Development and evaluation of a hardware-in-the-loop converter dolly platform for high capacity transport vehicles

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Abstract— **High Capacity Transport (HCT)-vehicles require different strategies in controlling lateral dynamics of the combinations to ensure optimal paths taken by the trailers. These steering algorithms have been developed in previous works and now need to be verified on the track. This work thus implemented a dolly experimentation platform incorporating a rapid-prototyping system to provide the possibility of evaluating these algorithms. The solution is detailed as a Hardware-in-the-Loop (HiL)-test linked with a vehicle dynamics framework in this publication. Results for this setups utilizing the aforementioned algorithms are presented and discussed. Nevertheless it is possible to run the outlined solution on-track, for which some suggestions are given at the end of this work.**

I. Introduction

- HCT gut fuer umwelt
- Economy
- Off-tracking reduction

The following points will be covered in this paper:

- hardware and software utilized to achieve HiL verification for an active converter dolly
- evaluation of existing delays in the implementation and their consequences
- discussion of three standard maneuvers for HCT-combinations executed on the developed HiL-system and their comparison with simulation results
- propose necessary changes to the set-up for taking the developed solution to the test-track in the future

II. Hardware-setup

A. dolly

The hardware base is a dolly manufactured by Parator Industries. The steering system is based around the Electronically-controlled hydraulic Trailer Steering (ETS) developed and built by V.S.E. Vehicle Systems Engineering B.V. (VSE) with two hydraulically steerable axles. It was originally meant to be used in trailer steering and as an after-market system does not tie in with any of the truck's communication networks or sensor data. This makes it OEM-independent and very robust. The ETS solely relies on the articulation angle between the leading and following unit on which the system is mounted and the speed of the combination. The articulation angle is gathered via a dedicated sensor mounted on the king-pin, the speed-signal is gathered from the ISO-11992 Controler Area Network (CAN).

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B. MABII

To execute the readily developed algorithms[1], that govern the steering of the HCT-combination needed to be ported to a platform, capable of interacting with the dolly and the tractor, while ensuring robust behavior during run-time. It was decided to incorporate the dSpace MicroAutoBoxII (MABII) by dSpace, a real-time platform for its advantages in automotive environments with a vast selection of in- and outputs for interfacing with vehicular communications systems (CAN, ethernet, FlexLink). It conveniently ties in with Simulink, which was used for algorithm development, for code-generation. Furthermore it physically is very robust and has good logging possibilities.

C. Arduino

D. interconnections between MABII/dolly/truck

III. Software-setup

A. VTM

To simulate the dynamic performance of the HCT-combination Volvo's Virtual Truck Model (VTM) came to use.

B. RTI Zeug

C. ControllDesk

IV. Delays

V. Maneuvers

VI. Results and discussions

VII. Related works

VIII. Conclusions

Appendix

Acknowledgment

References

[1] M.S. Kati, J. Fredriksson, L. Laine, B. Jacobson,"Performance Improvement for A-double Combination by introducing a Smart Dolly," in Proceedings of the 13th International Heavy Vehicle Transport Technology Symposium, San Luis, Argentina, 2014.