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# Wheelset & brake systems

## Uneven heating of railway wheels – simulations, lab tests, field measurements

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# Background

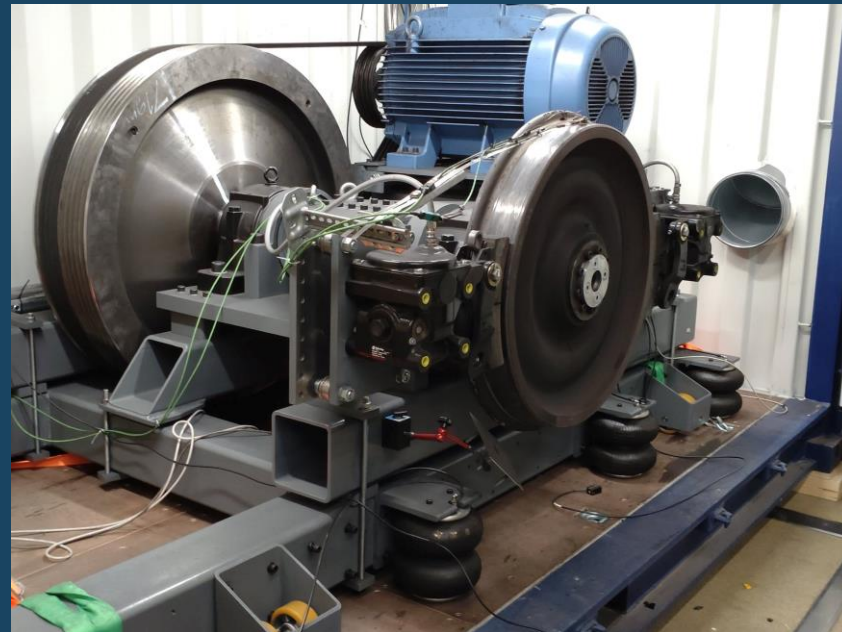
- Current approval of tread braked wheels
  - standardised brake rig testing
  - costly & limited in relevance
- Strive for virtual homologation
  - development, verification, and calibration of modelling framework
- Brake test rig at Chalmers
  - study of high temperature braking
  - soon extended with wheel–rail rolling contact
- Has also revealed unexpected findings



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# Chalmers brake rig

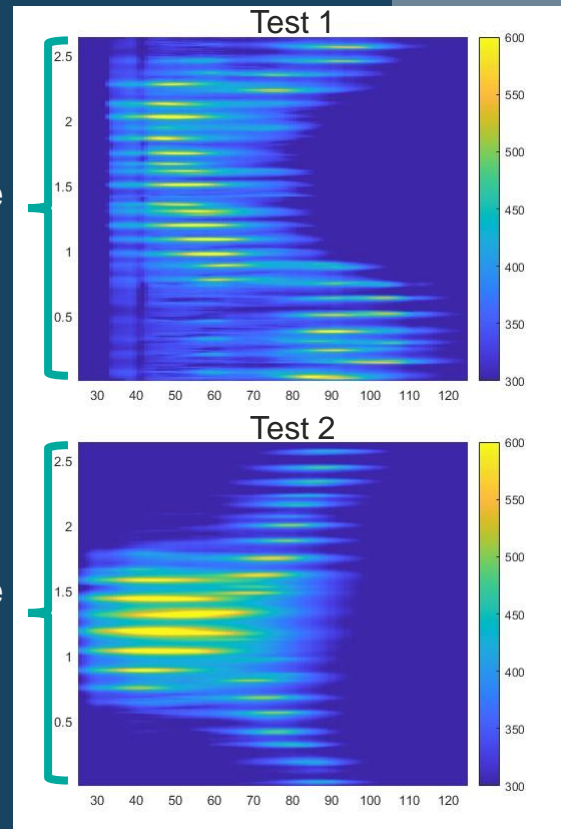
- Chalmers current brake rig
  - operational since autumn 2022
  - controlled in-house testing at varying power levels
- Upgrade with rail wheel
  - installation on-going
  - Allows e.g., rolling contact fatigue testing of *high temperature wheels*



