Direct low lateral slip roadgrip measurement compared with surface reflection of three laser beams

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Content

- Goals
- Methodology
- Results
- Conclusions and future work

Goals

- Primary goal: reduce deaths, injured and damages
- Secondary goal: educate vehicle owners about the importance of tire selection
- Third goal: create business opportunities in northern Sweden's car test industry

What is the right thing to do?

- Use good equipment to measure roadgrip and distribute the information to the public
- Inform vehicle owner that tire selection is a key issue as differences are significant
- Certification of winter tires through tests and maintain a index

How will we accomplish this?

The key is to work together!

- Work is headed by the Swedish road administration
- Supported by research entities, LTU, VTI etc.
- Legislations from government
- Information distribution through media
- Follow up by law enforcement
- Vehicle tire inspection
- Accident investigations

The scientific side is LTU:s part

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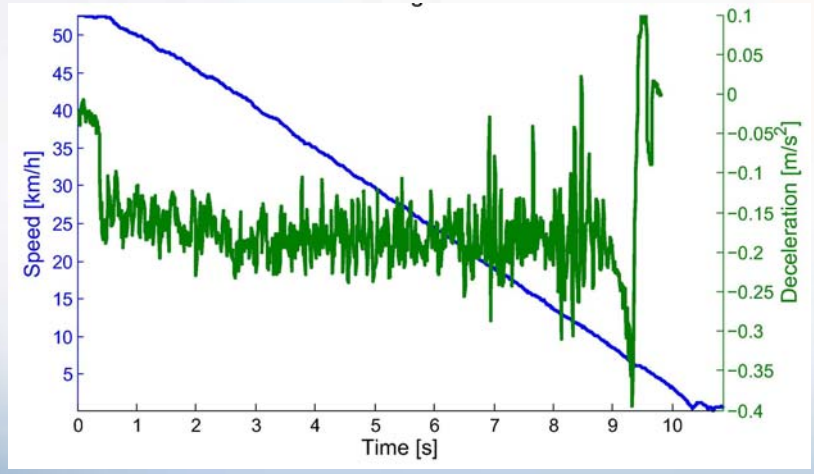
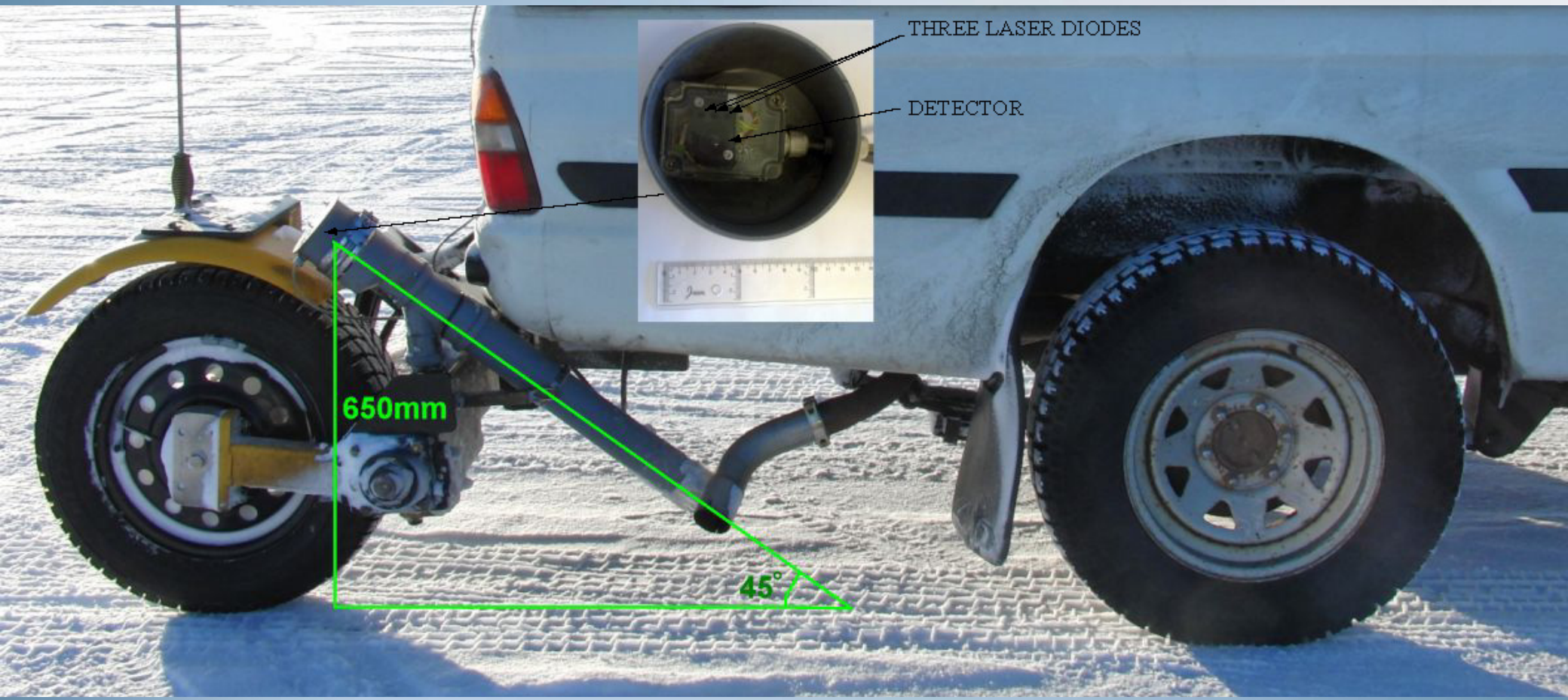


