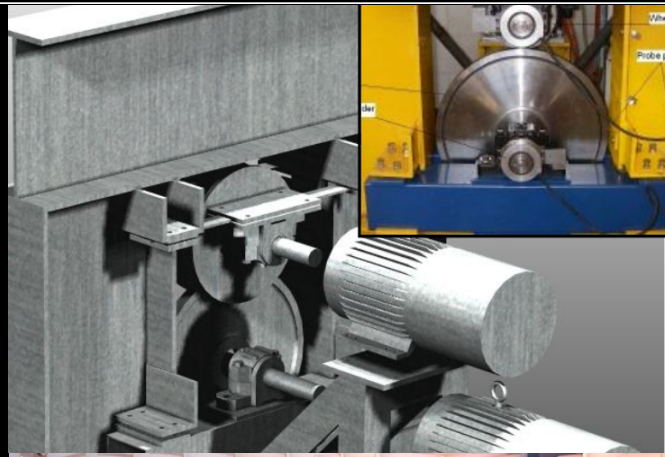
What is the individual influence of the…

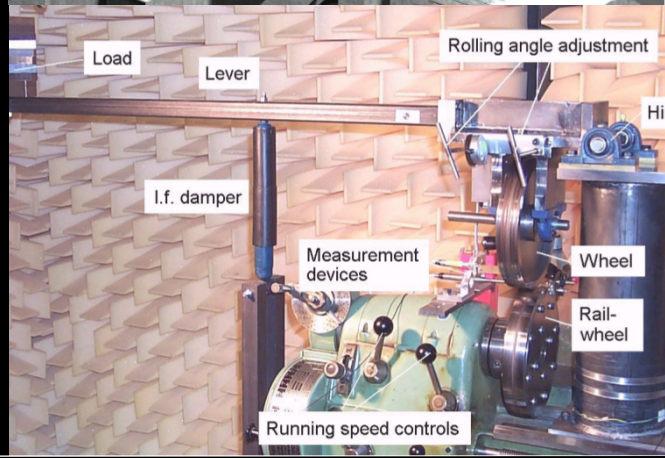
Weight of the trains?
Speed of the trains?
Size of the wheels?
Curvature of the track?
Weather?
Position of the wheel on the track?

Laboratory test rigs for squealing research

- Uni Delft / TNO
- Uni Queensland / CRC

- Two contacting, rolling wheels
  (one of them representing the rail)
- Control parameters independently
- Good reproducibility



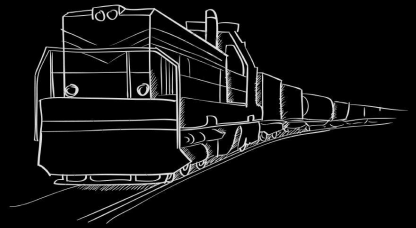


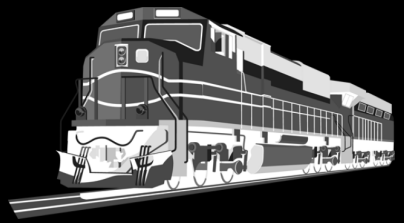
Master Thesis: Design of a Test Rig for Squeal Noise

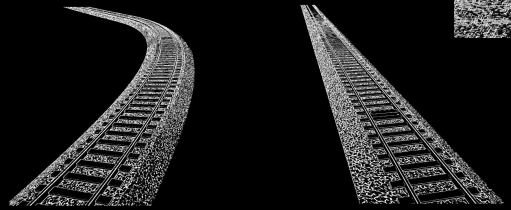
Project Goal: Building a test rig which can reliably and repeatably produce squeal noise for validation and other research purposes

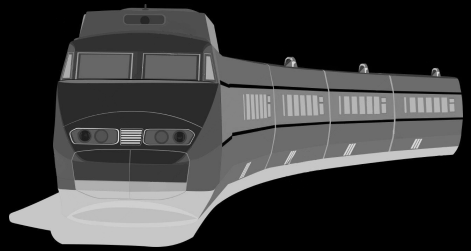
Thesis Goal: Designing this test rig, using available computer models to tune design parameters