# Experimental findings

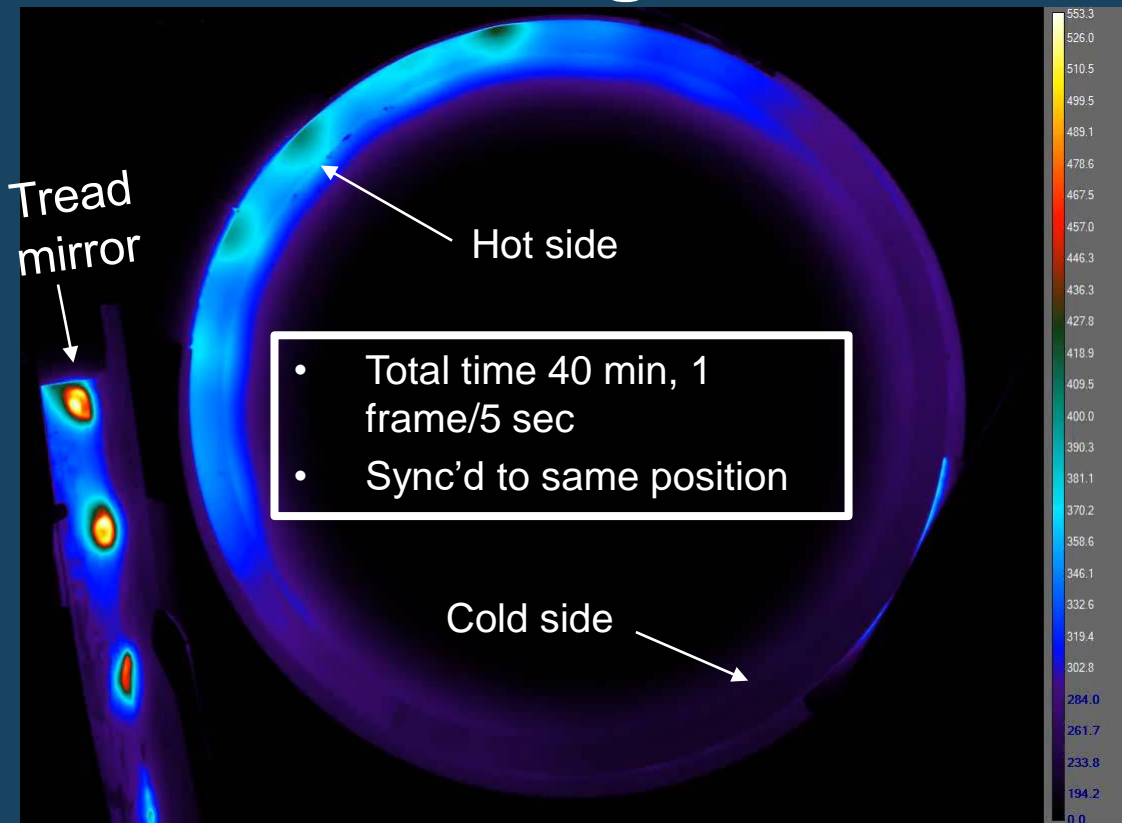
- Uniform heating tends to be localised
  - Too stiff braking system promotes localised heating
- Hot spot formations
  - almost stationary in position
- Some positions are *much* warmer than average
  - material degradation during long-term drag braking
  - implications for safety

