Derailment Detection in freight trains– Analysis of the influences on the longitudinal train dynamics

1st Session of the RID Committee of Experts' working group on derailment detection

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Agenda

1 Onboard derailment detection systems – state of the art

2 Emergency brake override/ Possibilities of the driver to detect a derailment

3 Analysis of the longitudinal train dynamics

4 Summary

Onboard derailment detection systems

state of the art

- Requirements of derailment detectors in UIC Leaflet 541-08 defined
- 3 vehicle detection systems have UIC approval (defined in appendix 541-08)
  - Knorr EDT 100
  - Knorr EDT 101
  - MZT Hepos MDV 100 (Wabtec)

→ all pneumatical / mechanical working→ no electric power supply needed

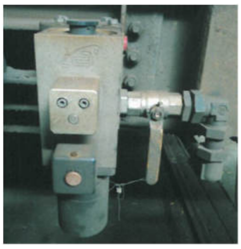
→ in case of detection: emergency brake by directly opening the main air line (not bypassed)

Onboard derailment detection systems

state of the art

Other detectors (not in the appendix to UIC 541-08 listed):

- Wabtec MDD 200
- Anetsis SICODE



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Emergency brake override

„Das automatische Einleiten einer Schnellbremsung wäre wegen der entstehenden Zug- und Druckkräfte im Zug vermutlich gar nicht die beste Lösung, weil damit eher Ereignisse wie Überpufferungen oder Entgleisung weiterer Fahrzeuge provoziert würden […]"

N.N.: Neuerlich Entgleisungsversuche. In: Eisenbahnrevue Österreich, 12, 2005, S. 584

"A false alarm of such a device may lead to train compression which is a contributory cause of freight train derailments (and also a significant operational disruption)"

Det Norske Veritas: Assessment of freight train derailment risk reduction measures. B3 – Top ten ranking of safety measures, Stockport (Cheshire), 2011

Emergency brake override

Emergency brake override is not nessesary:

- Often derailments are not visible for drivers (40% initially remain unnoticed)
- TSI railway tunnel also calls for immediate halt:

  *„4.4.2. Emergency rule: The IM's operation rules shall adopt and develop in more detail, if necessary, the principle that in case of an incident (**except a derailment, that requires an Immediate stop**) — The train shall be brought to a halt before entering a tunnel, or driven out of a tunnel "*

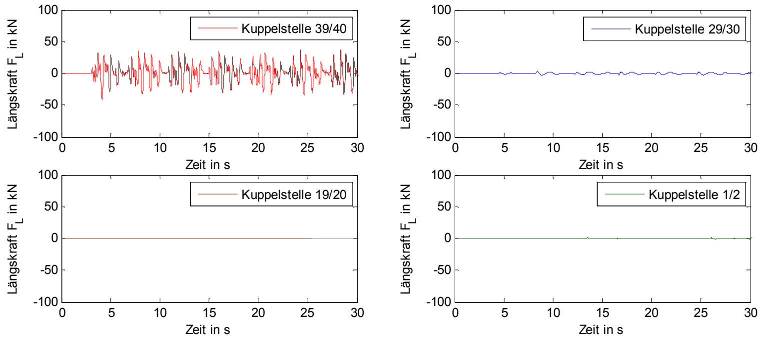
- Deutsche Bahn Richtlinie 408, Modul 0681: „ If you see as train crew that a danger that can be averted or mitigated by stopping the train, ***you must immediately perform emergency braking***."

Emergency brake override

derailments of one wagon in the train

Derailment of a single wagon in the train is often not noticed by the driver

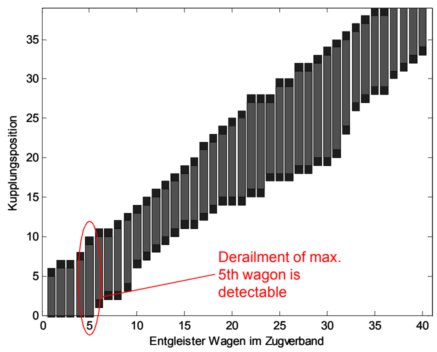
→ Comparison of longitudinal vibrations in a derailment of the last car of a 40-wagon train



