A statistical forecast model for road surface friction

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Winter in Finland

- Snow and ice may exist on roads almost 6 months per year in Finland.
- In the north, roads are covered by snow and ice most of the winter whereas in the south roads are tried to keep clear of ice and snow always when possible.
- Ice and snow reduce friction.
- In case of low friction values, risk of traffic incidents rise.
Friction model :: Background

- Friction means the grip between tires and road surface
- The amount of water/ice/snow on the surface as well as an estimation of friction can be measured by Vaisala DSC111 sensor
- FMI has developed a statistical friction model based on observations made by DSC111 sensor
- The model is running for points installed with DSC111 sensor
- The friction model was developed to help road maintenance personnel and meteorologists
- Also, product for drivers in ROADIDEA pilot
Road weather classification

Classification by Finnish Road Administration
Observed friction vs. snow+ice and water on the surface

Anjala’s observations winter 2007-2008

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Observed friction with ice and/or snow on the surface (water content in mm)
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Observed friction with water on the surface.
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Developed friction model

- Own formulas for snowy/icy, wet/damp and dry situations
- Friction is a function of depth of snow/ice/water on the surface
- Small temperature dependency in case of snow/ice on the surface
- $A - E$ are coefficients
- Minimum value for friction 0.10 and maximum 0.82
- Used formulas were developed using Utti’s data observed in winter 2007-2008
- Same formulas in use for all computation points
How does the friction model work?

- All input data available on FMI’s road weather model ➔ Friction formulas included into FMI’s road weather model
- Model takes into account weather parameters, precipitation, melting/freezing, evaporation/condensation, traffic wear, traffic heat, turbulence, ...
- Initialization is done by running the model with observations (48 hours)
- Forecasted values up to 48 hours
Simulated results :: modeled vs. observed

Simulations for Anjala’s point using independent data 2008-2009

Observed (OBS) and modeled friction (FC) in case of icy and/or snowy roads. Correlation 0.89.

Observed (OBS) and modeled friction (FC) in case of water on the road. Correlation 0.97.
Implementation

- Google.maps application presents 3 hour forecast of expected road weather
  - Temperature
  - Friction
  - Road condition
- Produced in collaboration with FMI, Destia and Demis
- http://pilot.roadidea.eu/friction/

- Also, a mobile phone application available
- Information of road weather (including friction), road weather pictures, warnings given by other users
- Produced in collaboration with FMI, Destia and Logica
Results

• Model simulates cases of poor friction very well, but…
• Friction model produces often too low values for friction too long time
  • FMI’s road weather model has too big storages for ice
  • The lack of road maintenance action
• More discussion on validation in next presentation by P. Nurmi / FMI
Problems

- Finnish road weather model has usually **too much ice (and frost) on the surface** ➔ **too low values for friction**
  - Need to develop the wearing of ice in the model
  - Need to improve influence of traffic

- **Common problem in road weather forecasts:** **no information about road maintenance actions** available
  - Modeling presents situation if no maintenance actions have been done
Conclusions and future

• Friction model is a new and innovative product
• Results are not as good as expected, but the problems are known
• Testing, evaluating and developing is an ongoing process

• Define station specific correlations at all computation points