3rd TrainDy Study

CEF UBS Action Project

29.11.2022 | CEF PSA UBS | Hybrid meeting

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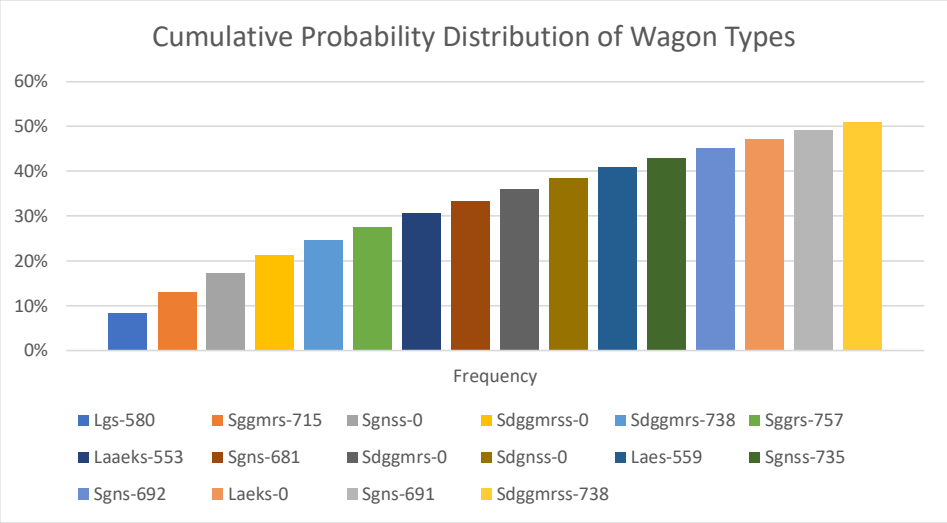
Working Steps

1. Using Real train data from operation in 2016 as basis for virtual train formation
2. Filtering real train data → taking into account only trains containing at least 1 intermodal wagon
3. Gathering cumulative probability distributions from filtered data
   - ➢ Distribution of Wagon type



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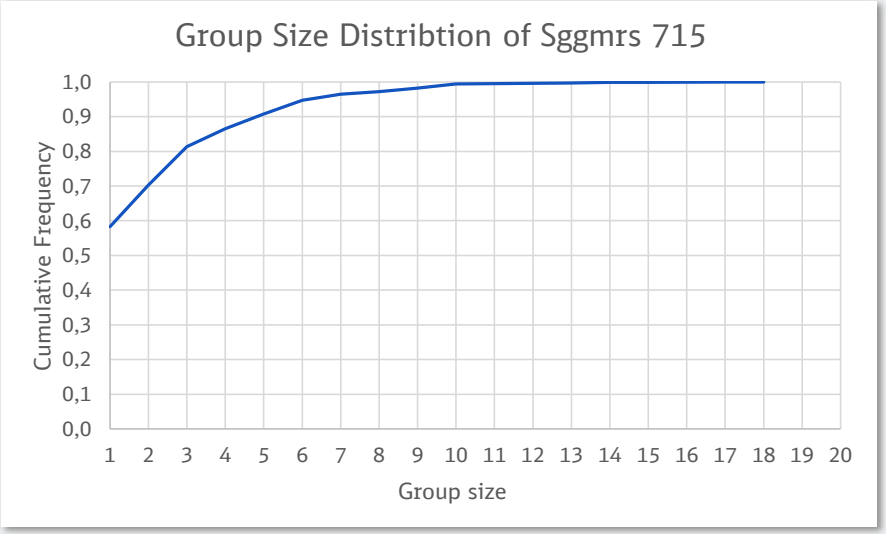
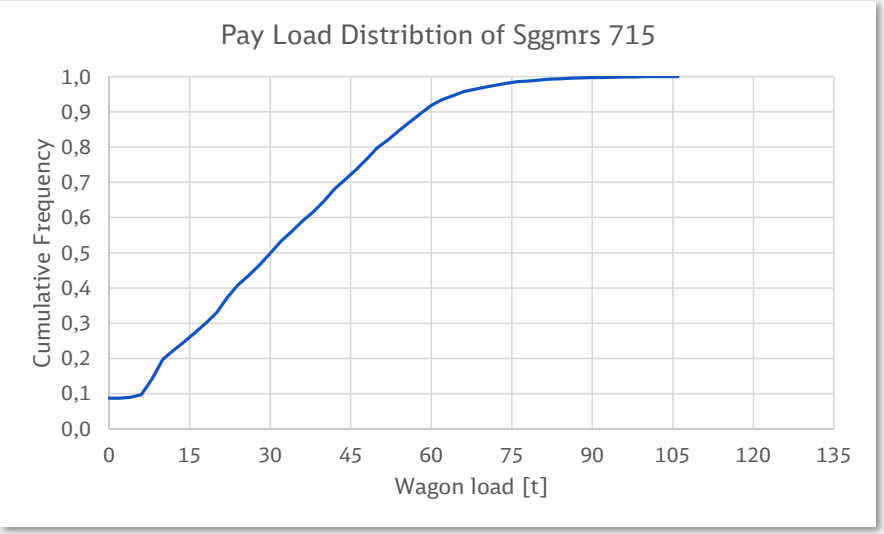
4. Gathering cumulative probability distributions from filtered data
   - ➢ Distribution of group size (number of wagons forming a group of the same wagon type)
   - ➢ Distribution of Payload for each wagon type