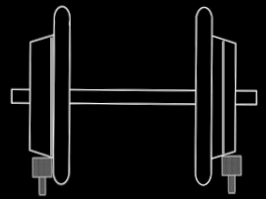
Parameters to be reproduced in the rig:







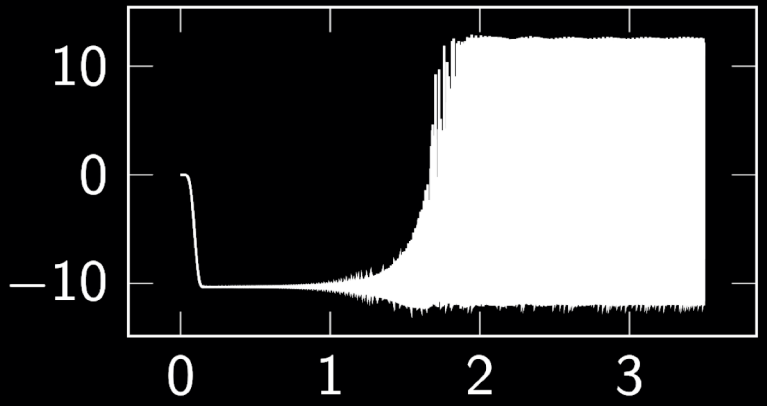




- Contact force
- Angle of attack
- Contact position
- Velocity
- Geometry
- Friction

Tuning using Parameter study

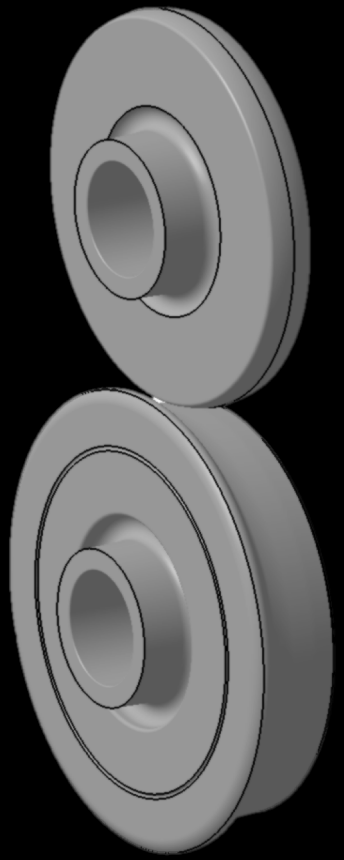
- Model can simulate two wheels rolling
- Squealing is found as high oscillations in the contact side force



