



**working to advance road weather
information systems technology**

New Road Surface Condition Sensors

<http://aurora-program.org>

Aurora Project 2005-06

**Final Report
August 2005**

About Aurora

Aurora is an international program of collaborative research, development and deployment in the field of road and weather information systems (RWIS), serving the interests and needs of public agencies. The Aurora vision is to deploy RWIS to integrate state-of-the-art road and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures. It is hoped this will facilitate advanced road condition and weather monitoring and forecasting capabilities for efficient highway maintenance, and the provision of real-time information to travelers.

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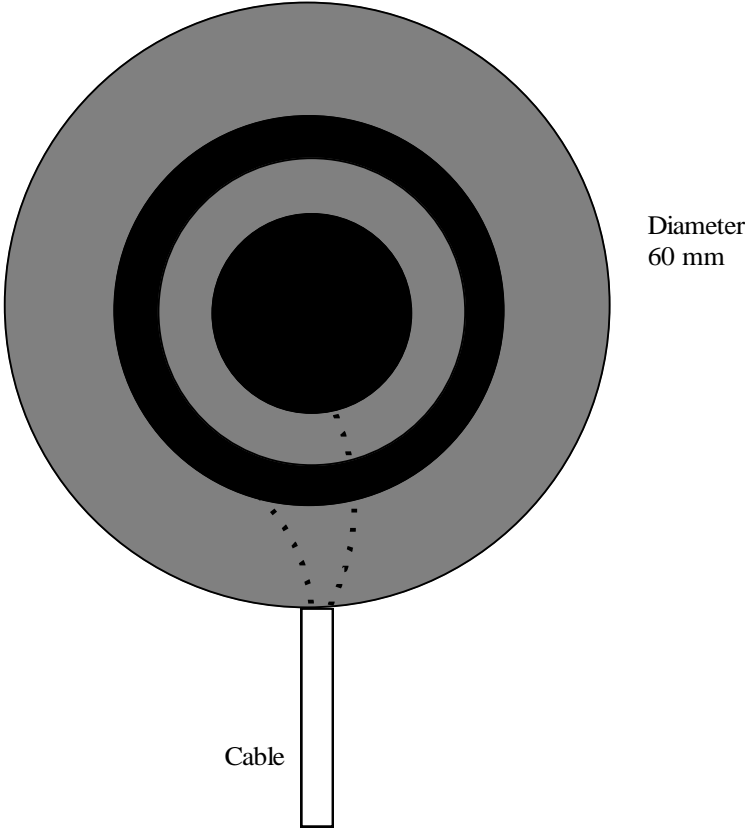
1. Background

Since the beginning of Roadway Weather Information Systems (RWIS) there has been a need for road condition sensors. The aim of this project was to test and verify the functionality of several types of cost-effective road condition sensors. Some more expensive types of passive and active sensors were also involved in this project for some short periods.

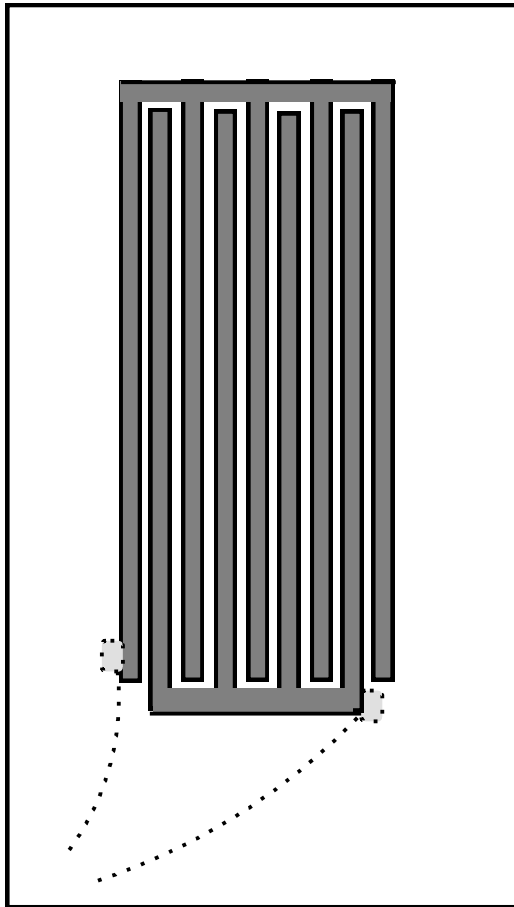
2. Theory

The simple passive sensors can only detect if the road is dry or wet. These sensors have a surface with areas that can conduct current. When the road is wet, the resistance between the conducting areas are significantly lowered. This decrease in resistance between the two conducting areas is monitored and used to determine if the road is dry or wet.