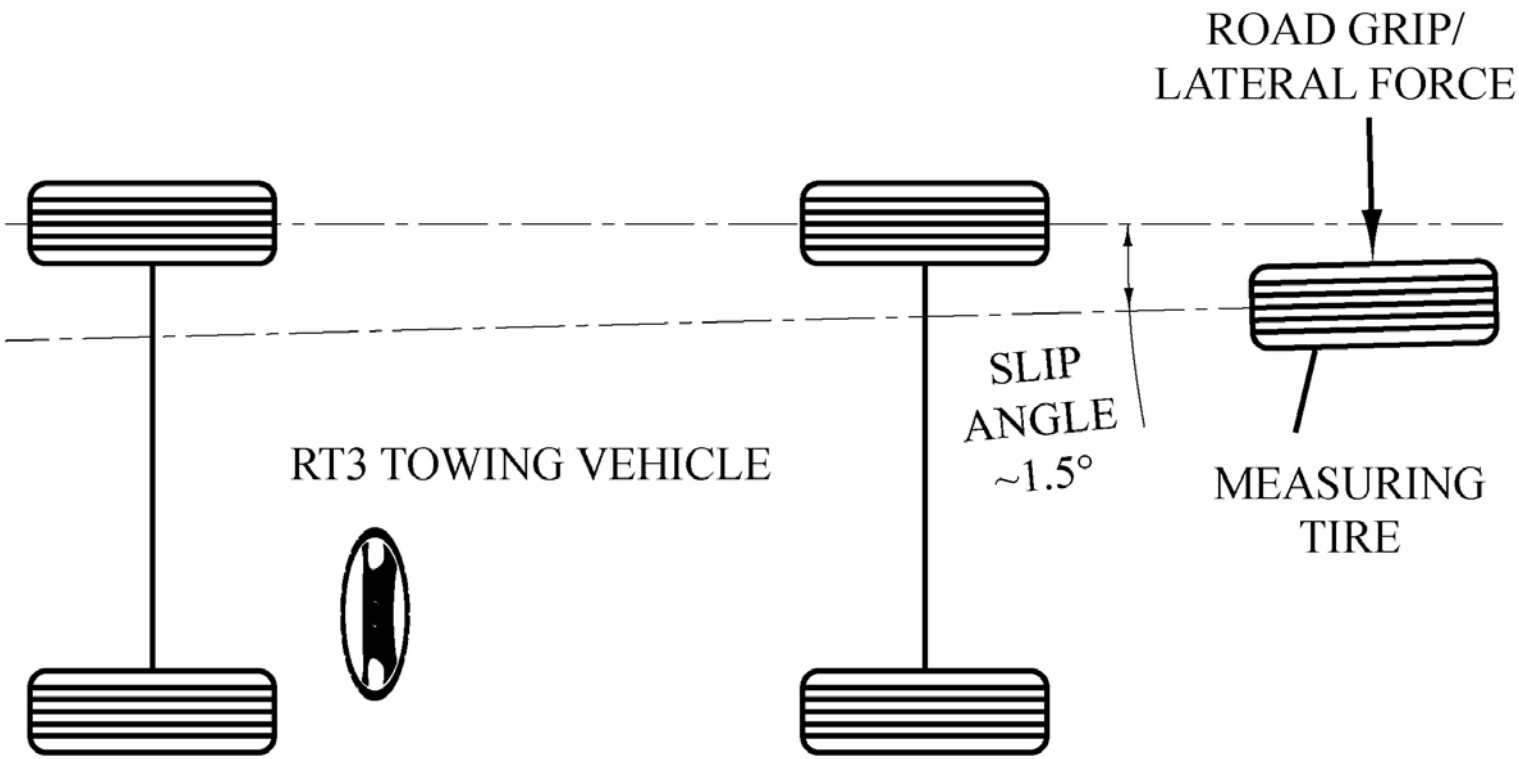
- Stop distance measurements
- Lane change tests
- RT3 and RT3-2 correlation tests
- Laboratory tests on rubber and ice
- Roadeye and IR-measurements
- Rubber tests

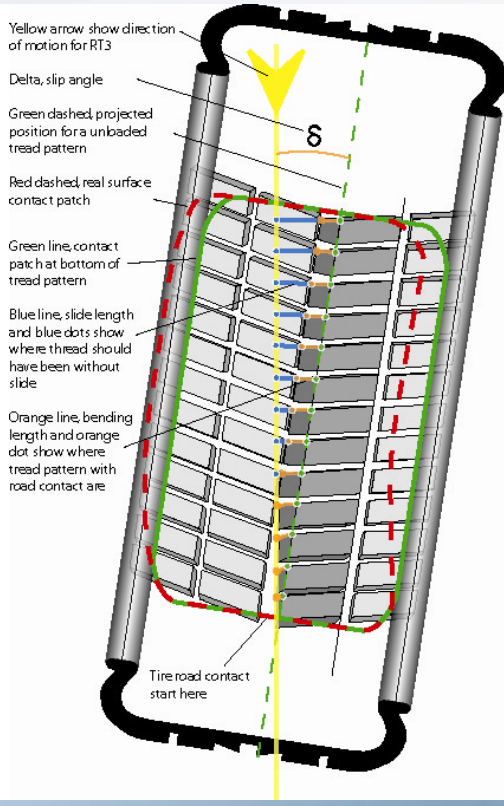
Methodology

Low lateral slip (RT3) as reference VS infrared spectroscopy (Road eye)