Sideforce F_y in kN vs. Time in s

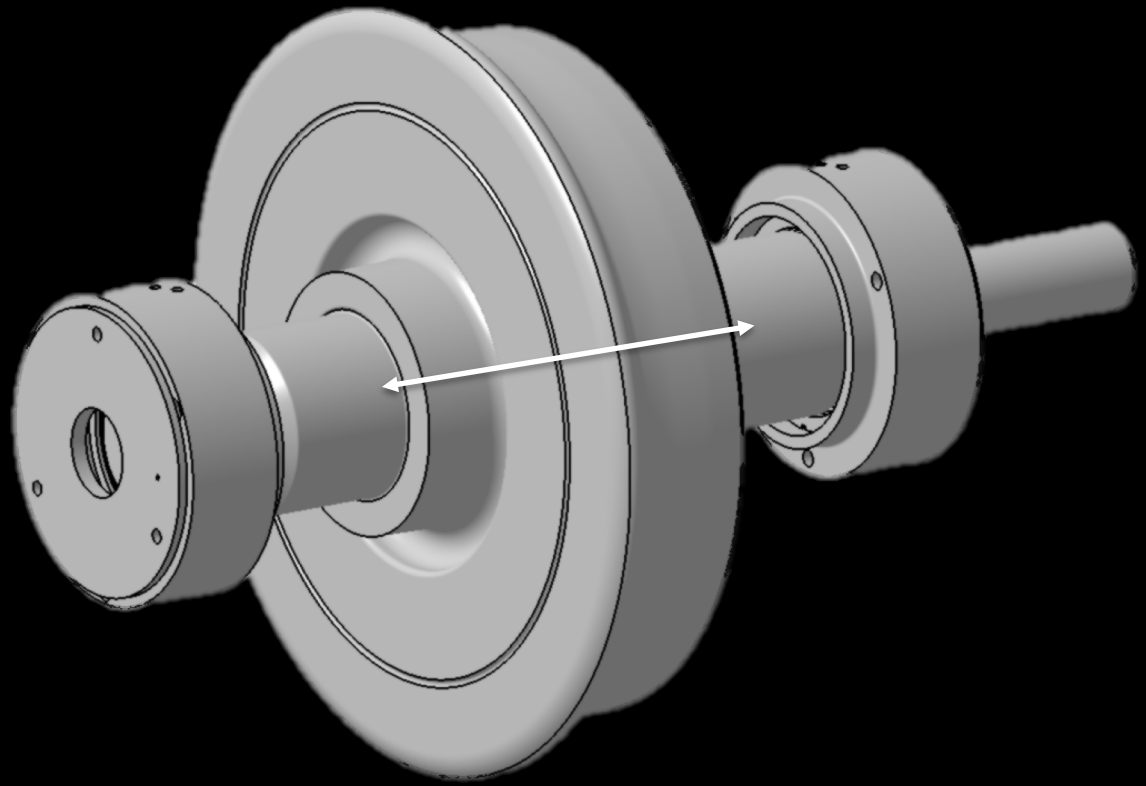
Rig design - Geometry

- Upper wheel acts as rail
- Running diameters 522 mm and 500 mm
- Weight 230 kg and 100 kg



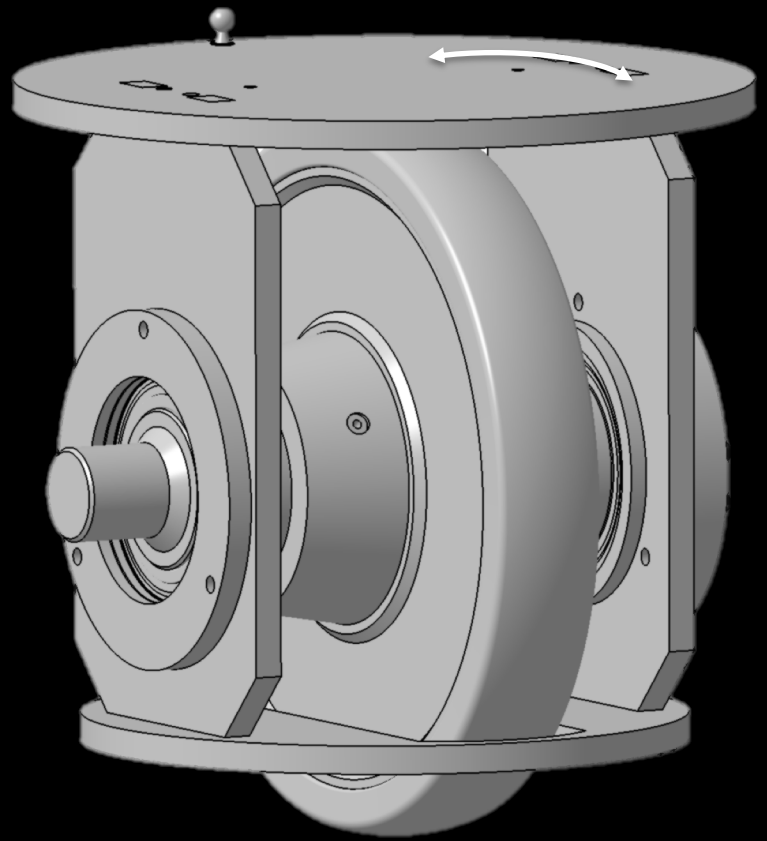
Rig design - Contact position

- Lateral shift of lower axle
- ±20 mm displacement
- Reproducible positioning via spacers