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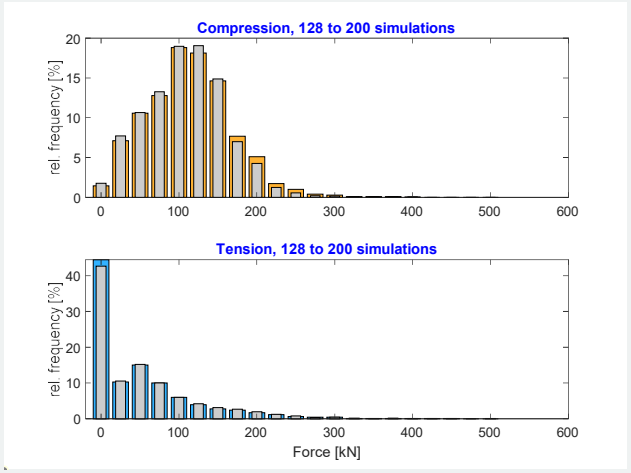
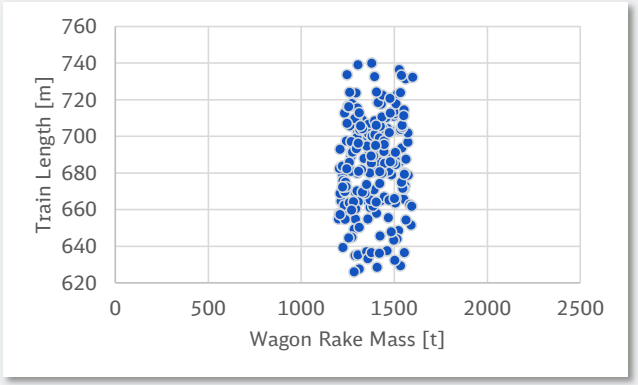
5. Building virtual data based statistics of filtered data and
   - in accordance with IRS 40421
   - applied manoeuvre:
     Emergency Brake as first scenario
   - applied brake blocks:
     Mix of Cast iron and Composite blocks type K
   - Train length between 650 and 740 m
     uniformly distributed
   - One locomotive
   - Sample size is 200 train

6. Simulation of Reference
   virtual trains with a wagon rake mass
   of 1200 to 1600 tons with Brake Regime LL





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7. Setting wagon mass to a **minimum of 32 tons** for trains with wagon rake mass > 1600 tons
   - Mass Scaling of wagon rake in accordance with proposal of Prof. Cantone

$$M_{new} = M_{new,min} + \frac{(M_{new,max} - M_{new,min})}{(M_{ref,max} - M_{ref,min})} (M_{ref} - M_{ref,min})$$