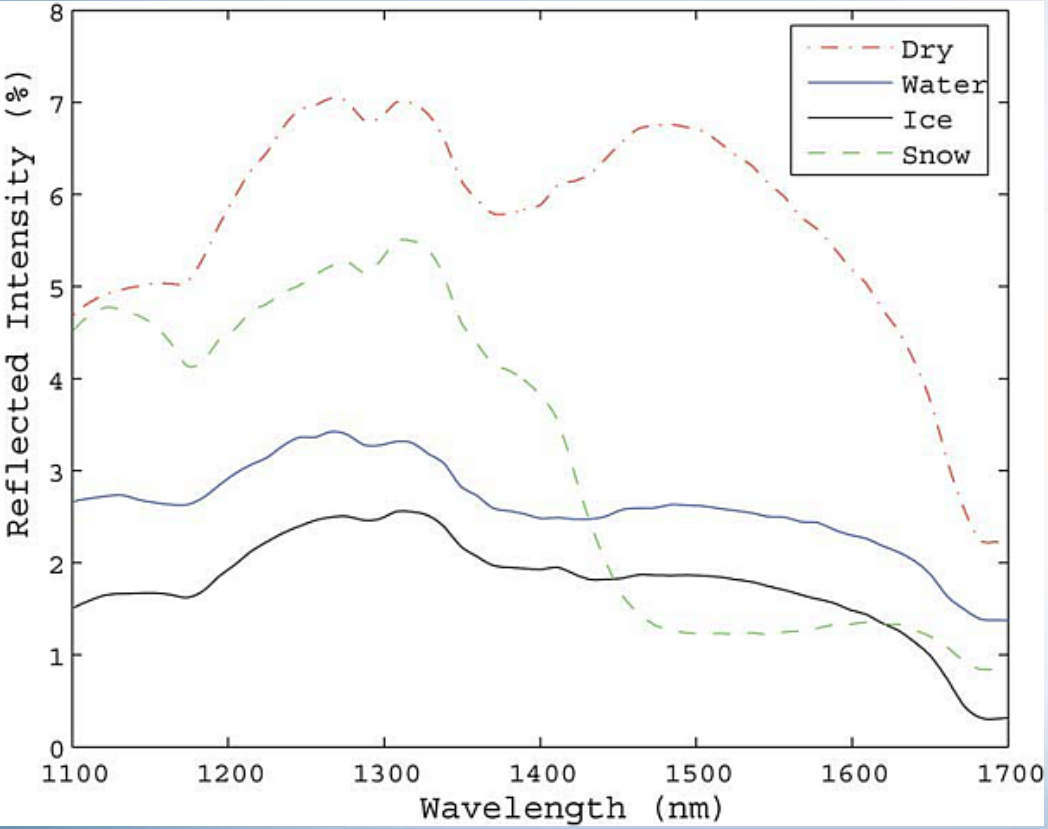


Roadgrip measurement through Low lateral slip





Surface measurement through near infrared spectroscopy



Reflected intensities for four surfaces when illuminated with a continuous spectrum from a halogen light source.

