Active steering assistance in a long timber vehicle

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Research focus:
Project partners

DOLL Fahrzeugbau AG

High-tech specialist for transport solutions
- Timber transport
- Heavy haulage
- Ground support equipment

Weiss Mobiltechnik GmbH

- Software solutions for machine control systems
- Diagnostic and maintenance software
- Commissioning and upgrading of mobile machines

DOLL

Weiss

www.weiss-can-sps.de
Structuring

The drivers influence to the working process

Challenges in the long timber haulage

Driver support by function automation

Impact of a driver assistance system in a long timber vehicle
The drivers influence to the working process

- Operation expenses
  - Fuel consumption
  - Wear
- Duration
- Quality of work

Example:
Holländer [1] compares drivers of a crawler excavator

8,6 % fuel savings (l/t)
30,9 % increase in productivity (t/h)
The drivers influence to the working process

- Operation expenses
  - Fuel consumption
  - Wear
- Duration
- Quality of work

Example:
Kirchbeck [2]: fully automatic control of the discharge chute
- Higher fill factor of the trailer
- Better focus on the harvesting process
The drivers influence to the working process

Economic interest to enable the driver to deliver best performance

- Avoid overstrain or subchallenge
- Focus on the main task
- Automation of incidental tasks
Challenges in the long timber haulage

- Overall length
  - 16.50 m
  - 18.75 m
  - 27.00 m

- Steering elements

Institute of Vehicle System Technology (FAST)
Chair of Mobile Machines (Mobima)
Challenges in the long timber haulage

- Track offset
  - 1,8 m
  - 2,1 m
  - 3,2 m

- Kinematic coupling
Challenges in the long timber haulage

- System meets the road traffic regulations
- Manual steering to adjust to the real needs
- Manual setting of the trailers track

High demand on the drivers concentration to steer truck and trailer simultaneously
Driver support by function automation

- Reduction of manual trailer steering events by an automated steering control

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<th>setting</th>
<th>Common state</th>
<th>Project aim</th>
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<td>Curvaceous and narrow lanes</td>
<td>large track offset; manual steering</td>
<td>Trailer follows the track of the tractor automatically</td>
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<td>Shunting backwards</td>
<td>Instable characteristics like a drawbar trailer</td>
<td>characteristics like a semi-trailer</td>
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Raising ease of use and system safety
Driver support by function automation

Setting up a polynomial of the geometric arrangement of a long timber vehicle

\[ f(x) = A x^4 + B x^3 + C x^2 + D x + E \]

\[ f(0) = 0 \]
\[ f'(0) = \tan \gamma \]
\[ f''(0) = \frac{(1 + (f'(0))^2)^{2/3}}{R} \]

\[ f(L) = 0 \]
\[ f'(L) = -\tan \beta \]
Driver support by function automation

Comparison of simulation results with respect to decrease of the track offset

- Tractor’s track
- Track of the trailer with usual steering kinematics
- Track of the trailer with activated assistance system
Driver support by function automation

- **Sensors**
  - Angles
  - Distance between turntables
  - Velocities

- **Additional 32 bit controller**

- **Execution**
  - More powerful hydraulics
  - Proportional valve control
Driver support by function automation

Operation

- „Ratio Plus“ Display
- DOLL control panel
- Control pad
Impact of a driver assistance system in a long timber vehicle

In the diagram:

- GPS-satellites
- Glonass-satellites
- RTK-Rover
- Position data
- RTK correction signal

The diagram illustrates the impact of a driver assistance system in a long timber vehicle, showcasing the integration of GPS and Glonass satellites for positioning and RTK technology for precise signal correction.
Impact of a driver assistance system in a long timber vehicle

- System comparison in a roundabout
  - Reduction of the road demand by 36.6 % [1]
  - 18.1 % increased velocity

![Diagram showing system comparison in a roundabout with annotations for driving surface limits, tractor's track, track of the trailer with usual steering kinematics, crossed area of the tractor, and additionally demanded area of the trailer and payload.](image-url)
Impact of a driver assistance system in a long timber vehicle

- Enhanced ease of use
  - Additional system information
  - Extra functions
- Higher driving speeds
- Relaxed driver
- Increased driving safety
- KWF innovation award
- Certified by the TÜV SUD Munich
Impact of a driver assistance system in a long timber vehicle
Literature