Tread, one revolution



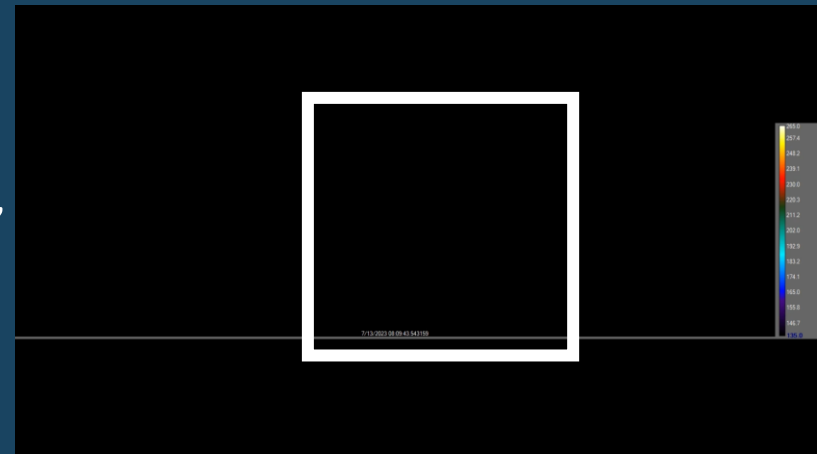
Tread, one revolution

# Experimental findings



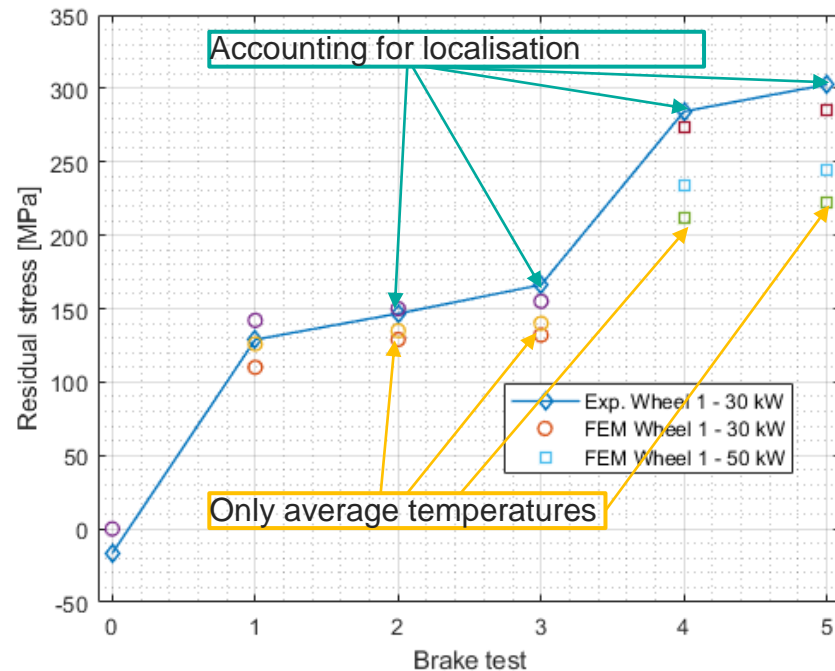
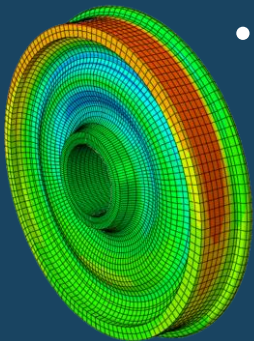
# Field tests LKAB Iron Ore Train

- Uneven distribution between wheels, and around wheels
  - Small number of unevenly heated wheels (approx. 1/50)
  - Significant spread in wheel temperature, even in same bogie
- Uneven heating implies out-of-round wheels during braking and increase of wheel-rail contact forces



# Possibilities to simulate

- New material model
  - good agreement between simulations and brake rig testing
  - inclusion of rolling contact 2024
- Thermal localisation
  - necessary to account
    - gives significant increase in residual stress levels





# Concluding remarks

- Enhanced understanding of block – wheel – rail system
  - potential to enhance wheel designs
  - potential to reduced wheel–rail thermal damage
  - reduced risks of derailments from wheel fracture
- New brake research testing facility
  - high temperature testing of braking equipment
  - already identified previously unknown phenomena with significant implications
  - can test operationally relevant scenarios and calibrate models
- Potential for virtual homologation





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