Emergency brake override

derailments of one wagon in the train

Possibilities of the driver to detect a derailment of a single wagon



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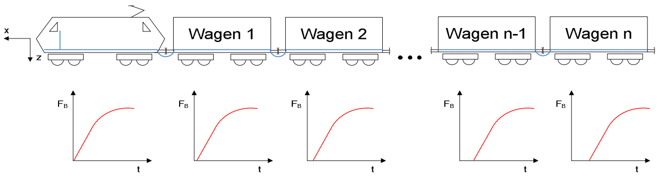
Longitudinal train dynamics

fundamentals

Introduction of a brake pressure reduction in the brake pipe

- In the case emergency brake: complete draining of the main pipe
- Entire volume of air flowing through an opening into the environment



- Delayed response in the train → formation of longitudinal forces

Longitudinal train dynamics

Factors influencing the longitudinal forces

Train parameters

- Mass of the train
- Number of wagons
- Train lenght
- Number of locomotives

Waggon parameters

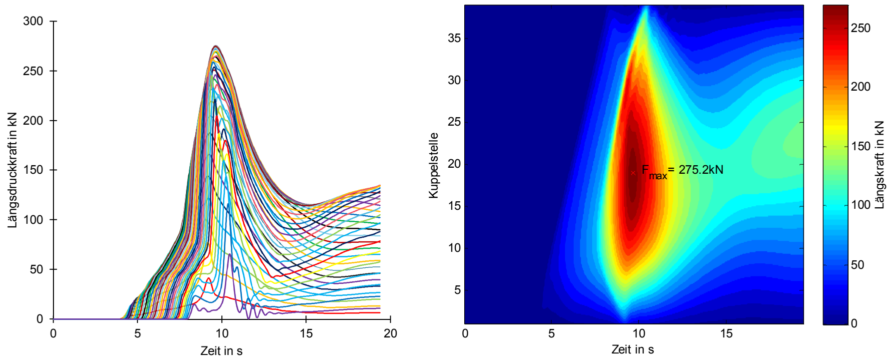
- Coupling system
- Loading of the wagons
- Clearance between buffers
- Traction forces

Braking system

- Main pipe pressure
- Goods/passenger braking system
- Distributor valve
- Transmission of the braking impulse
- Velocity of the train
- Friction of braking shoes
- Dynamic braking force
- Point of draining of the main pipe

Selected results of the longitudinal dynamics

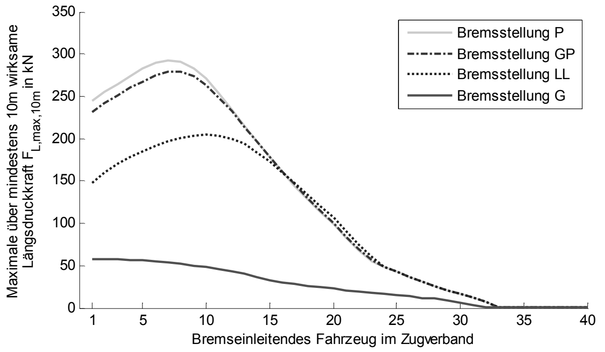
Course of the longitudinal forces during braking



boundary conditions: 40 wagons, mass: 1200 t, iron cast shoes, clearance betewenn buffers: 5 mm, velocity: 40 km/h, passenger brake

Selected results of the longitudinal dynamics

Course of the longitudinal forces during braking

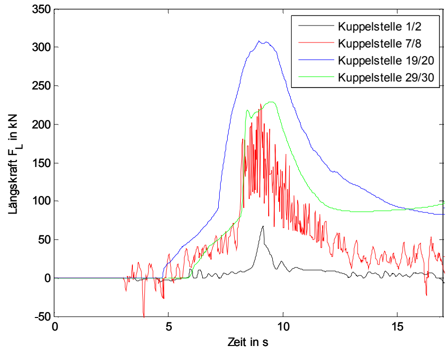


conditions
40 wagons
mass: 1200 t
Iron cast braking shoes
clearance between buffers: 5 mm
velocity: 40 km/h

Selected results of the longitudinal dynamics

Derailment of one wagon

Comparision of longitudinal forces – braking initiation at wagon 7 because of detection



→ the maximum of logitunial force is not on the derailed wagon

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Summary

Derailment of one wagon is for drivers partially undetectable
→ technical systems useful

When braking initiation in the train longitudinal compressive forces may be higher than the braking initiation by the driver

Possibility to reduce the longitunial forces: adjustment of the pressure in the main pipe in the case of braking application (instead of operating emergency brake)

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Thanks for your Attention