10.8 AURORA PROGRAM RESEARCH ACTIVITIES

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1. INTRODUCTION

Aurora is an international program of collaborative research, development and deployment in the field of road weather information systems (RWIS), serving the interests and needs of public agencies.

The program, launched in 1996, brings together a number of United States, Canadian and European agencies. Current members include nine United States Departments of Transportation (DOT's)--Alaska, Illinois, Iowa, Minnesota, New York, Pennsylvania, Tennessee, Virginia, and Wisconsin; Ontario and Québec Ministries of Transportation; and the Swedish National Road Administration. The United States Federal Highway Administration (FHWA) actively supports the program, as do numerous universities and research-oriented organizations, including the National Oceanic and Atmospheric Administration's (NOAA's) Forecast Systems Laboratory (FSL).

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.

Aurora research projects encompass a broad range of areas of interest. These include:

- Decision Support Systems
- Mesoscale modeling
- Standards and architecture
- Microscale modeling
- Equipment evaluation
- Information outreach
- Road condition monitoring

Aurora is sponsoring a number of research projects in support of these interest areas. This paper will outline some of these projects.

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2. DEVELOPMENT OF ROAD WEATHER ENVIRONMENTAL SENSOR STATION (ESS) OBSERVATION SYSTEMS

One project championed by Virginia DOT aims to build a foundation of observation systems to collect, assimilate, and make available ESS data that is based on open system principles, is able to be checked for quality, and can be incorporated and integrated into other observational networks, similar to other sources of weather information.

This project has four goals:

- Develop and implement standards for installation and calibration of observing stations
- Develop and implement standards for observations, including communications protocols.
- Develop and implement quality control and quality assurance algorithms to ensure that the data being collected are valid.
- Warehouse the data in a format that makes it widely available.

Aurora took on a lead role in this national effort in hopes of spurring quick action regarding attainment of the above goals. To date, contacts have been made with the American Association of State Highway Transportation Officials (AASHTO) in an attempt to bring them into the process. Aurora will also be represented on the National Transportation Communications for ITS Protocol (NTCIP) working group. This should enable Aurora to have significant input in the development of new standards.

3. COMPILATION OF RWIS SPECIFICATIONS

Virginia DOT is championing another project in which goal is to a compile the RWIS specifications being used by member agencies. The aim of this project is to develop a database of Aurora member RWIS construction, maintenance, and forecast specifications.

While Phase 1 of this project was initially completed in 2001, it is essentially an ongoing effort. Aurora keeps the list of member agency specifications updated continuously. Phase 2 will ask member agencies to discuss successes and failures associated with each posted specification.

The objectives of this project are:

- Obtain existing contract specifications for RWIS construction, maintenance, and forecasting that have been implemented by Aurora members.
- Identify user issues associated with the contracts.
- Obtain costs for equipment and services based upon the contracts by each agency.
- Create a database of agency specifications, costs, and issues and post this information on the Aurora web site.

Results of Phase 1 are available on the Aurora web site at http://www.aurora-program.org/matrix.cfm. To date, this web site contains the following documents:

Construction/Installation: 3
System Maintenance: 6
Road Weather Forecasting: 4

3. PAVEMENT TEMPERATURE SENSOR ACCURACY

Aurora has initiated a project championed by the Wisconsin DOT aimed at determining the accuracy of various types of pavement temperature sensors. There are three primary types of sensors the organization hopes to study.

The most common sensor is the passive sensor. It is a fixed pavement temperature sensor connected to an ESS. It contains a device that directly measures the temperature inside an enclosure embedded in the pavement. It also uses electrical conductivity to measure chemical concentration and the freezing point of the solution.

A second type of fixed sensor s the active sensor. They also measure pavement temperature, but determine the freezing point of the solution by cooling it until ice begins to form.

The final type of sensor to be tested is the infrared non-contact instrument. These are usually mounted on a vehicle, meaning they are mobile. Many state DOT's have begun using these instruments in the past 5 years.

The Aurora project will examine all three types of sensors in both laboratory and operational environments in order to determine which type of sensor is most accurate in measuring pavement temperature. Sensors of each type, manufactured by a variety of vendors, will be tested, starting in the winter of 2002-03.

4. BENCHMARKING THE PERFORMANCE OF RWIS FORECASTS

Weather and pavement forecasts are an integral component of any RWIS. Aurora is funding a research effort championed by the Ontario Ministry of Transportation that aims to review the state-of-the-art within the meteorological community this area.

The project has four primary objectives:

- Review state-of-the-art practices in meteorological verification.
- Review the current status of RWIS verification efforts by public agencies.
- Establish procedures and parameters which can be used to measure forecast accuracy in any country.
- Benchmark the accuracy of forecasts provided to member agencies.

In Phase 1 of the project, Aurora member agencies were surveyed to determine what efforts were being made to verify RWIS forecasts. Very few of them had undertaken any formal efforts in this area. Only the Wisconsin and Iowa DOT's have undertaken any major work on forecast verification. Both of these agencies have used some commonly-established methods from the meteorological community in performing forecast verification.

