

Experiences in development and testing of the ROSA road weather station

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1. Introduction

Road weather stations are designed as tools for road maintenance. They provide up-to-date information on road and weather conditions to assist decisions about various road maintenance actions. The information available from a road weather station is more detailed and accurate than general weather data, as it is based on measurements done locally at the site.

Recently road weather stations have also been gaining a role in automatic traffic control and also in warning road users of hazardous driving conditions.

A road weather station has to perform multiple functions, and it also consists of multiple measurement devices, whose functions need to be combined in the best possible manner. This paper contains observations how this could be best realised and how it was done in developing the ROSA road weather station manufactured by Vaisala Oy.

2. Functions of a road weather station

A road weather station is often expected to perform the following four functions:

- Provide information on the state of the road surface. In general, how slippery the conditions may be, and in particular, whether the surface is covered with water, ice, snow or frost, and what is the amount of the coverage. Also the road surface temperature is measured.
- Provide local weather information. This includes normal weather data, such as temperature, humidity, precipitation, wind conditions and visibility.
- Measure the amount of de-icing chemical, usually salt, on the road surface.
- Provide predictions on how the road conditions are likely to develop or change.

The purpose of all this information is to help making decisions for road maintenance actions. Because the information provided by a road weather station is complex and there is a relatively large amount of it, it is important that there is a human interpretation between the data and the actions. The design of a road weather station is necessarily such that the data it provides is never 100 percent correct and reliable, even excluding the predictions. But it is not in any way difficult for a human user with a little training to determine the situation even if the measurement data provided by the road weather station is conflicting.

It is for the above reason that a road weather station is generally designed in such a way that it provides a wealth of information and does not simply tell the user if salting or plowing the road is needed. The user makes decisions and the weather station only helps with the information.

There is a need to use the weather station data for automatic traffic control. This is possible, of course, but only a small well defined part of the data should be used for this purpose.

The ability of a road weather station to predict future developments is limited. It is possible to obtain correct predictions based on patterns of change in local conditions at the site. An example of this is the development of frost in suitably freezing conditions. Most of the important changes in road conditions are, however, caused by non-local factors, such as arriving weather fronts. A road weather station cannot possibly predict those, unless it is a part of a large network of interconnected stations.

3. ROSA road weather station

A ROSA weather station is an integrated system that has several sensors connected to it, which continuously carry out a number of separate measurements. The results of those measurements constitute the input into a model, which further refines the information. Some of the measurement results, such as air temperature and road surface temperature are also shown as such in the station output messages. The station contains a computer

program that applies the model and determines the road surface state and possible alarms and warnings. The ROSA system is illustrated in figure 1.

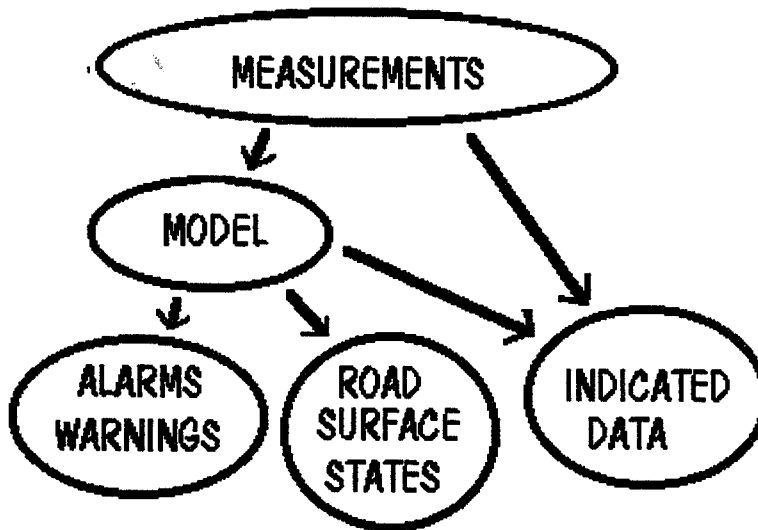


Figure 1 ROSA system

The possible road surface states in ROSA are: dry, moist, wet, icy, snowy, frosty, moist salty and wet salty. This is more than is often found in other systems. Besides determining the road surface state, the program also computes estimates for important quantities that are not obtained directly from the measurements, such as the amount of salt on the road, the thickness of water on it and also a nominal freezing temperature.

Other than giving out warnings and alarms, the ROSA system does not predict how the situation on the road will develop further in time. There is only one alarm in ROSA, namely the 'ice alarm' which means that there is a high probability that the road is slippery because of ice or snow, and there is practically no salt there. There are three warnings: ice warning, frost warning and rain warning. The warnings mean that the weather and the situation on the road is such that road maintenance actions, such as salting, may be needed in the near future.

4. Concluding remarks

To get the maximal benefit of any tool, it is important to know what it does and what it does not and how it is best used. This is also very true with a road weather station. The observations of an automatic station will never always agree with human observers. Also the station, unfortunately, has technical limitations that human observers do not have. For example, the weather station usually gets its information from only one spot on the road

surface, while a human can easily survey a large area and so is able to determine the overall situation more reliably.

Also, the lack of prediction is a serious limitation, as it would be very useful to have this ability. But perhaps the weather station user can do the prediction himself or herself, as humans are much more proficient in such matters than machines might ever be.