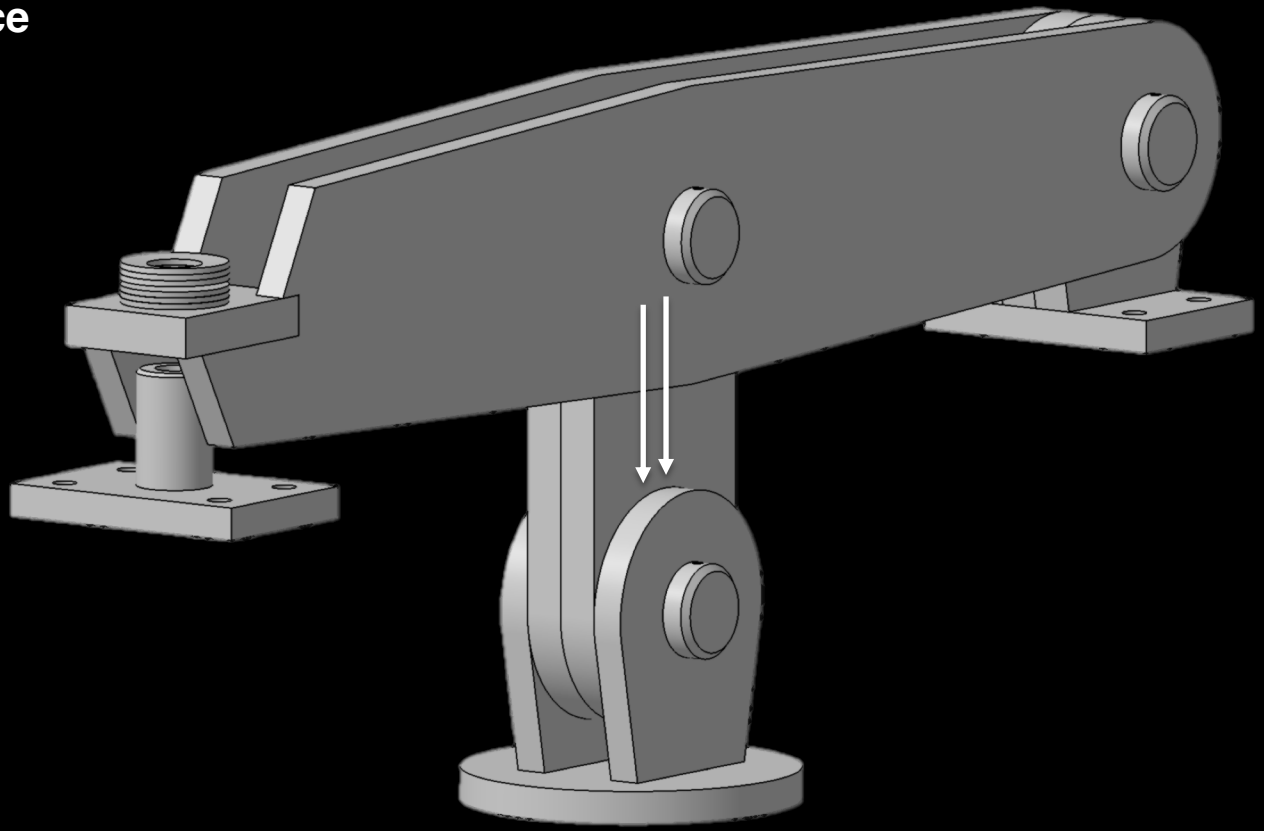
Rig design - Contact angle

- The upper wheel suspension can rotate
- $\pm 5^{\circ}$ angle
- Reproducible positioning via spacers