Wavelengths 980 nm, 1323 nm and 1566 nm was selected

Yellow = Dry

Blue = water

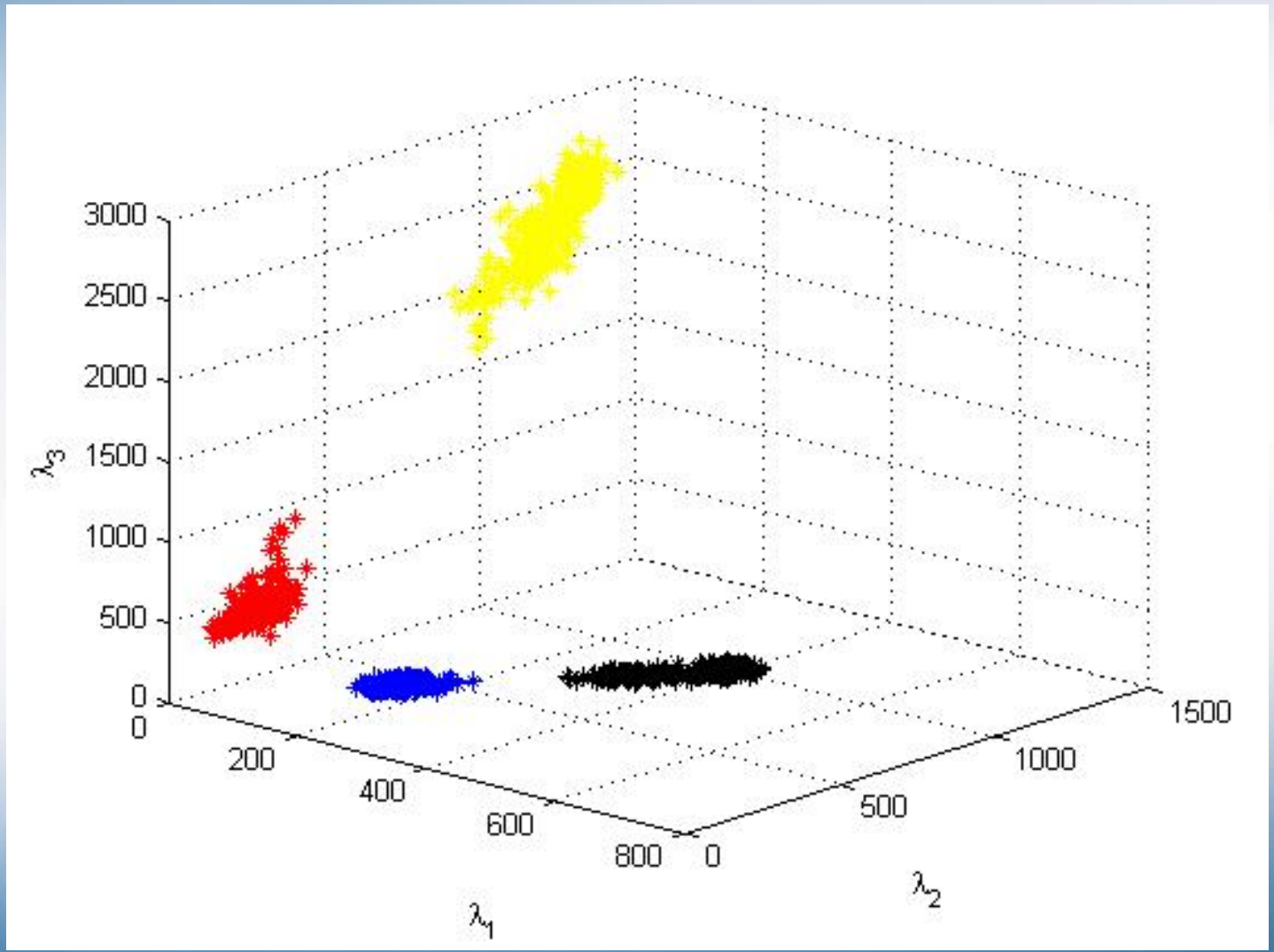
Black = ice

Red = snow

λ_1=1566 nm

λ_2=1323 nm

λ_3=980 nm



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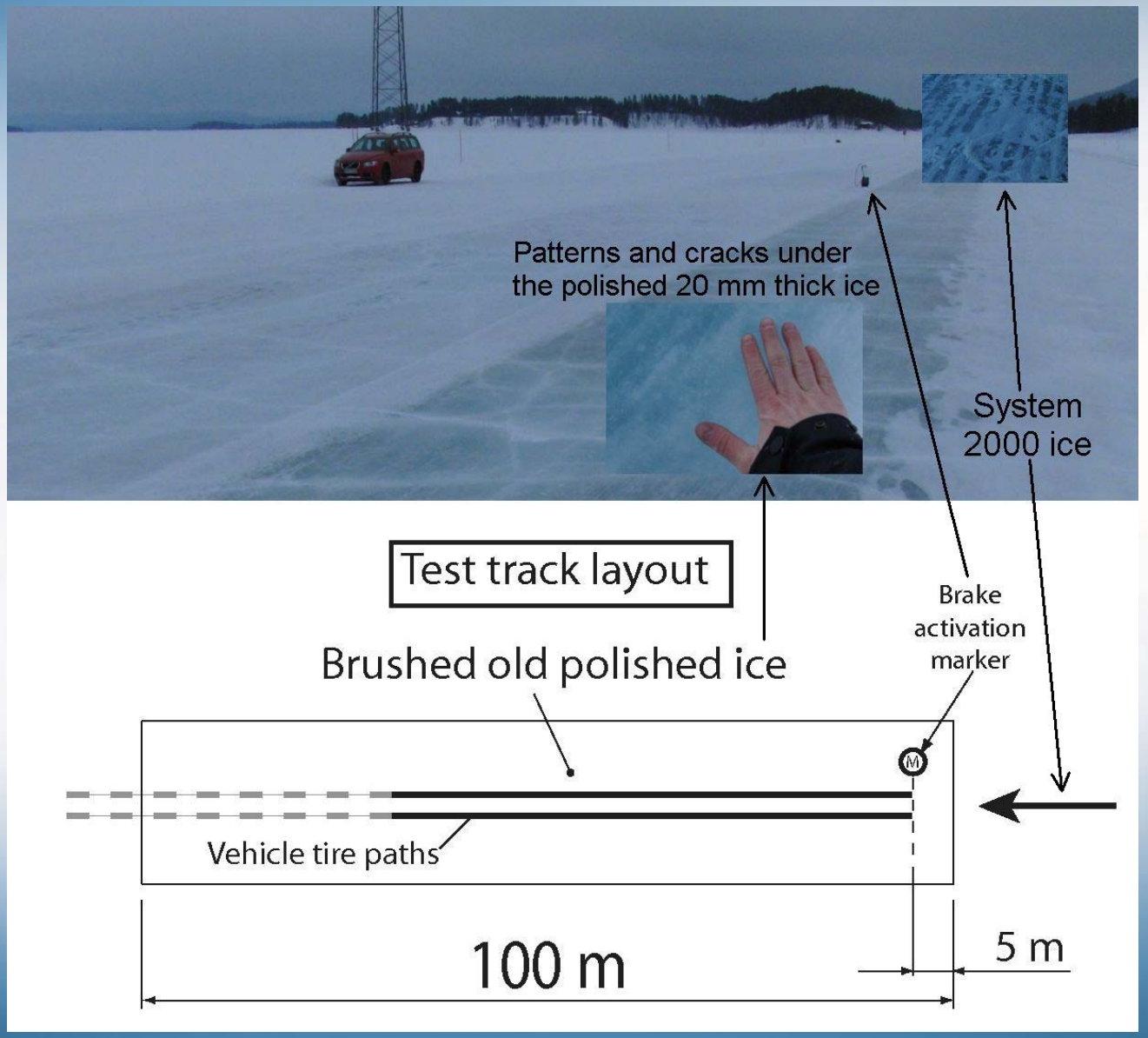
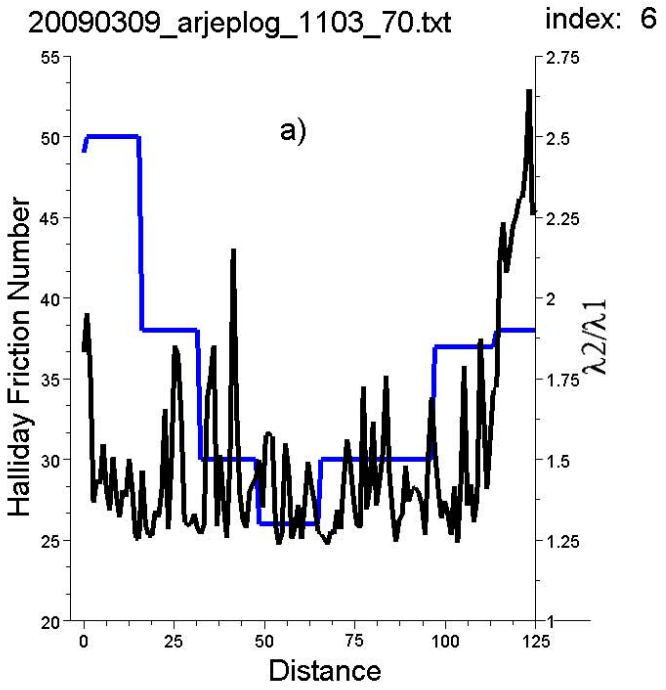
Test layout


