PBS

Sogol Kharrazi

PBS in Sweden

PBS requirements

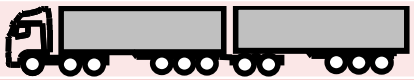
- Is PBS a good approach?
- Swedish roads & weather

PBS assessment

- Preferably simulation/equation based
- What is the required complexity of models
- There is a need for standard tire model(s)

PBS vs. Subjective Measures

- Driving simulator study with 55 truck drivers
- Each driver, drove a pair of vehicles, a conventional and a HCT vehicle
- There were three pairs of vehicles
  - Tractor-Semi & Adouble
  - Nordic & Truck-Bdouble
  - Truck-CAT & Truck-Duo CAT

	Heavy Vehicle Combination		
1	Tractor-Semitrailer		40T/16.5m
2	Tractor-Semitrailer-Dolly-Semitrailer (Adouble)		80T/30m
3	Truck-Centre Axle Trailer		40T/19m
4	Truck-Centre Axle Trailer-Centre Axle Trailer		74T/28m
5	Truck-Dolly-Semitrailer (Nordic)		64T/25m
6	Truck-Dolly-Link Trailer-Semitrailer (Truck-Bdouble)		83T/32m

Results of Simulator Study

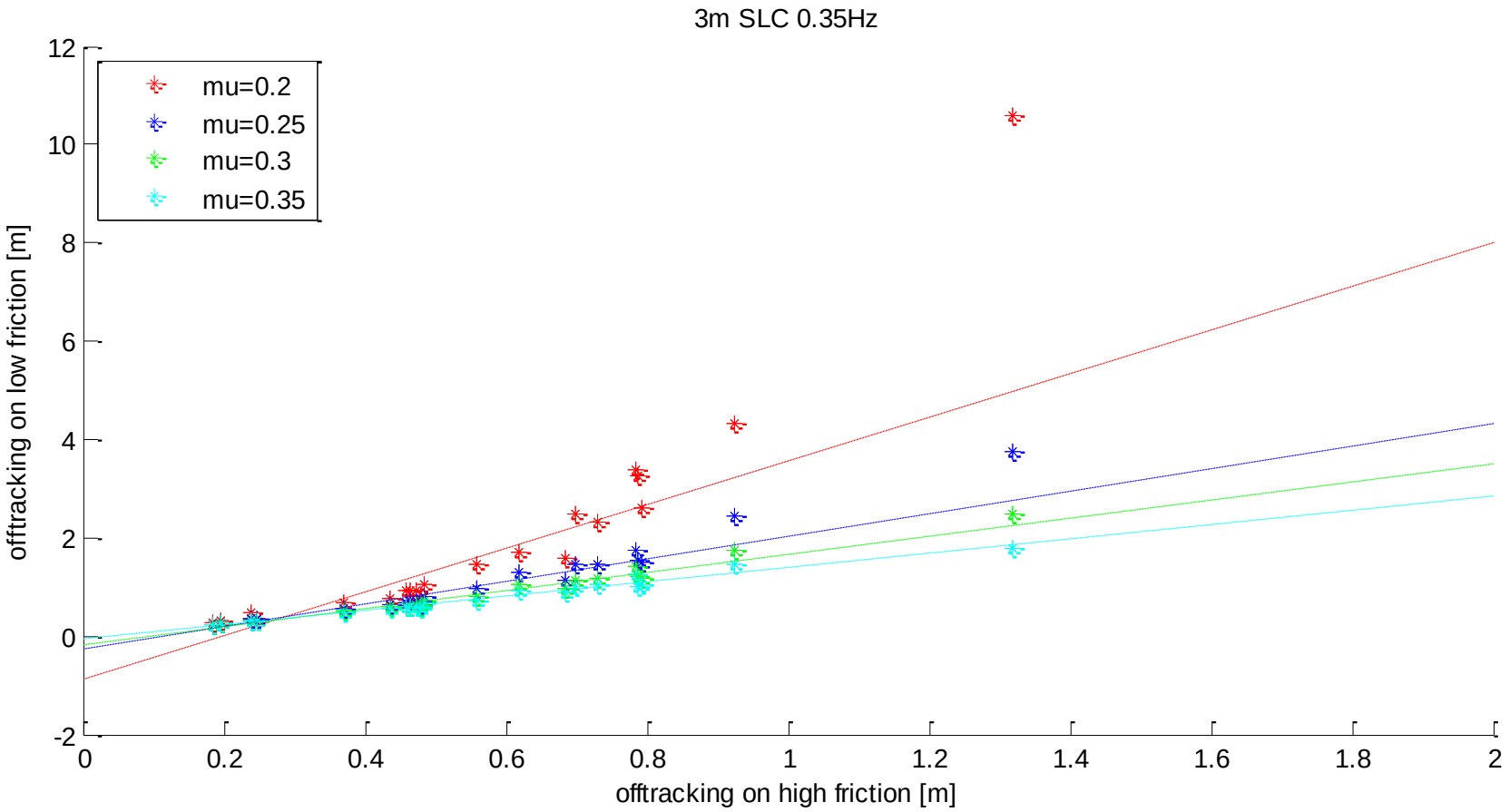
- The average ranking of the total driving experience realism was 5.2 out of 7.