   - Mass scaling is only applied if wagon's maximum pay load* is not exceeded

8. Simulation of Variants:
   - Variant 1: Reference + Brake Regime XLL (Locomotive and first 7 wagons in Brake Position G)
   - Variant 2: Variant 1 + Mass shift to mass range **1600 to 2200** tons
     + 32 tons minimum mass of wagons
   - Variant 3: Variant 2 + shifting articulated and permanently coupled wagons to end of train
   - Variant 4: Variant 3 in reverse order

* Maximum pay load does not correspond to axle mass limit of 22.5 tons but to the maximum load observed in the statistical database from real operation

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9. Ratio of Occurring Force versus Tolerable Force for each wagon:
   - in accordance with IRS 40421
   - Determination of relevant load L_{Low} for articulated or permanently coupled wagons:

$$L_{High} = \min\left(L, \frac{L_{Wagon,max}*}{2}\right)$$
$$L_{Low} = L - L_{High}$$

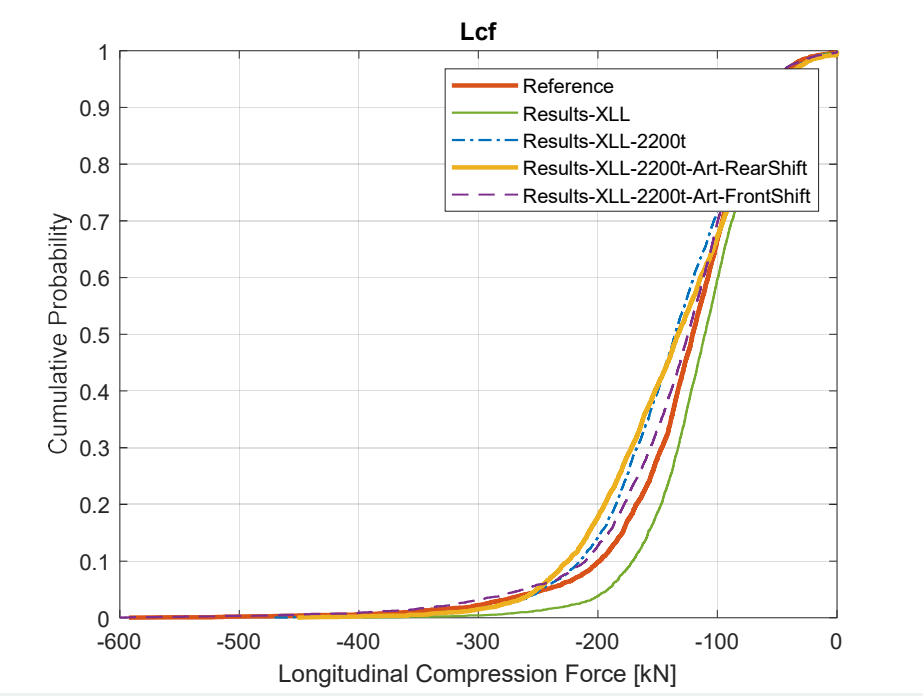
10. Comparison Preliminary Results of Reference and Variants