Patterns and cracks under
the polished 20 mm thick ice
System
2000 ice
Test track layout
Brushed old polished ice
Brake
activation
marker
M
Vehicle tire paths
100 m
5 m

Results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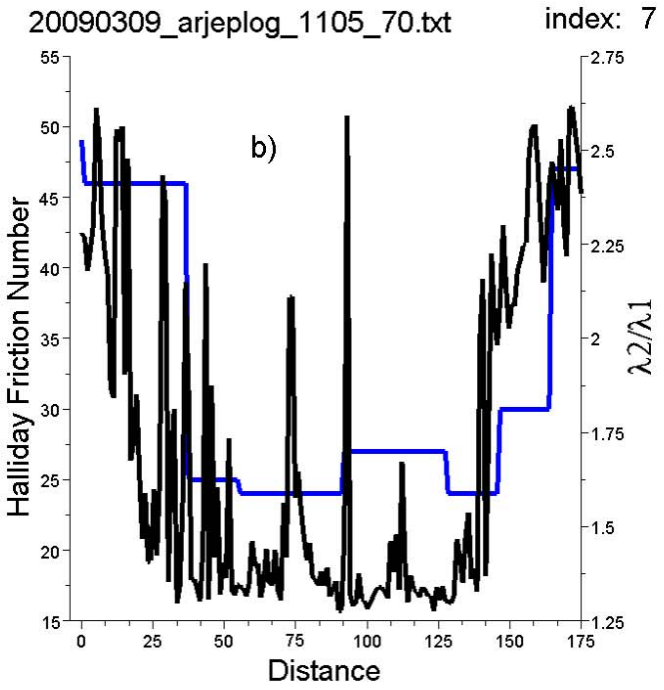
index: 6
a)
Halliday Friction Number
λ2/λ1
Distance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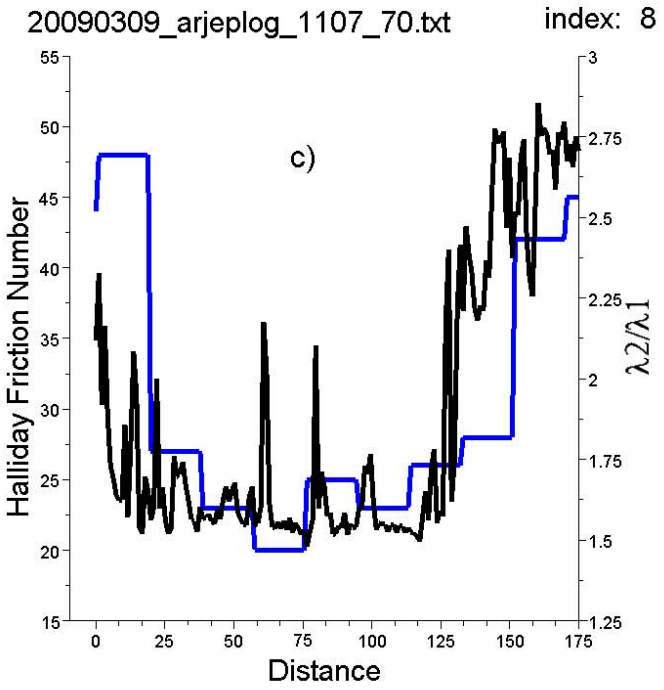
b)
Halliday Friction Number
λ2/λ1
Distance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index: 8
c)
Halliday Friction Number
λ2/λ1
Distance

Conclusions

- Near infrared spectroscopy can be used to detect and distinguish between snow and ice.
- Information regarding surface temperatur is needed
- Information regarding surface roughness and surface structural strength is needed.

Future activities, LTU

On going:

- Suggest tire test procedures in collaboration with SRA, VTI, STRO and other interested parties
- Preparations to test RT3-2, surface properties with RoadEye, temperature on surface and in the air, humidity, radiation, dew point and surface structure
- Measure properties of winter tires with focus on rubber compounds

Completed:

- Test different roadgrip devices, RT3, Coralba, ViaFriction, TWO, SRIS Volvo and V-BoxIII
- How to create laboratory ice
- Surface measurements with Master exact and WYKO
- Measure stop distances for studless winter tires with V-Box3i, Focus on low friction surfaces

Thank you for your attention!

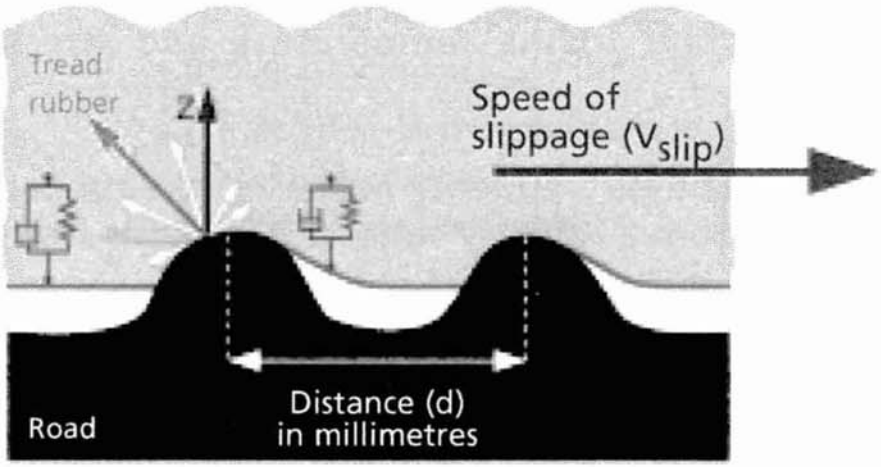
Questions?