- The last question: how difficult or easy is to drive the HCT vehicle in comparison with the conventional vehicle?
  (1: much easier up to 7:much more difficult)
  - Tractor-Semi & Adouble **4.8** a bit more difficult
  - Nordic & Truck-Bdouble **3.7** almost the same
  - Truck-CAT & Truck-Duo CAT **4.9** a bit more difficult

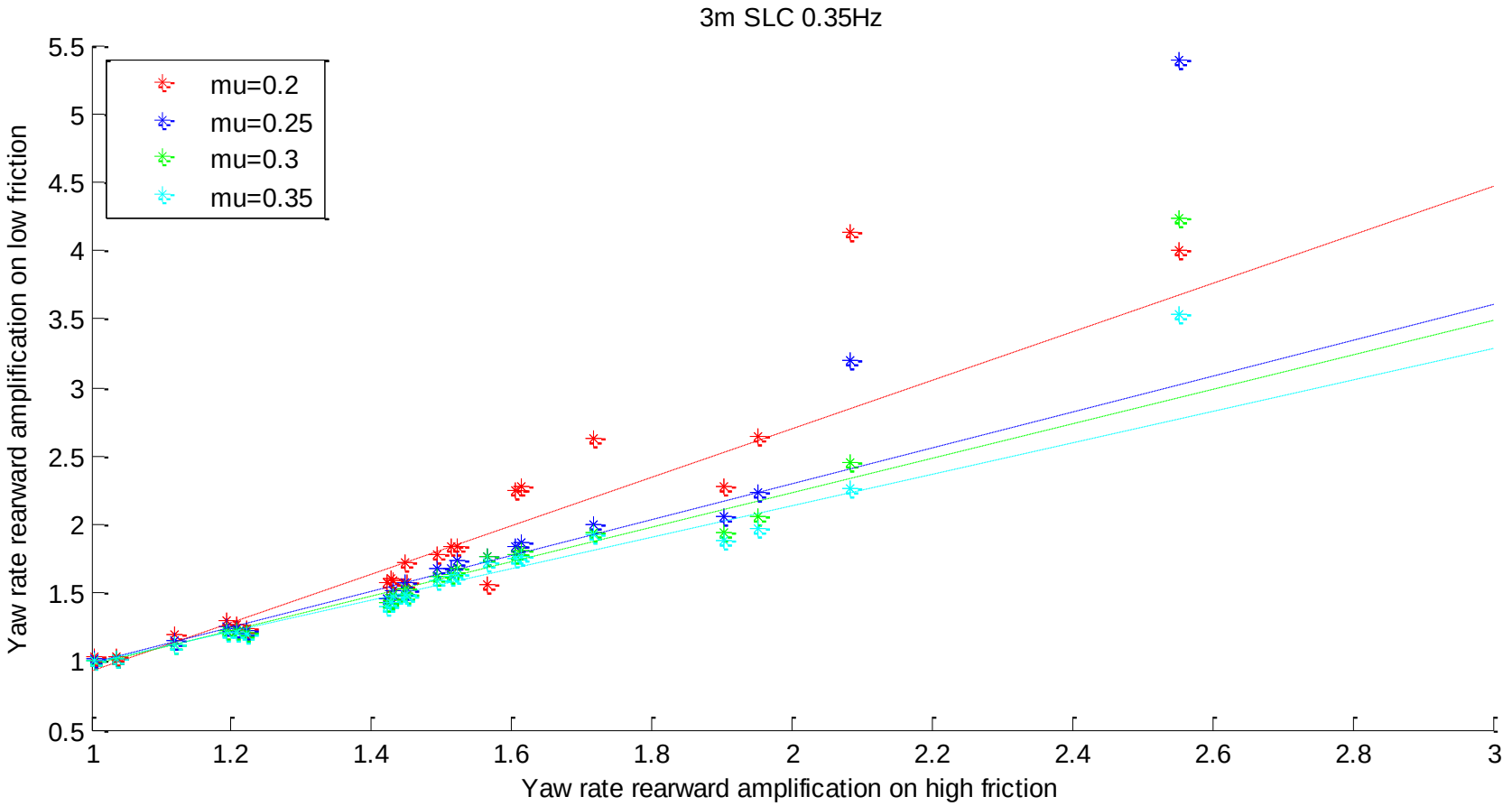
- There is a strong correlation between drivers' perceived performance of the vehicles with the PBS measures investigated in the study