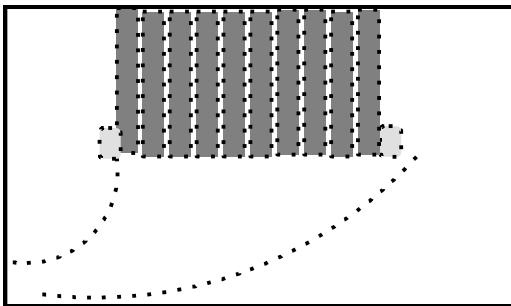
Simple passive sensors



AerotechTelub Round type (called AT DWR in the following charts). This is a sensor made of composite plastic material.



100mm



40mm

AerotechTelub Finger type (called AT DWF). This is a sensor made of composite plastic material.

Sensor from China called (called TI). This is a sensor made with stainless steel conducting rings and asphalt in between. It is a round sensor, approximately 100 mm in diameter.

The above passive sensors are powered by AC voltage to prevent the materials in the sensors from leaching.

In the following chart pictures, the outputs from the sensors are shown as a value above 150 if the sensor is dry. A value below 150 indicates that the sensor is wet.

Advanced passive sensor (present in project only for short time):

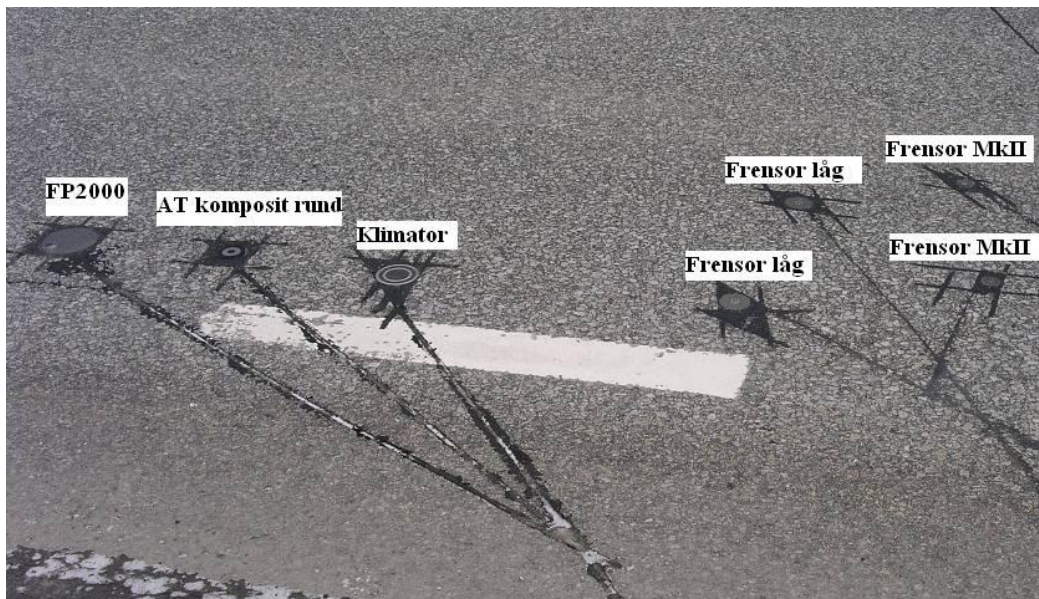
SSI sensor FP2000 (called FP2000)

Advanced active sensor (present in project only for short time):