Roadgrip, what is it?

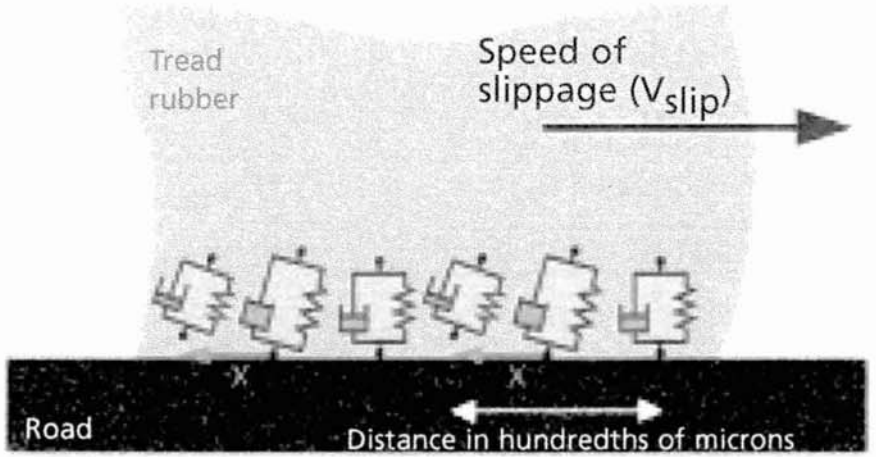
- Hysteresis
- Adhesion
- Physical interlock

Hysteresis and Adhesion

ROAD ROUGHNESS EFFECTS (INDENTATION)

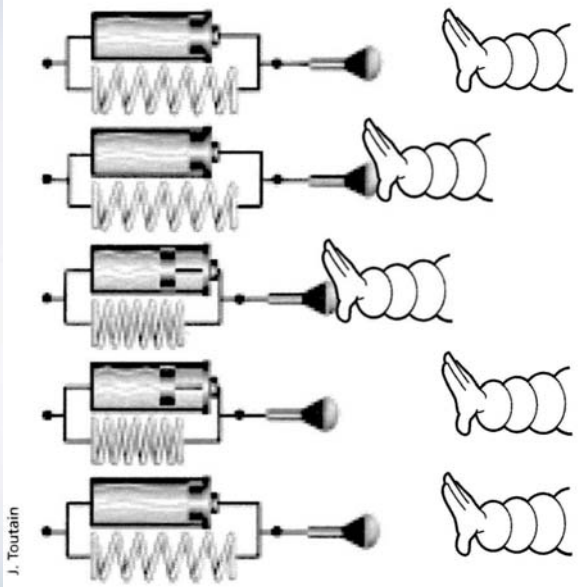


MOLECULAR ADHESION



Hysteresis

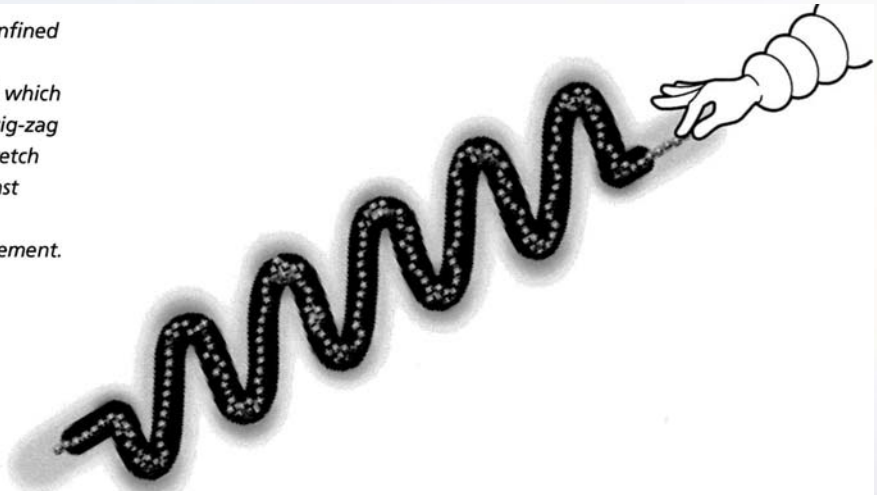
- A visco-elastic material can be represented by a spring and piston assemby as shown below:

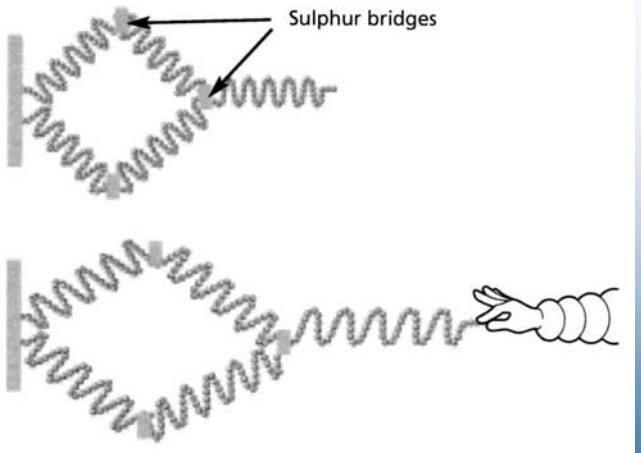


- There is partial dissipation of the energy supplied. This is **energy loss.**

- Compression and return to the initial state take place with a phase lag in relation to the force applied; this is known as **hysteresis.**