S. Kharrazi, B. Augusto and N. Fröjd, "Assessing dynamics of heavy vehicles in a driving simulator," Journal of Transportation Research Part F: Traffic Psychology and Behaviour, vol. 65, pp. 306-315, 2019.

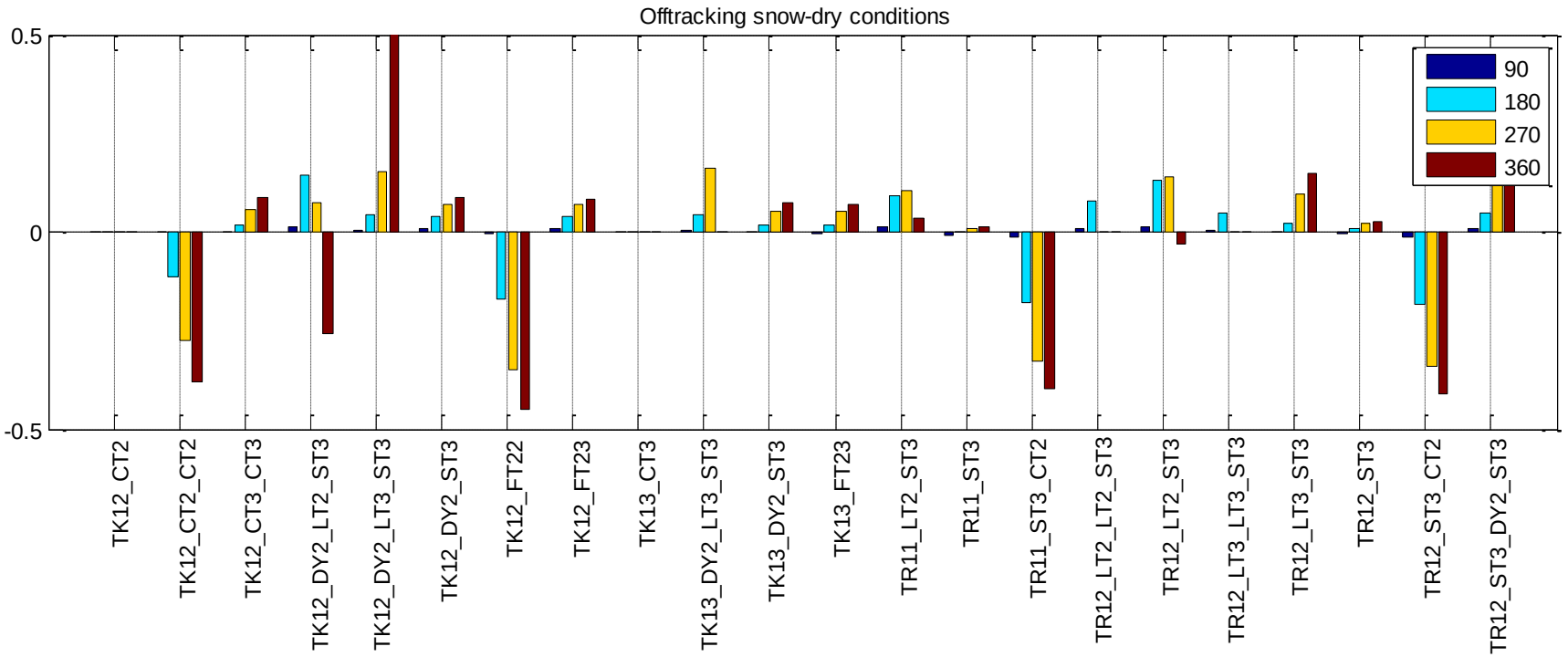
Winter vs. Summer - Offtracking



Winter vs. Summer – Rearward Amplification