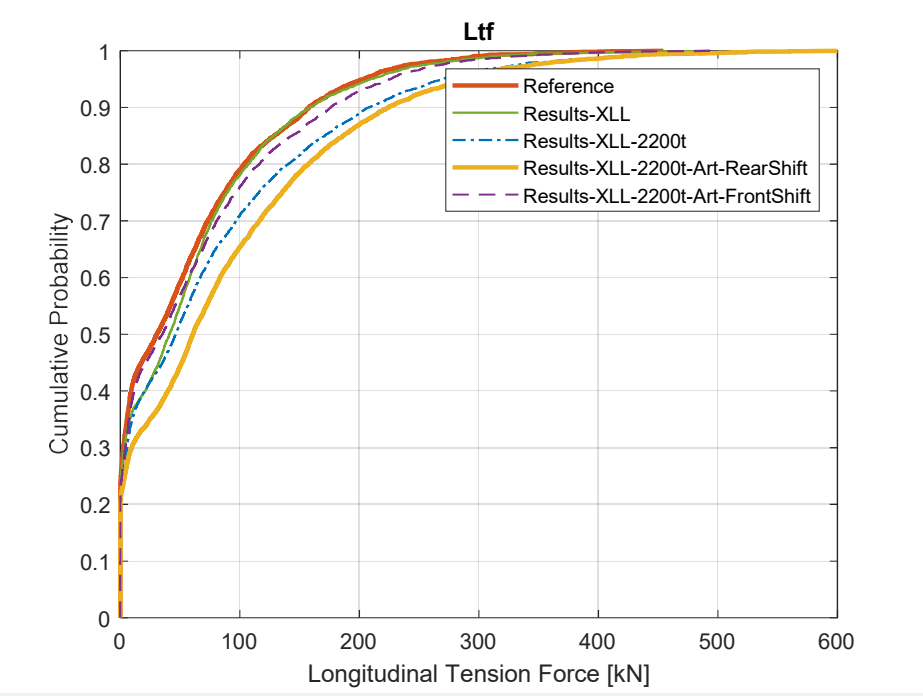
11. Discussion of Results within TrainDy Working Group → Modifications & Optimisations

* $L_{wagon,max}$ is the maximum pay load observed in the statistical database from real operation

Longitudinal Forces

Preliminary Results
Longitudinal Forces of all Wagons





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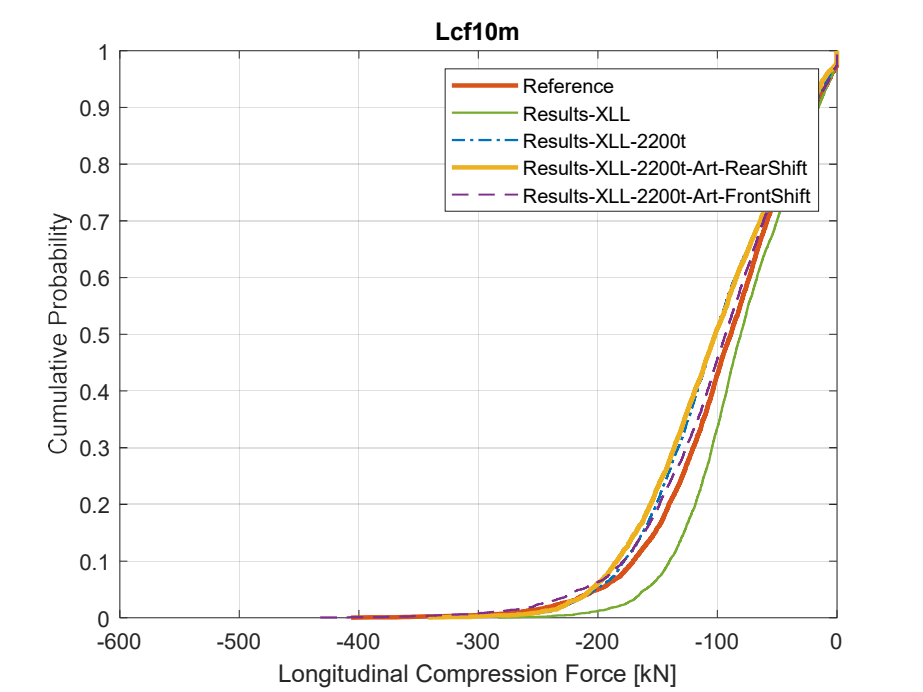
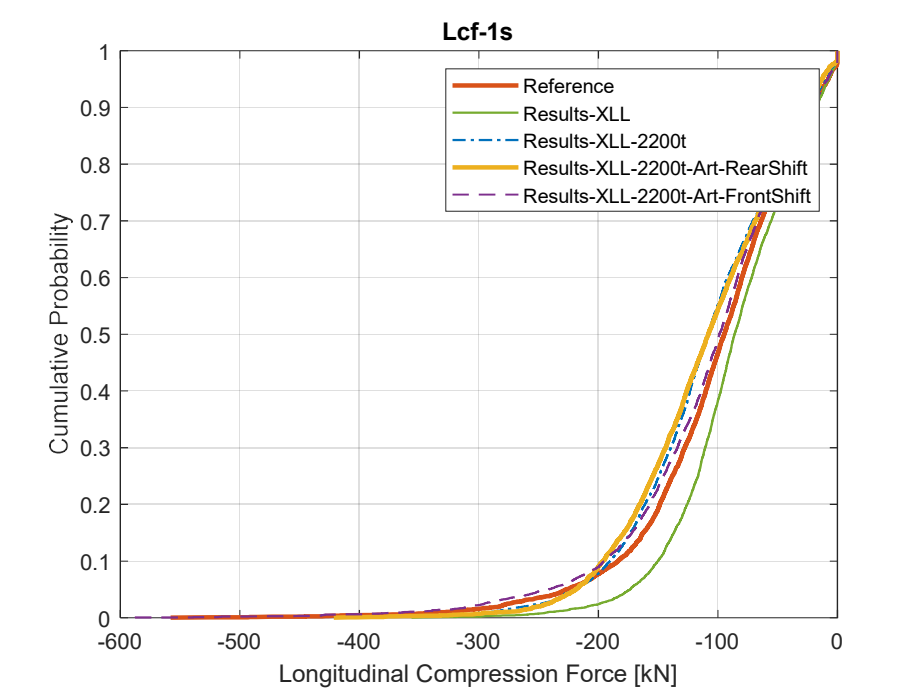
Minimum Compression Forces in interval (10m or 1s)