Next, weather forecast agencies, both public and private, will be queried in order to determine the state-of-the-art in forecast verification. RWIS forecast vendors will also be contacted.

The final, and most ambitious, phase involves the potential for benchmarking the quality of RWIS forecasts. Aurora will explore the possibility of recommending a methodology that transportation agencies can use both to monitor forecast accuracy and possibly to set goals and standards in contracts with weather forecast agencies.

5. TRAINING INITIATIVES

For years, it has been thought that RWIS training lagged behind technology, meaning many users did not know how to properly apply RWIS information into their daily operations. Aurora has undertaken two projects that will address the myriad of issues related to training.

5.1 Computer-Based Training Development

The first of these is a plan to assist AASHTO in the development of a computer-based training program for RWIS combined with a technology known as anti-icing, a method of preventing snow and ice from building up

and bonding on roadways. While AASHTO is the lead agency, several Aurora members have played key roles in driving this project. Representatives from Iowa DOT and Wisconsin DOT are members of the technical oversight committee charged with reviewing the training program.

The objective is to develop a comprehensive, interactive training program for winter operations. The training program will include segments on RWIS, anti-icing, chemicals, and other related aspects of winter operations. The interactive training will incorporate scenario based training exercises, tutorials, and links to other snow and ice information from around the world.

Twenty-six states, plus the American Public Works Association (APWA), FHWA, and Aurora have contributed to this project. Three more states are in the process of joining the pooled fund. Several Canadian provinces have also expressed an interest in receiving the materials. Most states have chosen to receive a customized version of the training. This customization process will begin in late 2002, after participating states have had the opportunity to comment on the lessons developed thus far.

5.2 Road Weather Training Program for Improved Winter Response

The Québec Ministry of Transportation is championing a project that hopes to take the training that is being developed for the province, and build on it to develop a course that could be used by all Aurora Program members. The goals are to improve winter response capabilities of operators and managers, and to enhance skills and knowledge base for using climatological data received from remote weather stations.

The project consists of five tasks:

- Develop a two-day training session for winter maintenance personnel by Québec Ministry of Transportation.
- Adapt the Quebec material for Provincial Ministry of Transportation personnel and circumstances.
- Analyze needs of Provincial Ministry of Transportation personnel in understanding and using weather and climatological data, and plan learning objectives for training to be appropriate for areas of greatest interest and need.
- Pilot a course.
- Deploy the course in other Canadian Provinces.

The training session has been developed. Currently, the translation of fifteen chapters of information is underway. Québec has begun the effort to combine these lessons into a common format under one program.

6. IMPROVED FROST FORECAST MODEL

Aurora is also concerned with microscale forecast questions for phenomena that affect roadways. One such area of interest is road frost.

The Iowa Department of Transportation, in conjunction with Iowa State University, is championing a study aimed at improving road frost forecast models. The current state-of-the art in road frost forecasting models is limited at best. There is a need in the winter road maintenance community for more accurate predictions of exactly when and where frost will occur. This project aims to address that need.

The objective of the project is to determine under what condition frost on bridge decks creates slippery conditions and then develop a forecast model that can predict when this may occur at a site or across a region. The project will begin in 2003, and is expected to be complete by the end of 2004.

7. SYNTHESIS OF ROAD WEATHER FORECASTING

Two years ago, Aurora undertook a study to compile information on how much various countries' government-sponsored forecast agencies supported those countries' RWIS programs. The report detailing the results (Newsome, 2001) shows that most countries' national meteorological agencies strongly support road weather programs in their countries.

Nine countries (Canada, Denmark, Finland, Germany, Japan, New Zealand, Norway, Sweden, and the United Kingdom) responded to the survey. The United Sates was excluded from the survey, since the purpose was to determine what level of support foreign agencies were providing.

Most of the transportation agencies surveyed have formal written agreements with the corresponding national meteorological agency. Some agreements only cover real-time road weather data, but most include the weather organization providing forecasts to the transportation agency.

In that respect, most countries that responded have closer working agreements with the national meteorological agency than transportation agencies in the United States have with the United States National Weather Service. Most road agencies receive some form of road weather forecast, some with forecast

pavement information, from their national weather agencies.

8. SUMMARY

The Aurora consortium continues to be at the forefront of RWIS research. Each year, it undertakes several new projects aimed at furthering the study, implementation, and use of RWIS.

This paper has outlined only a portion of the research that Aurora is doing, or has completed. Since its inception 7 years ago, Aurora has completed seven research projects. Another twenty-one projects are in various stages of completion.

Further information about all projects, as well as Aurora in general, is available at http://www.aurora-program.org.

REFERENCES

Newsome, P., cited 2001: Synthesis of road weather forecasting. [Available online at *http://www.aurora-program.org/projectdetail.cfm?projectID=20*]