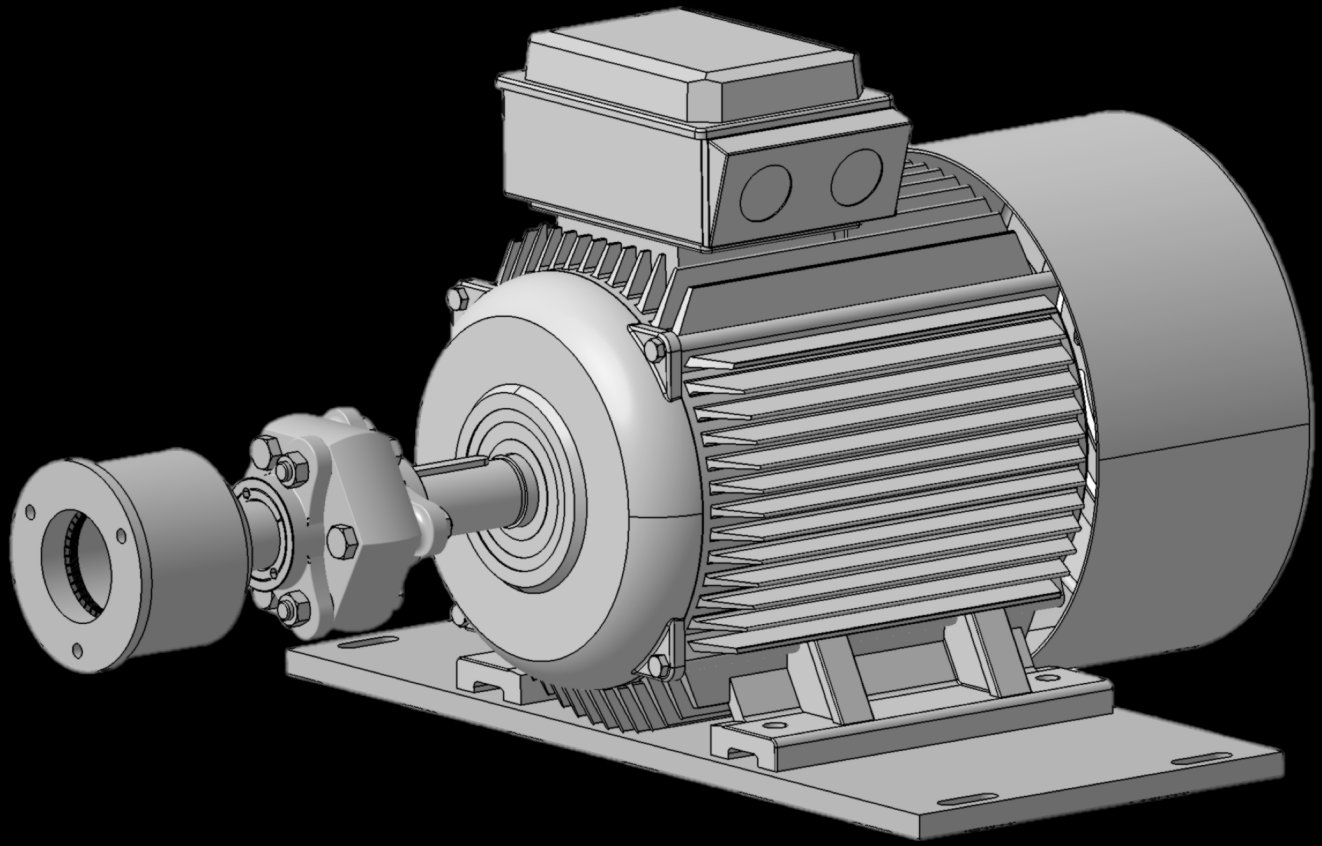
Rig design - Contact Force

- Contact force via disk springs
- Up to 3.5 tons at the contact point