Preliminary Results

Filtered Compression Forces of all Wagons





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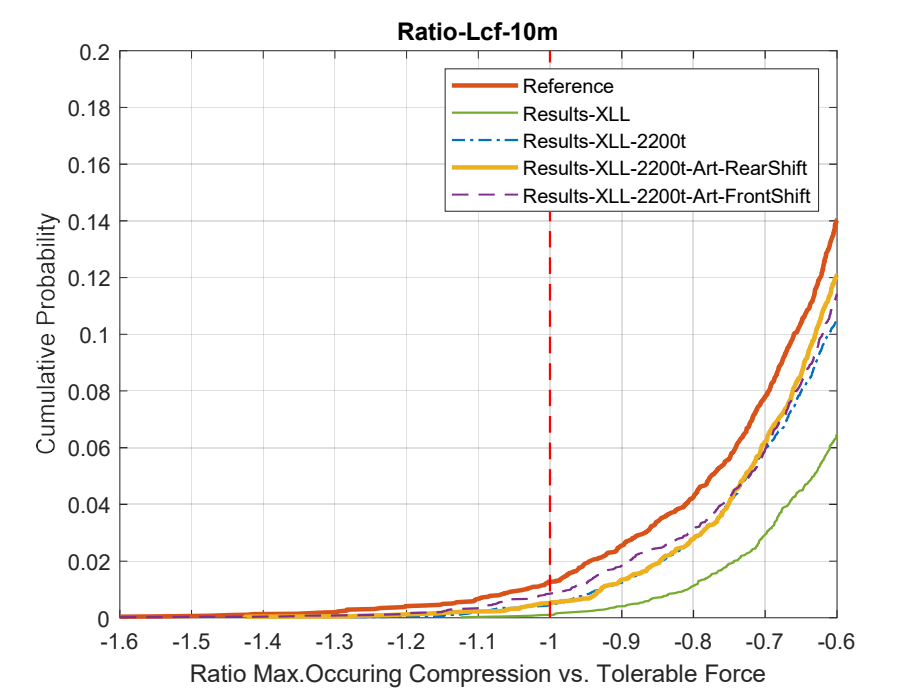
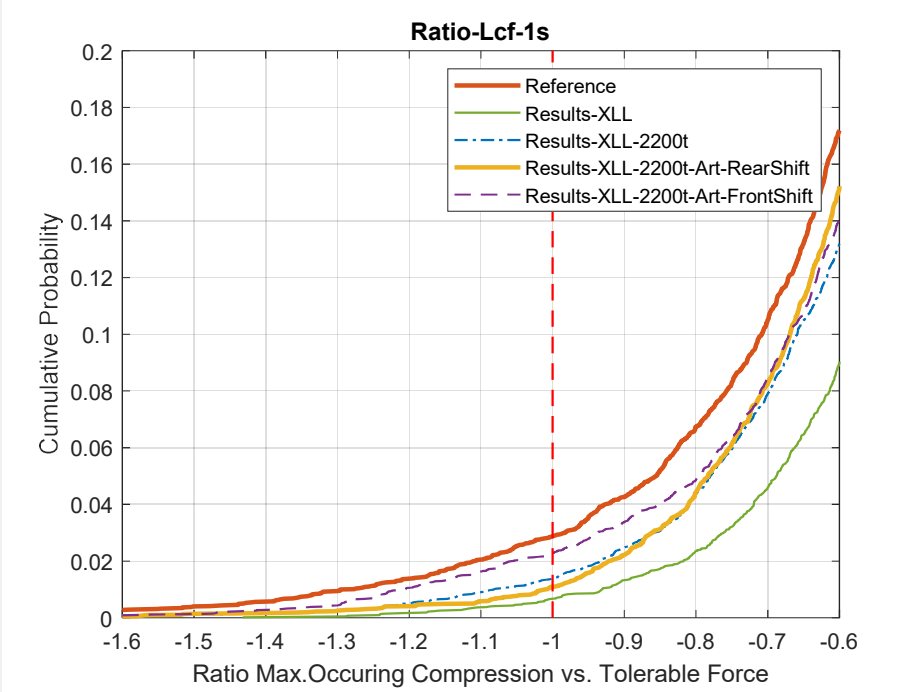
Potential Derailment