Winter vs Summer – Low Speed Maneuvering



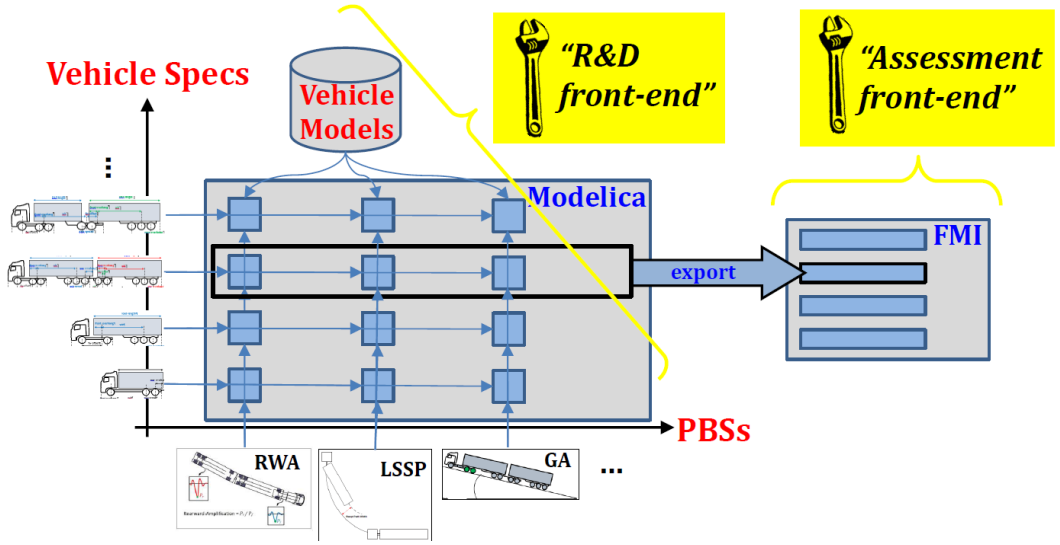
PBS Assessment Tool

Transportstyrelsen lastbilskalkylator (truck calculator)

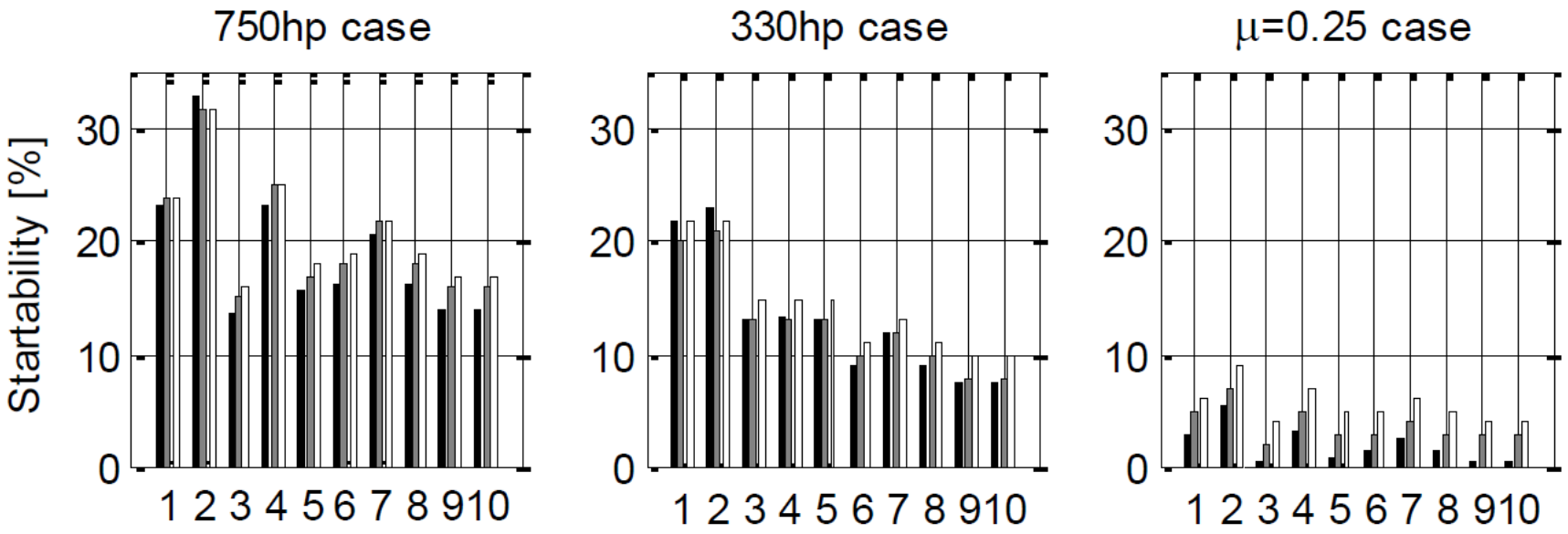
- A web-based tool which uses vehicle registered information
- Support tool for vehicle manufacturers/drivers/hauliers
- https://lastbilskalkylator.azurewebsites.net/

