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„Towards real-time skid resistance forecast“

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1 Modelling - Salt usage and cost comparison
2 Skid resistance - importance of road surface texture

- Small amounts of snow or ice have no relevant impact on skid resistance if the mean texture depth is large enough to absorb this amount.

- Continuous precipitation results in a filled texture resulting in a decreasing contact area of tire and road surface.

- Thus the road texture provides a buffer for small amounts of precipitation.

- Furthermore this buffer gives the winter maintenance personal time for preparation.

*Contact area: Tire – Road*
3  Determination of road macro texture

- **Laser scan (1/10 mm)**
  - Very precise
  - Only in laboratory

- **RoadSTAR (1 mm)**
  - Whole network scans
  - Moderate precision

- **Sand patch (Ø 0.18-0.25)**
  - Easy & cheap
  - Only single points
4 Correlation between texture determination methods

**Laser scan - Sand patch**

- Linear correlation between volumetric and geometric methods with $R^2 = 0.9799$ quiet good
- Offset of $\sim 1500 \text{ mm}^3$ with geometric method due to exact determination of the highest peak in surveyed area
- Easy and cheap volumetric sand patch method can be used with only a few exact topography scans in laboratory as background

\[ V_L = 1.335 \times V_{SP} + 101.3 \]
4 Correlation between texture determination methods

Sand patch - RoadSTAR

- Correlation between sand patch and RoadSTAR with $R^2=0.646$ moderate
- One sided 90% prediction bound for new observation used to keep the odds of less road texture volume the measured below 10%
- With improved network scans the safety buffer for texture volume could be reduced

$$MTD = 1.1354 \times MPD - 0.4685$$
5 Road surface texture – Difference between pavements

Flexible Pavement (7 years old)

Rigid Pavement (2 months old)
6 Road surface texture and filled surface area

Volume vs. Area

- Filled surface area is the area where precipitation covers the road texture.
- 100% filled surface area means no direct contact between tire and road texture.
- Tested rigid pavements show more road surface texture than flexible pavements.
- With flexible pavement 80% of the available texture volume is filled with only 20% of the surface covered.
- Under constant precipitation rate the last 80% surface area are covered rapidly.
6 Towards skid resistance prediction

Skid resistance vs. Area

- Based on skid resistance of roads under usual measurement conditions the impact of snow or ice can be predicted depending on filled volume and surface area.

- With increasing macro texture filling rate the contact area is gradually covered with snow or ice leading to a sudden drop of skid resistance between 60 to 90% of filled macro texture volume.

\[
SR = SA_{snow} \times SR_{snow} + (100\% - SA_{snow}) \times SR_{wet}
\]
7 Animation - Macro texture and skid resistance

Braking distance dry (130 km/h) = 83 m
Braking distance snow/ice (130 km/h) = 665 m
8 Skid resistance and precipitation film measurements

Skid resistance

- Treatment raises skid resistance level for ~ 60 Minutes
- Continuous precipitation lowers skid resistance again

Precipitation film

- Snow has been removed with treatment
- Formation of ice Layer 60 Minutes after treatment
9 Conclusions and Outlook

Outlook and further application

- Correlations between accurate laboratory measurements and available MPD – measures on network level have been established.

- Relation between macro texture volume and filled surface area can be used as indicator of reduced skid resistance based on contact area of road surface - tire

- Established correlation of this sudden drop of skid resistance in line with observed data between 60% to 90% of filled macro texture volume

- Based on further extensive research in field and laboratory measurements during the next 3 years the presented findings and approaches will be sharpened and verified
Thank you for your attention!