Preliminary Results

Ratio Occurring vs. Tolerable Force for each wagon





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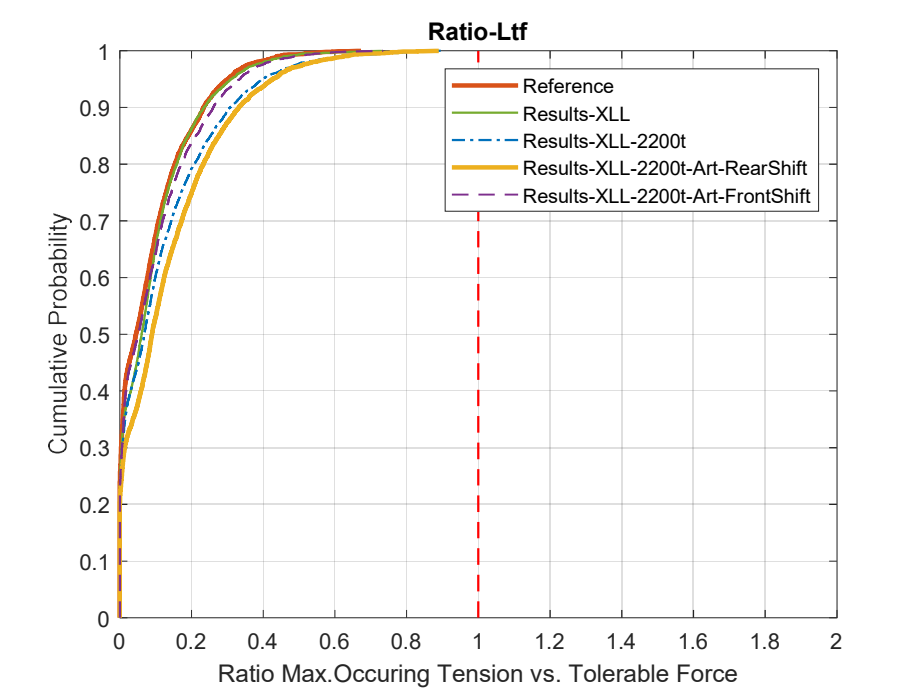
Potential Disruption

Preliminary Results

Ratio Occ. Vs. Tolerable Tension Forces, all Wagons



Limit Tension: 675 kN
in accordance with EN 15566

- fatigue criterion
- referring to 1450 load cycles
  (associated with 20 years of operation)

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Thank you for your attention!