Chalmers open tool

- Modelica based

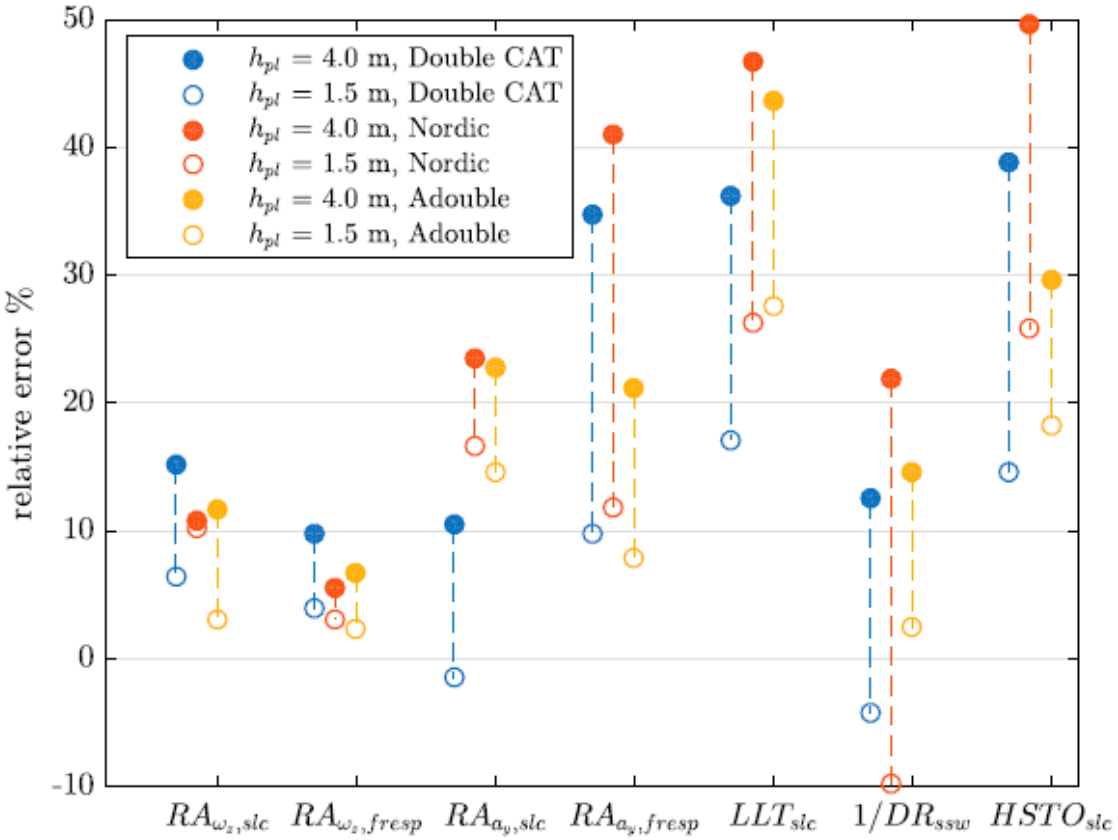


Model Complexity - Startability



Black OEM model, grey intermediate model, white simple expression

Model Complexity – High Speed Stability

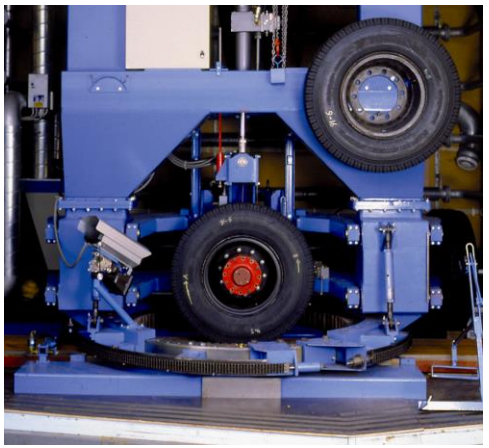


Linear bicycle model vs. multi-body model

Standard tire model(s)

Measuring a selection of tires common in Nordic market

- 7 different trailer/steer tires + 2 worn tires
- 2 different drive tires (new & worn)
- 2 different twin trailer tires (new & worn)



Different road surfaces

- Asphalt (VTI)
- Ice (VTI)
- Snow (Oulu University)

PBS Project Publications

S. Kharrazi, B. Augusto and N. Fröjd, “Assessing dynamics of heavy vehicles in a driving simulator,” Journal of Transportation Research Part F: Traffic Psychology and Behaviour, vol. 65, pp. 306-315, 2019.

V. Santahuhta, “Roll dynamics and tyre relaxation in heavy combination vehicle models for transient lateral manoeuvres”. Chalmers Master thesis report, 2019.

M. M. Islam, N. Fröjd, S. Kharrazi and B. Jacobson, “How well a single-track linear model captures the lateral dynamics of long combination vehicles,” Vehicle System Dynamics, vol. 57, no. 12, pp. 1874-1896, 2019.

F. Bruzelius, S. Kharrazi, “Low speed performance based standards for the Nordic countries,” Accepted for publication in International Journal of Heavy Vehicle Systems.

S. Kharrazi, “Performance based standards project in Sweden,” in proceedings of the 15th International Symposium on Heavy Vehicle Transport Technology, Rotterdam, Netherlands, 2018.