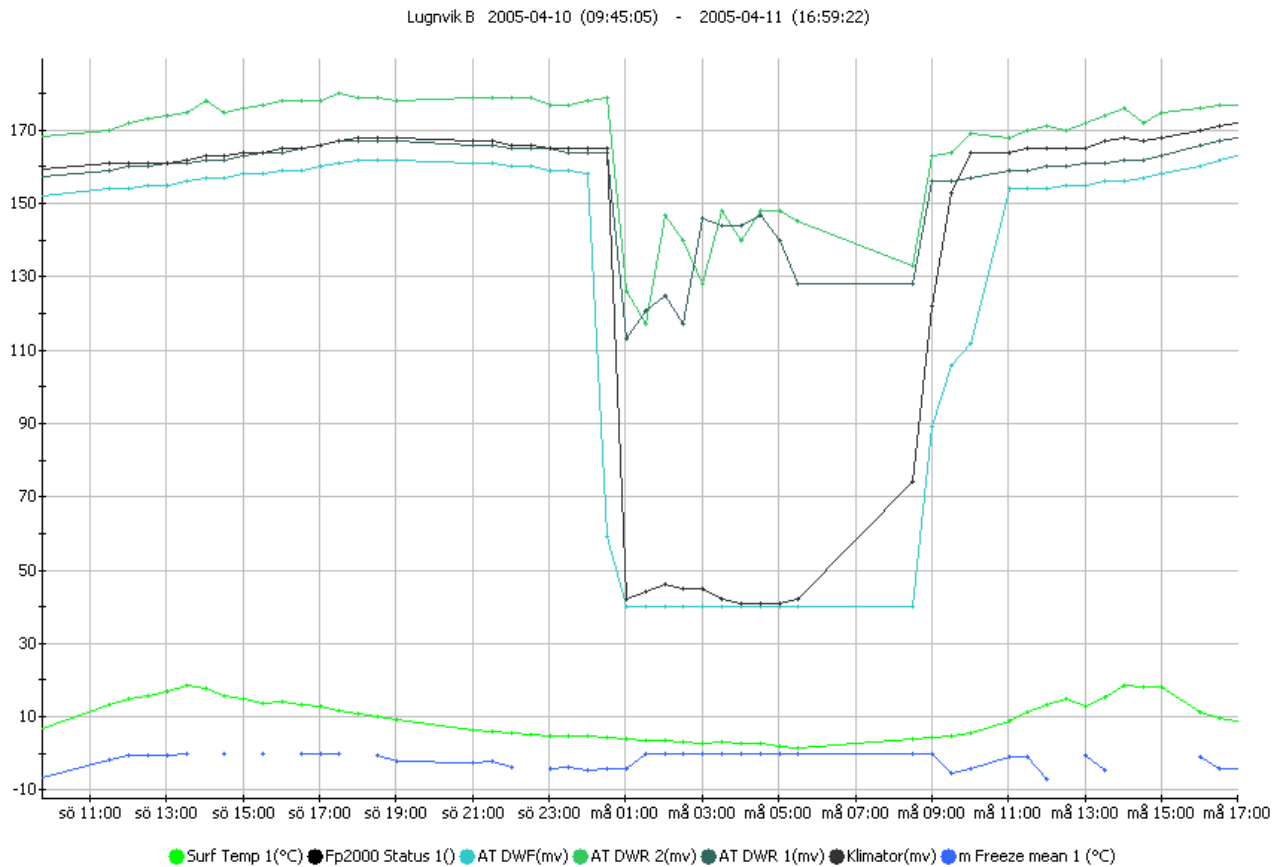
Frensor MkII (Called m Freeze mean in the following charts)

3. Field installation

The sensors are installed close to each other in the road surface. See photo below.