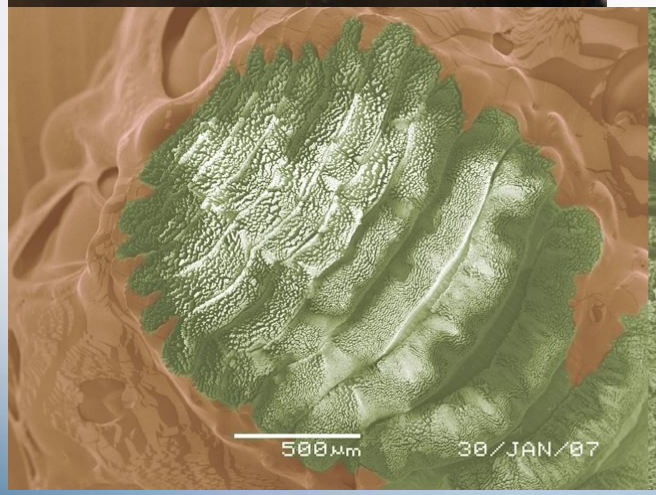
Each molecular chain is confined by the other chains in its environment, in a "space" which may be represented by a zig-zag shaped tube. When we stretch the molecule, it rubs against the walls of this "tube", which slows down its movement.

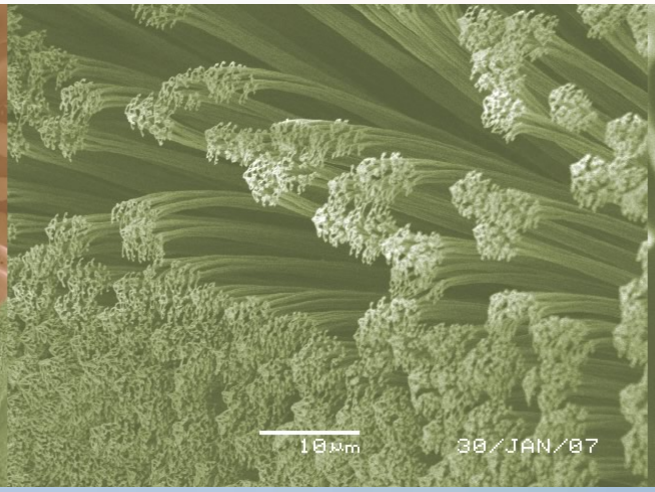


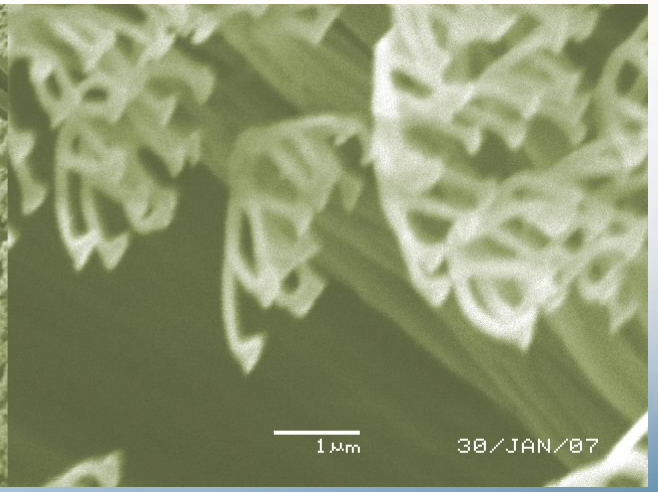


Adhesion

Adhesion occurs when two surfaces are so close that the molecules start to interact with Van der waals forces





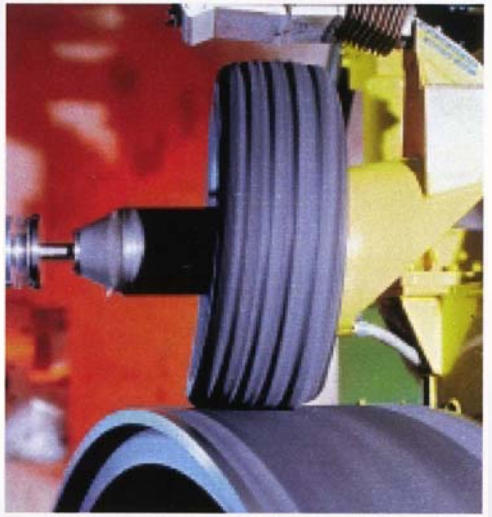


Physical interlock

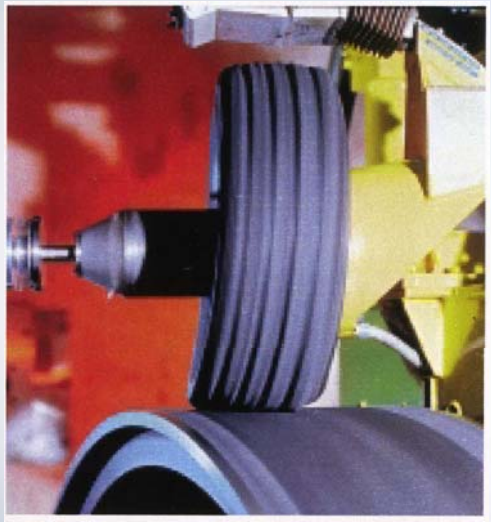
- Occurs when the thread patterns interlocks with the road surface, i.e.. Stones, ice ridges etc.
- Snow compacted and pressed against the surface