Sandberg, U., Kharrazi, S. and Mioduszewski, P., “Comparison of noise emission of HCT and classic vehicle combinations for timber transportation in Sweden”. Submitted to the International Symposium on Heavy Vehicle Transport Technology (HVTT15), Rotterdam, The Netherlands, 2018.

S. Kharrazi, F. Bruzelius and U. Sandberg, “Performance based standards for high capacity transports in Sweden-FIFFI project 2013-03881-Final report,” VTI, report 948A, 2017.

B. Jacobson, P. Sundström, S. Kharrazi, N. Fröjd and M. Islam, “An open assessment tool for performance based standards of long combination vehicles”. Chalmers research report, 2017.

PBS Project Publications

K. Kashampur, “Assessment tool for performance of high capacity combination vehicles including envelopes for A-double vehicles”. Chalmers Master thesis report, 2017.

S. Kharrazi, “Performance of High Capacity Vehicles, Winter Versus Summer,” in proceedings of the 14th International Symposium on Heavy Vehicle Transport Technology, Rotorua, New Zealand, 2016.

F. Bruzelius, S. Kharrazi and E. Pettersson, “Model and road surface sensitivity of longitudinal Performance based standards,” in proceedings of the 14th International Symposium on Heavy Vehicle Transport Technology, Rotorua, New Zealand, 2016.

S. Kharrazi, R. Karlsson, J. Sandin and J. Aurell, “Performance based standards for high capacity transports in Sweden: FIFFI project 2013-03881: Report 1: Review of existing regulations and literature,” VTI, report 859A, 2015.

S. Kharrazi, J. Aurell, M. S. Kati, B. Jacobson, N. Fröjd and T. Asp, “Towards performance based standards in Sweden,” in proceedings of the 13th International Symposium on Heavy Vehicle Transport Technology, San Luis, Argentina, 2014.

THANK YOU!

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