4. Results

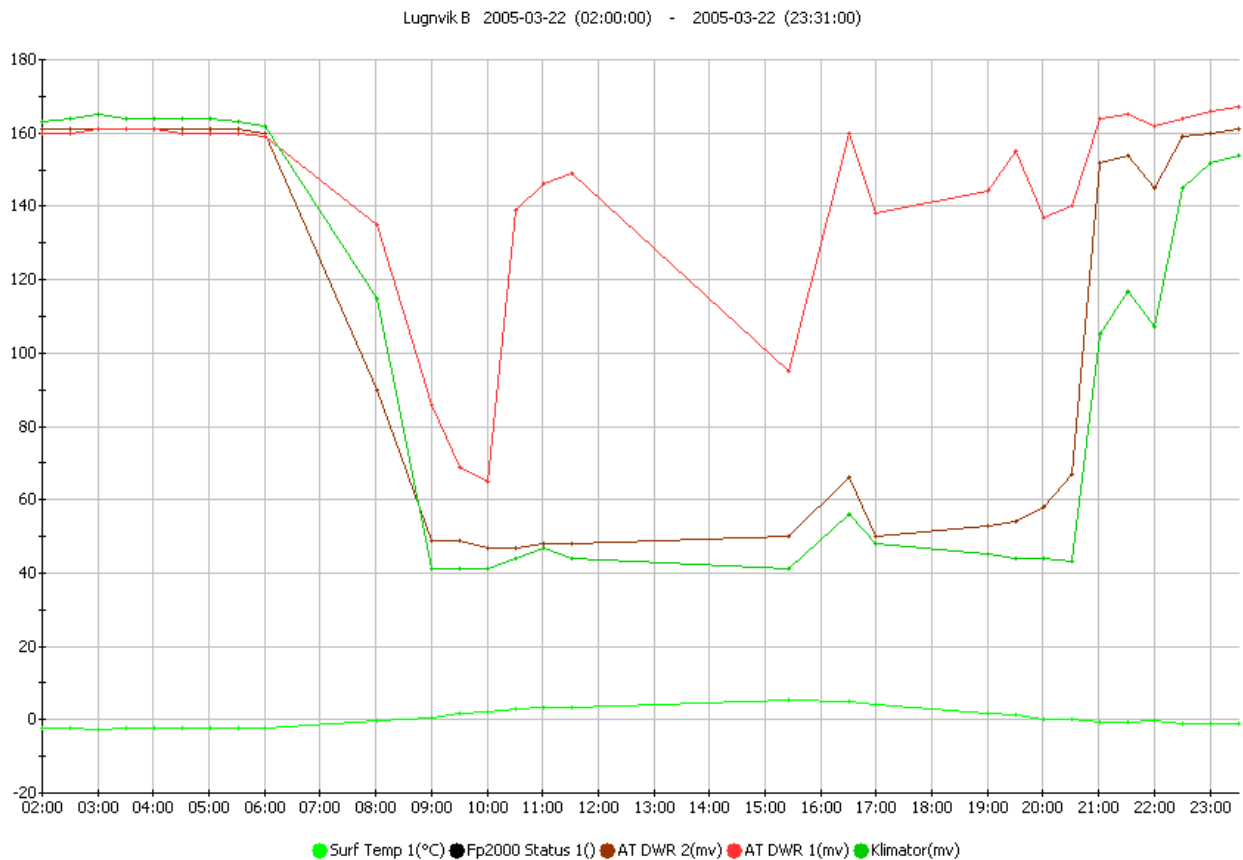


In the above chart, the TI (named Klimator) and AT DWF sensors show a detection of a wet surface at approximately 2005-04-11 01:00. The Frensor also shows freezing point detection in that period. The reason that the Frensor detects a freezing point for a longer time than the passive sensors is because there is a small amount of remaining water present at the Frensor sensor.

The TI sensor and the AT DWF sensor give a distinct indication of when a surface is wet. The other passive sensors also detect a wet surface, but the detection is a bit less distinct.

The SSI sensor has reliable algorithms to detect when the surface is wet. See the table below.

Date/time	Fp2000 Status 1	AT DWF	AT DWR 2	AT DWR 1	Klimator
2005-04-11 11:01:33	<Dry>	154,0 mv	168,0 mv	159,0 mv	164,0 mv
2005-04-11 10:01:33	<Dry>	112,0 mv	169,0 mv	157,0 mv	164,0 mv
2005-04-11 09:31:33	<Dry>	106,0 mv	164,0 mv	156,0 mv	153,0 mv
2005-04-11 09:01:33	<Dry>	89,0 mv	163,0 mv	156,0 mv	122,0 mv
2005-04-11 08:31:33	<Wet>	40,0 mv	133,0 mv	128,0 mv	74,0 mv
2005-04-11 05:31:33	<Wet>	40,0 mv	145,0 mv	128,0 mv	42,0 mv
2005-04-11 05:01:33	<Wet>	40,0 mv	148,0 mv	140,0 mv	41,0 mv
2005-04-11 04:31:33	<Wet>	40,0 mv	148,0 mv	147,0 mv	41,0 mv
2005-04-11 04:01:33	<Wet>	40,0 mv	140,0 mv	144,0 mv	41,0 mv
2005-04-11 03:31:33	<Wet>	40,0 mv	148,0 mv	144,0 mv	42,0 mv
2005-04-11 03:01:33	<Wet>	40,0 mv	128,0 mv	146,0 mv	45,0 mv
2005-04-11 02:31:34	<Wet>	40,0 mv	140,0 mv	117,0 mv	45,0 mv
2005-04-11 02:01:33	<Wet>	40,0 mv	147,0 mv	125,0 mv	46,0 mv
2005-04-11 01:31:33	<Wet>	40,0 mv	117,0 mv	121,0 mv	44,0 mv
2005-04-11 01:01:33	<Wet>	40,0 mv	126,0 mv	113,0 mv	42,0 mv



Above is another detection of a wet road surface. In this chart, all sensors have detected a wet surface. The TI and the AT DWR 1 sensor give a distinct indication of a wet surface. The AT DWR 2 sensor is of exactly the same type as the AT DWR 1 and it is installed close to AT DWR 1.

5. Conclusions

Advantages:

- The simple passive sensors correctly indicate a dry or wet road condition.
- The simple construction also seems to imply a good reliability and a long lifetime of the sensors.

Disadvantages:

- The sensors cannot detect the presence of salt on the road.
- The sensors cannot detect the presence of ice or snow on the road.

Installation issues:

Sensor location in the road is important. Sensors installed in road tracks and in between tracks sometimes show different readings, especially during periods of the road just being wet or drying up.

Because of the low cost of these simple passive road condition sensors, it is cost effective to install them when referring to the road status information they can provide.

6. Future

The installed sensors tested during this project will be further installed and data will be collected during the coming winter season.

AerotechTelub has initiated the development of a simple passive sensor with integrated Pt100 DIN class A sensors. Depending on the pricing, it may be of great interest on the market.