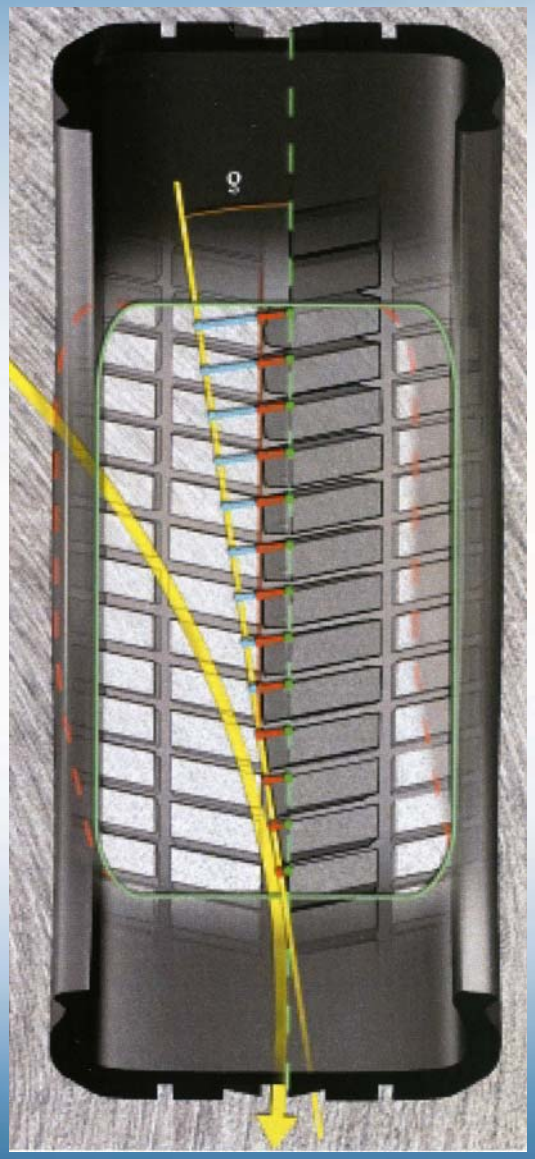
RT3 = Low lateral slip

- Lateral slip angel 1.5°



Lateral load 1





top of tread blocks
bottom of tread blocks
length of shear
length of slippage
projection of top of tread blocks on road surface
point on road surface
tangent to wheel path

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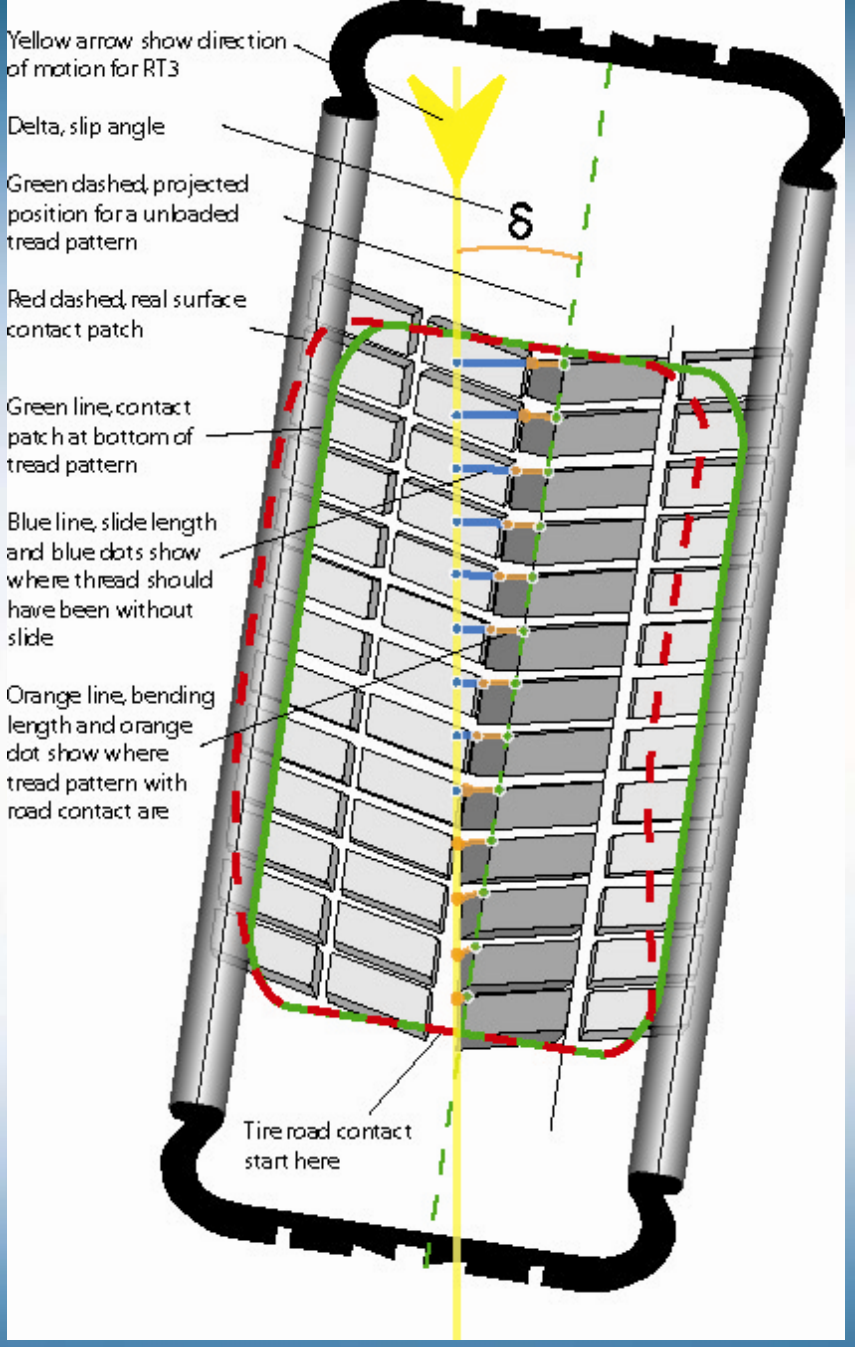
Lateral load 2



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The road away and back again

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