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A statistical model for road surface friction forecasting applying optical road weather measurements

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Road surface friction is defined as the grip between car tyre and underlying surface. Poor friction often plays a crucial role in wintertime car accidents. Friction can decrease dramatically during snowfall or when wet road surface temperature falls below zero. Even a thin layer of ice or snow can decrease friction substantially increasing the risk of accidents. Many studies have shown that road surface temperature, road conditions and friction can fluctuate dramatically within short distances under specific weather situations. Friction or grip can be improved with road maintenance activities like salting and gritting. Salting will melt the ice or snow layer, whereas gritting will improve the grip. Salting is effective only above -5C temperatures. Light snowfall together with low temperatures can result in very slippery driving conditions.

Finnish Road Administration's observing network covers c. 500 road weather stations in Finland. Almost 100 of them are equipped with optical sensors (in winter 2008-2009). The number of optical sensors has increased remarkably during past few years. The optical measuring devices are Vaisala DSC111 sensors which measure the depth of water, snow and ice on the road surface and also produce an estimate of the state of road and prevailing friction.

Observation data from road weather stations with optical sensors were collected from winter 2007/08, and a couple of representative (from a weather perspective) stations were selected for detailed statistical analysis. The purpose of the study was to find a statistical relationship between the observed values and, especially, the correlation between friction and other road weather parameters. Consequently, a model based on linear regression was developed. With the model friction being the dependent variable, the independent variables having highest correlations were the composite of ice and snow (water content) on the road, and the road surface temperature. In the case of a wet road surface, the amount of water was the best predictor for friction. The models were tested with an independent sample from winter 2008/09.

Finnish Meteorological Institute (FMI) has been running an operational road weather prediction model for about ten years. The model predicts e.g. the road surface temperature and the layers of snow, ice and water on the road. With the addition of the statistical friction model, road surface friction will be a new forecast parameter. There are, however, some challenges to be solved before operational applicability. A major issue is how to take road maintenance activities, and especially the salting, into account.

This study is carried out within the EU/FP7 Project ROADIDEA, where the major frame of reference is to develop new and innovative products for traffic and transport sectors.