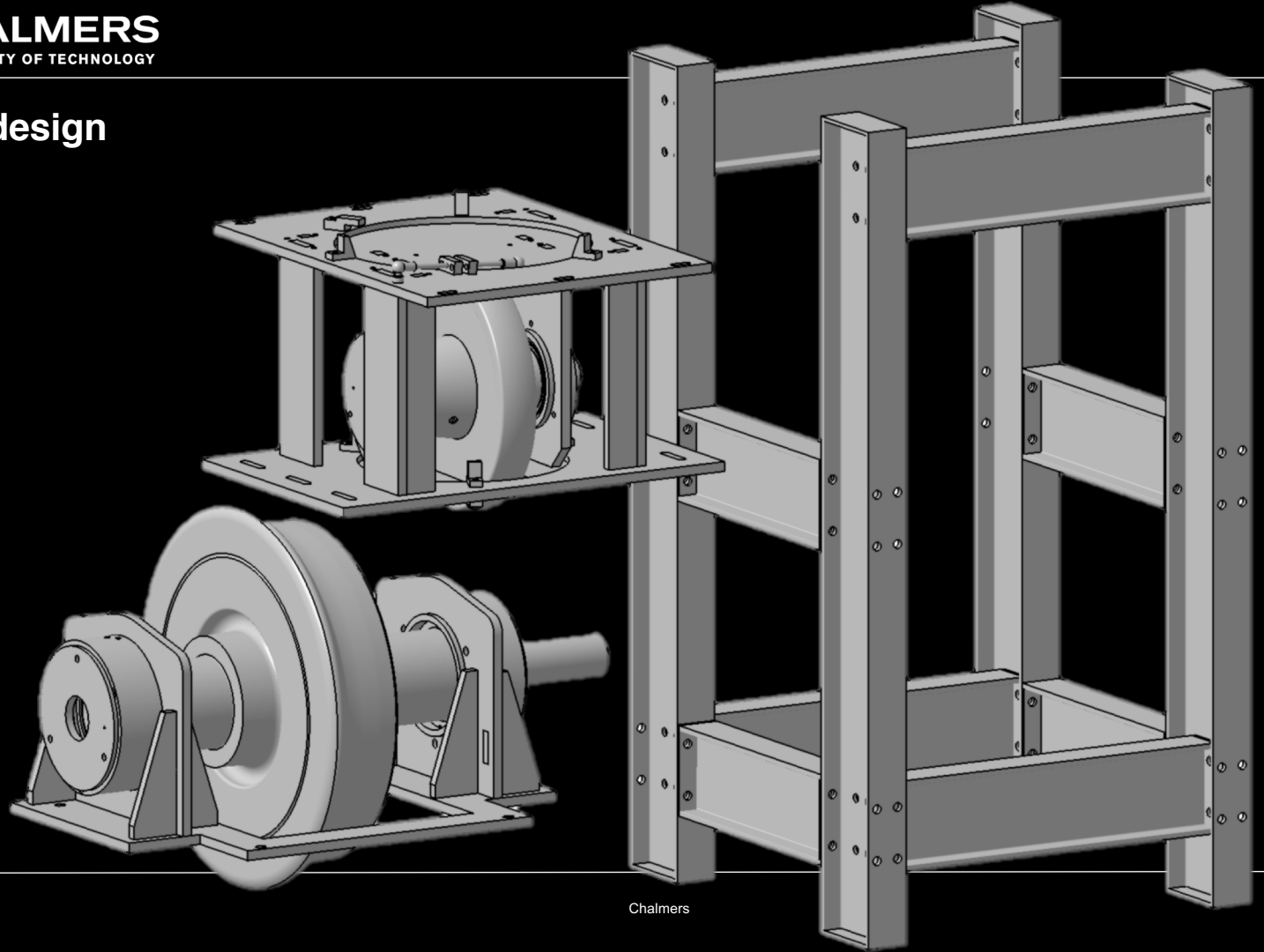


Rig design - Velocity

- Up to 500 rpm
- 50 km/h
- 210 Nm torque



Rig design



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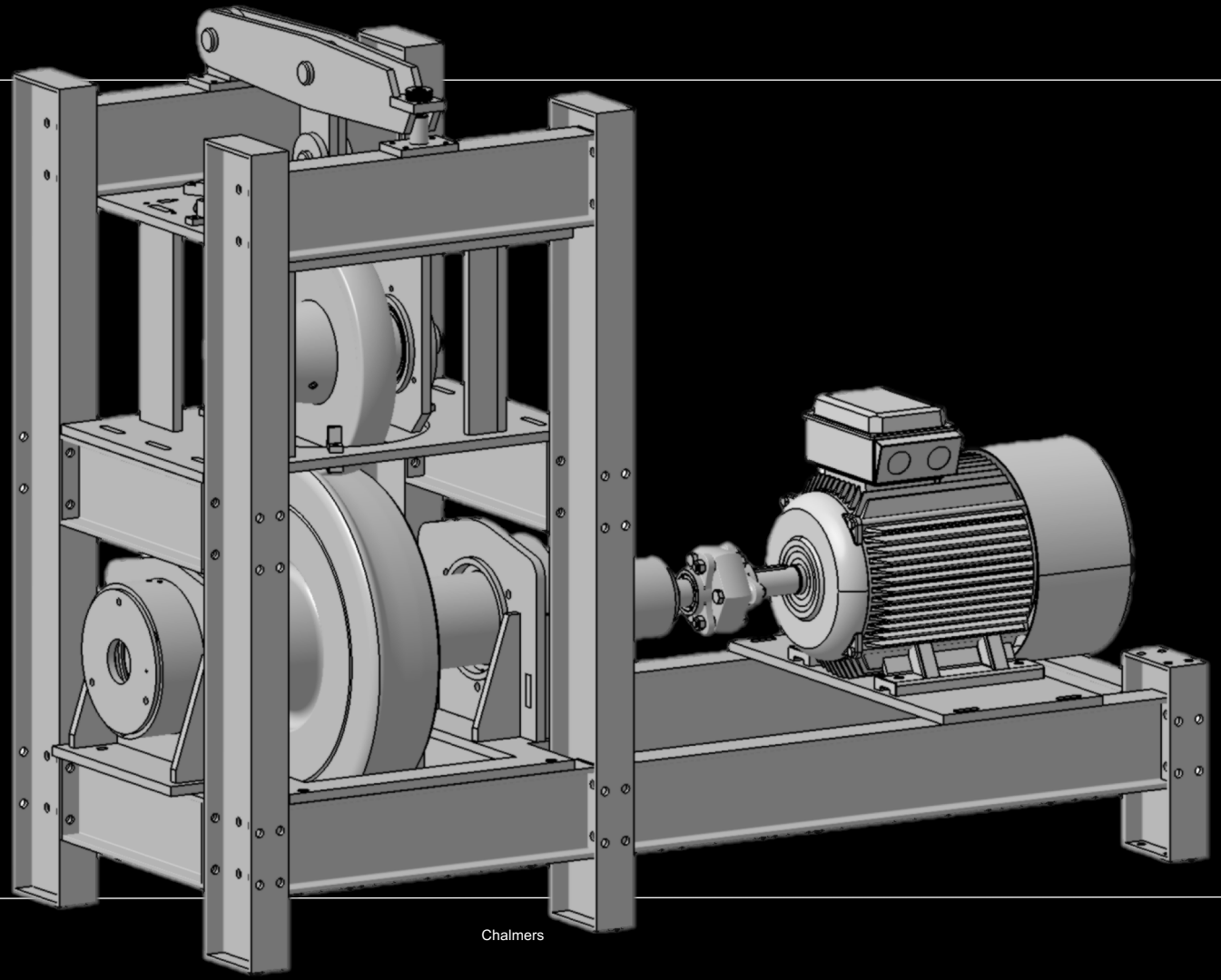

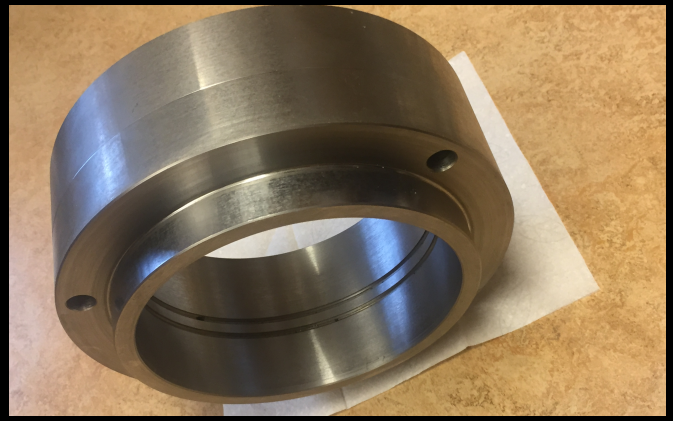

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